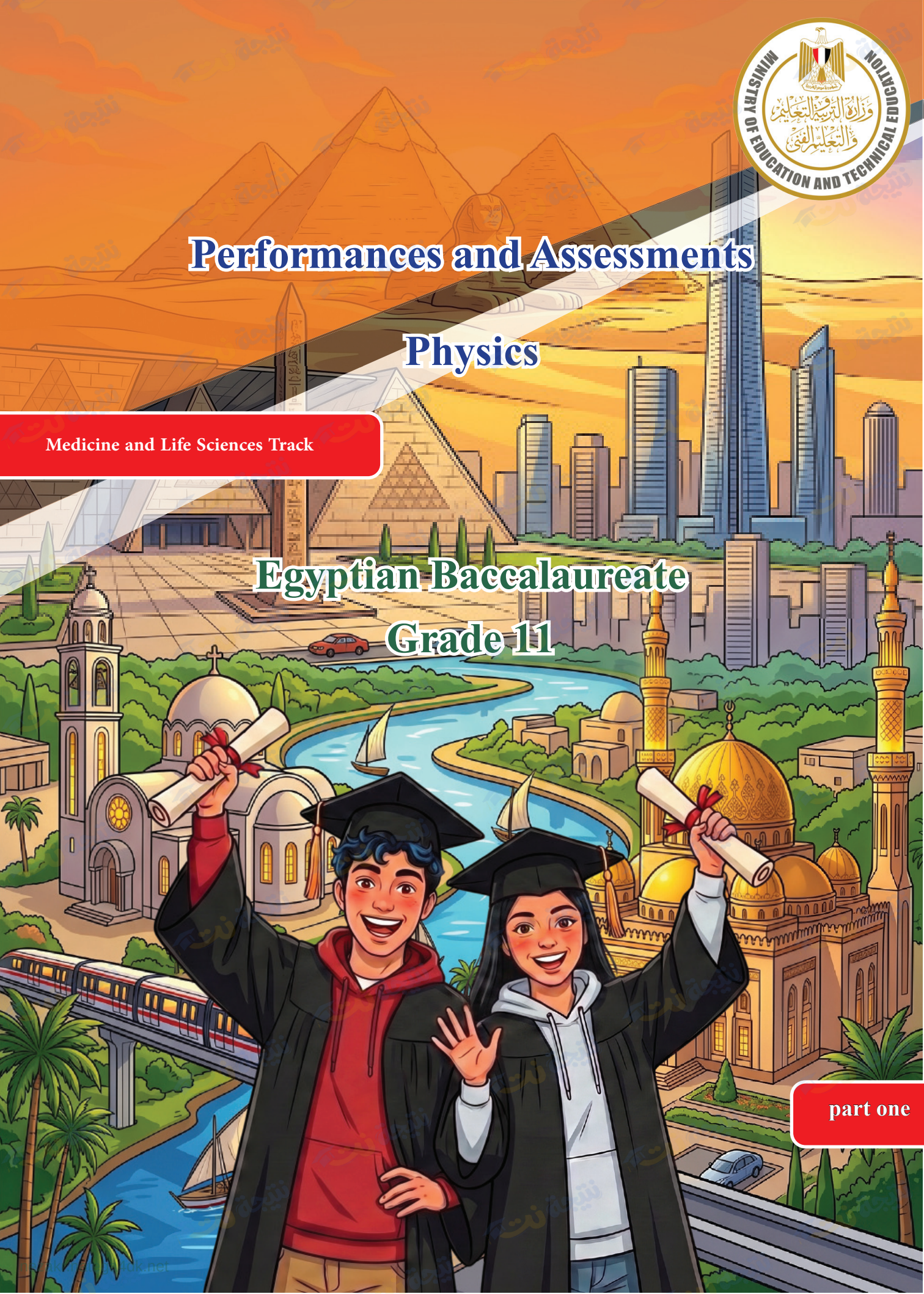
Performances and Assessments

Physics

Medicine and Life Sciences Track

Egyptian Baccalaureate

Grade 11



part one

Introduction

The Ministry of Education and Technical Education recognizes the importance of empowering teachers with effective tools that elevate classroom performance, enhance the quality of education, and improve its outcomes. This is a real response to the voices of teachers, interacting with the feedback channels from the educational field, and meeting the needs of teachers for flexible and comprehensive educational tools that assist them in fulfilling their noble educational mission. This book has been designed to serve as an integrated educational support for teachers, helping them in planning and executing their teaching tasks efficiently. It also facilitates continuous assessment processes. The content has been designed to offer diverse models of effective classroom performance and educational activities created based on an interactive methodology that enhances active learning. It contributes to a qualitative shift in teaching practices, clearly focusing on the student as the core of the educational process. The book includes formative and diagnostic questions, as well as purposeful learning tasks that students can complete as homework, enhancing the integration of learning inside and outside the classroom and contributing to the sustainable construction of learning for students. These tools help develop critical and creative thinking, deepen understanding, and support and enhance student motivation, giving them a sense of achievement and excellence. It also includes short weekly tests and periodic assessments, allowing teachers to measure the extent of learning outcomes and address learning gaps early, providing feedback on the initial results. The performances at the end of each month are concluded with immediate training sessions that help improve student performance. These assessments are gradual, taking into account individual differences and targeting various levels of cognitive development, within a framework of diversity, depth, and integration, preparing students for monthly tests efficiently. This book is a true translation of the Ministry's directions to ease the burdens on parents, provide supporting educational content that enriches the classroom environment, and allow teachers more time for educational innovation and productive interaction with their students. It also forms an effective tool in supporting the Ministry's direction to enhance learning outcomes, achieving a real transformation in the learning environment—from memorization to understanding, from rote learning to application, and from passive reception to active participation. When we place this work in the hands of teachers and students, we hope it will be a valuable contribution to improving academic performance, enhancing the quality of education, and becoming an additional cornerstone in building a generation that is aware and knowledgeable, equipped with the skills and competencies needed for success in a world that demands creativity and innovation. It aims to have a tangible impact in realizing an ambitious educational vision for the future of education in our beloved country.

Allah is the one sought for help, and He guides to the right path...

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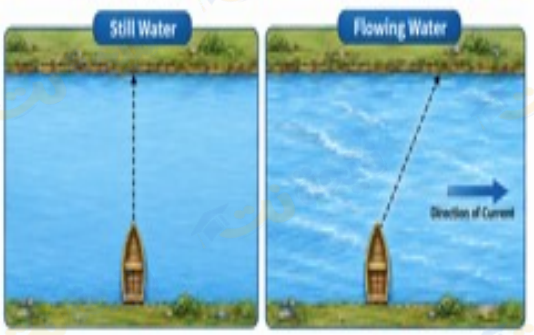
First Period

Week .....

Lesson 1-1: Vectors of Velocity and Relative Velocity

Date: .....

Classroom Performances

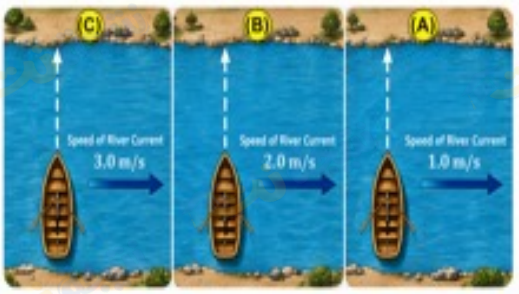


1. Compare the motion of the boat in still water with its motion in flowing water, as shown in the two figures. Then answer the following questions:

   (a) Explain why the point at which the boat arrives on the opposite bank is different in the two cases.

   (b) What is the effect of the river current on the direction of the boat's resultant velocity?

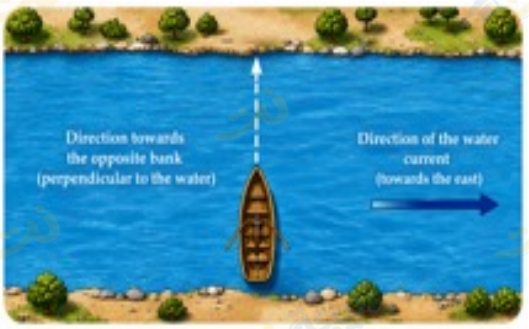
2. Choose: In the three cases shown, the boat moves at a constant speed of 4.0 m/s relative to the water, directed perpendicular to the two banks. Which of the following alternatives represents the magnitudes of the boat's velocities relative to the Earth, in order from smallest to largest?



A) C > B > A B) A > B > C

C) C > A > B D) B > C > A

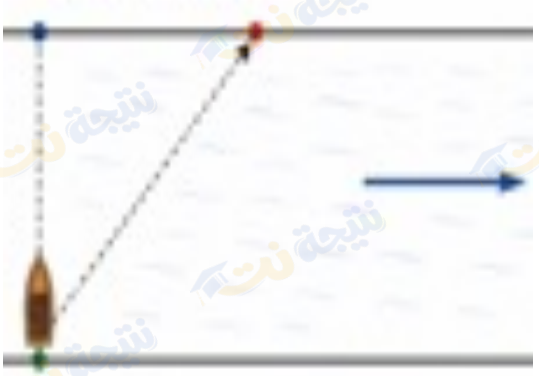
Homework Performances



1. A boat moves in a river. Its bow is directed perpendicular to the two banks, while the water current flows eastward, as shown in the figure. Explain how the direction of the boat's motion relative to the Earth is affected by the direction of the boat's motion relative to the stationary water.

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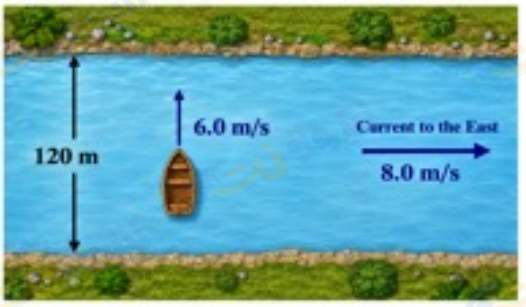
2. A boat moves in a river. Its bow is directed perpendicular to the two banks, while the water current flows eastward. The figure shows the boat's expected path in the absence of the current and its actual path in the presence of the current. Explain why the boat reaches a point different from the point directly opposite its starting position, explaining the role of vector addition in determining the actual direction of the boat's motion relative to the Earth.



3. An inclined conveyor belt carries a box at a constant speed in a direction making an angle of 60° with the horizontal. What is the ratio of the vertical component to the horizontal component of the box's velocity, v_y / v_x?

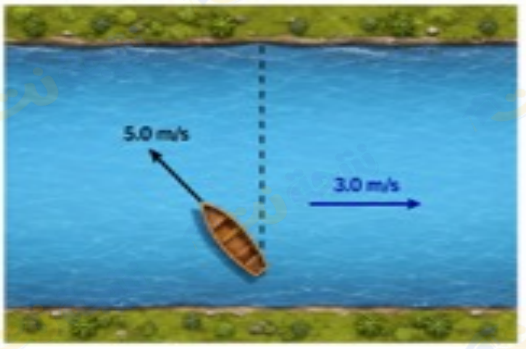


4. Choose: A boat crosses a river 120 m wide, as shown in the figure. It moves at 6 m/s relative to the water in a direction perpendicular to the two banks, while the water current moves eastward at 8 m/s relative to the bank. What is the magnitude of the displacement of the boat in the eastward direction during its crossing of the river?



A) 80 m B) 120 m C) 160 m D) 240 m

5. Choose: A boat moves at 5 m/s relative to the water, while the river current flows eastward at 3 m/s. The boat is steered at an angle against the current so that it crosses the river perpendicular to the bank. What is the magnitude of the boat's velocity relative to the bank?



A) 2m/s B) 4m/s C) 5m/s D) 8m/s

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Second Period

Week .....

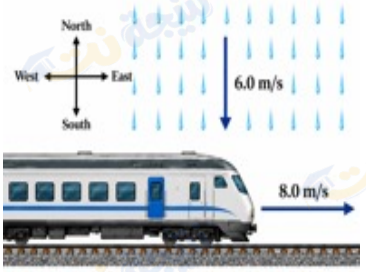
Relative Velocity

Date: .....

Classroom Performances



1. In the two figures shown, which of the two trains is stationary and which is moving, and in what direction? Explain your answer.



2. Choose: A train moves eastward at 8 m/s while rain falls vertically downward at 6 m/s relative to the Earth. What is the magnitude of the rain's velocity relative to a passenger on the train?

A) 2.0 m/s B) 7.0 m/s

C) 10 m/s D) 14 m/s

Homework Performances



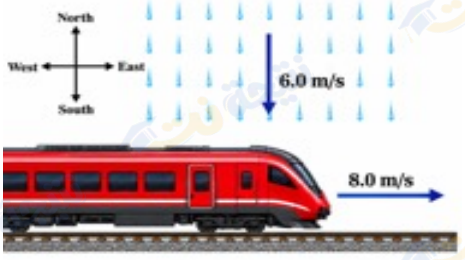
1. In the figure shown, aircraft A flies eastward at 12 m/s, while aircraft B flies northward at 5 m/s. What is the magnitude of the velocity of B relative to A?



2. Two cars start simultaneously from the same intersection along two perpendicular roads. Car A moves eastward at 15 m/s, while car B moves northward at 20 m/s. Calculate:

(a) The distance between them after 12 s.

(b) The velocity of car B relative to car A.



3. A train moves eastward at 8 m/s while rain falls vertically downward at 6 m/s relative to the Earth. Calculate:

(a) The magnitude of the velocity of the raindrops relative to a passenger on the train.

(b) The angle made by the raindrops' velocity relative to the direction of motion of the train.

(c) What happens to the angle that the raindrops' velocity makes with the horizontal if a wind blows at 8 m/s in the direction of motion of the train?

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4. Choose: Player A runs eastward at 8 m/s, while the ball moves northward at 6 m/s. What is the angle made by the velocity of the ball relative to player A with the westward direction?



A) 37° south of west B) 37° north of west

C) 53° north of west D) 90° west

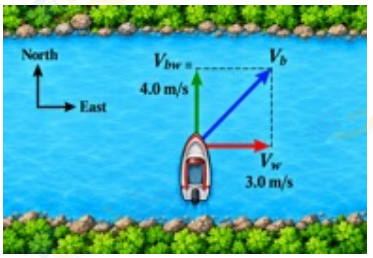
Week .....

Weekly Assessment

Date: .....

Group A

1. A boat moves at 4 m/s northward relative to the river water, while the current flows eastward at 3 m/s relative to the bank. Which of the following represents the boat's velocity relative to the bank?



A) 5 m/s toward the northeast B) 1 m/s toward the north

C) 7 m/s toward the east D) 12 m/s toward the northwest

2. Rain falls vertically downward relative to the Earth while a train moves horizontally to the right. How does the direction of motion of the raindrops appear to a passenger inside the train?



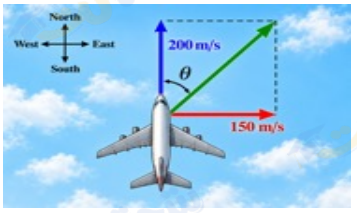
A) Vertically downward

B) Downward and toward the rear of the train

C) Downward and toward the front of the train

D) Horizontally in the direction of motion of the train

3. An aircraft travels northward at 200 m/s relative to the surrounding stationary air. When it enters a region where wind blows eastward at 150 m/s, calculate:



(a) The magnitude of the aircraft's resultant velocity relative to the Earth.

(b) The angle by which the aircraft's path is deflected toward the east of north.

4. A boat crosses a river 160 m wide, moving perpendicular to the bank relative to the water. It follows a straight path of length 200 m relative to the bank and reaches the opposite bank. Due to the motion of the boat and the uniform current, calculate:



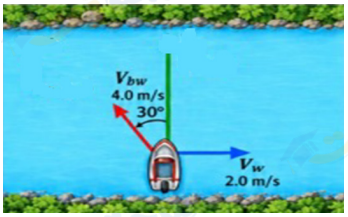
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(a) The distance through which the boat is carried in the direction of the current.

(b) The ratio between the speed of the current and the speed of the boat relative to the water.

5. Explain why a river current parallel to the banks does not affect the crossing time of a boat directed perpendicular to the bank, provided that its speed relative to the water remains constant.

Group B



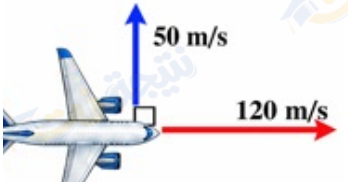
1. Choose: A river current flows eastward at 2 m/s, and the pilot of a boat steers the boat at 4 m/s relative to the water at an angle of 30° to the north. What is the direction of the boat's motion relative to the bank?

A) To the north in a straight line

B) Toward the northeast

C) Toward the northwest

D) Eastward, parallel to the bank



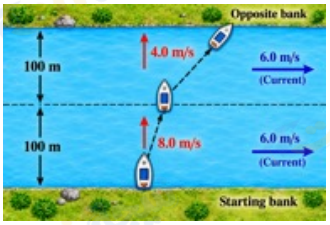
2. Choose: An aircraft moves eastward at 120 m/s relative to the surrounding stationary air. A wind blows northward at 50 m/s. What is the aircraft's velocity relative to the Earth?

A) 70 m/s eastward

B) 170 m/s toward the northeast

C) 130 m/s at 23° north of east

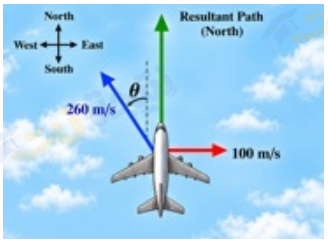
D) 130 m/s at 67° north of east



3. Choose: A boat crosses a river 200 m wide, moving perpendicular to the bank at 8 m/s relative to the water. During the first half of the river's width, the current remains at 4 m/s, while during the second half it decreases to a constant 6 m/s eastward. Calculate:

(a) The total time required to cross the river.

(b) The boat's eastward displacement when it reaches the opposite bank.



4. An aircraft wants to move exactly northward relative to the Earth, while a wind blows eastward at 100 m/s relative to the stationary air. If the aircraft's speed relative to the air is 260 m/s, calculate:

(a) The angle through which the aircraft's nose must be directed west of north.

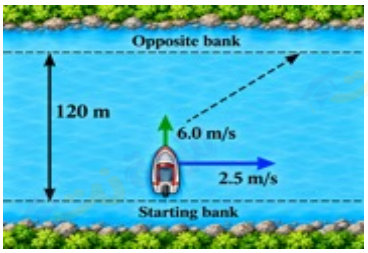
(b) The magnitude of the aircraft's resultant velocity relative to the Earth.

5. Explain: A passenger on a stationary train sees vertical raindrops, whereas a passenger on a moving train sees the raindrops in a direction different from vertical.

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Group C

1. Choose: A boat crosses a river 120 m wide at 6.0 m/s perpendicular to the bank relative to the water, while the current flows at 2.5 m/s. What is the distance through which the boat is carried by the current before reaching the opposite bank?



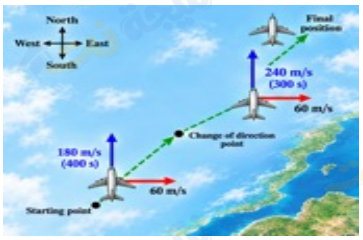
A) 25 m B) 50 m C) 72 m D) 130 m

2. Choose: Rain falls vertically downward at 8 m/s, while a train moves horizontally at 6 m/s. What is the angle of inclination of the apparent path of the raindrops to the vertical direction?



A) 37° B) 49° C) 53° D) 60°

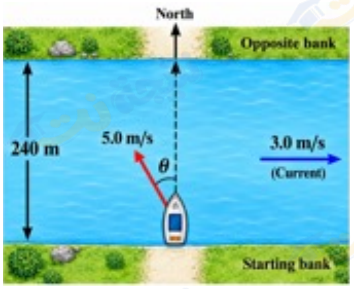
3. An aircraft moves in two successive stages while a constant wind blows eastward at 60 m/s, perpendicular to the aircraft's direction of motion relative to the air. In the first stage, the aircraft flies northward at 180 m/s for 400 s. It then flies northward at 240 m/s for 300 s relative to the stationary air. Calculate:



(a) The magnitude of the aircraft's resultant displacement relative to the Earth during the two stages.

(b) The magnitude and direction of the aircraft's average velocity relative to the Earth during the two stages.

4. A river 240 m wide flows eastward at 3 m/s, and the boat's speed relative to the water is 5 m/s. The boat is steered at an angle west of the direction perpendicular to the bank so that it reaches the point directly opposite its starting point. Calculate:



(a) The angle at which the boat must be directed relative to the perpendicular to the bank.

(b) The time required to cross the river.

5. Explain: A passenger inside a moving train sees the vertical raindrops as inclining.

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First Period Week .....

Lesson 1-2: Horizontal Projectile Motion

Date: .....

Classroom Performances



1) The figure shows the path of a cannonball launched horizontally from a cannon with an initial velocity (v) until it reaches point B.

A) At which of points 1, 2, or 3 is the horizontal component of the velocity greatest? Explain your answer.

B) At which of points 1, 2, or 3 is the vertical component of the velocity greatest? Explain your answer.

C) Write a formula for calculating the horizontal displacement AB.

D) Write a formula for calculating the vertical displacement CB.

E) If the launch speed of the projectile is increased to (2v) from the same height, what happens to each of the following?

1. The time taken for the projectile to reach the ground.
2. The horizontal range of the projectile.

2) An object is projected horizontally at a speed of 14.7 m/s from a height of 19.6 m above the ground. Assuming that the acceleration due to gravity is 9.8 m/s², find the following:

A) The time taken for the object to reach the ground, in seconds.

B) The horizontal range of the object, in meters.

C) The speed of the object immediately before it hits the ground, in meters per second.

Homework Performances

1) Choose: The horizontal motion of a projectile launched horizontally from a certain height is characterized by:

A) Constant acceleration B) Constant velocity

C) Increasing acceleration D) Increasing velocity

2) Choose: Doubling the initial horizontal velocity of a horizontally projected object while keeping the height constant will result in:

A) Doubling the time of flight B) Reducing the time of flight by half

C) Doubling the horizontal range D) Increasing the horizontal range to four times

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3) An object is projected horizontally at a speed of 4m/s from a certain height and reaches the ground after 2s. Calculate the height from which the object was projected and its horizontal range. ($g = 10 m/s^2$)

4) What happens to the horizontal range of an object projected horizontally if the height of the launch point is increased while keeping the initial horizontal velocity constant? Explain why.

5) An object is projected horizontally from the top of a building 45 m high with an initial horizontal velocity of 20 m/s, neglecting air resistance and taking the acceleration due to gravity as $g = 10 m/s^2$. Calculate:

1. The time taken for the object to reach the ground.
2. The horizontal range traveled by the object before reaching the ground.

Week ..... Second Period

The laws of horizontal projectiles

Date: .....

Classroom Performances

1) Two projectiles are launched horizontally from two different heights as follows:

- The first projectile is launched from a height of 20m with a horizontal velocity of 10 m/s.
- The second projectile is launched from a height of 80m with a horizontal velocity of 20 m/s.

Neglecting air resistance and taking $g = 10 m/s^2$, find the ratio between:

a. The time taken by the first projectile to reach the ground and the time taken by the second projectile to reach the ground.

b. The horizontal range of the first projectile and the horizontal range of the second projectile.

2) What happens to the time taken for an object to reach the ground and its horizontal range if the object is projected horizontally from the same height but with a greater horizontal veloc-

Homework Performances

1) The horizontal projectile motion of an object launched from a certain height is characterized by:

A) Zero acceleration during the horizontal motion of the projectile

B) Zero acceleration during the vertical motion of the projectile

C) Acceleration equal to the acceleration due to gravity during the horizontal motion of the projectile

D) Acceleration equal to half the acceleration due to gravity during the vertical motion of the projectile

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2) Choose: What happens when the initial horizontal velocity of a horizontally projected projectile is increased while keeping the height constant?

A) The time of flight increases
B) The time of flight remains constant
C) The horizontal range remains constant
D) The horizontal range decreases

3) Two projectiles are launched horizontally from different heights, neglecting air resistance:

- The first projectile: height h and initial horizontal velocity v.
- The second projectile: height 4h and initial horizontal velocity 2v.

If the acceleration due to gravity is constant, find the ratio between:

a. The time taken by the first projectile to reach the ground and the time taken by the second projectile.

b. The horizontal range of the first projectile and the horizontal range of the second projectile.

4) A billiard ball rolls off a table that is 0.6 m high with an initial horizontal velocity of 2.4 m/s. What is the time required for the billiard ball to reach the ground, and what is the horizontal distance between the edge of the table and the point where the ball lands? (g =10m/s^2)

Week .....

Weekly Assessment

Date: .....

Group A

1) Choose: An object is projected horizontally from the fourth floor of a ten-floors building, neglecting air resistance. If the object is projected horizontally from the tenth floor with the same initial horizontal velocity, then:

	The time taken for the object to reach the ground	The horizontal range of the object
A	decreases	decreases
B	decreases	increases
C	increases	increases
D	increases	decreases

2) A helicopter is flying horizontally at a speed v at a height(y) , and it needs to drop a package of food to a man standing on the ground. What distance should separate the helicopter from the man when the food package is dropped?

A. $\sqrt{\frac{2gy}{v^2}+y^2}$ B. $\sqrt{\frac{2v^2y}{g}+y^2}$ C. $\sqrt{2gv^2y+y^2}$ D. $\sqrt{\frac{2gv^2y+1}{y^2}}$

3) An object is projected horizontally at a speed of 6.0 m/s from a certain height and reaches the

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ground after 3.0 seconds. Calculate the height from which the object was projected and its horizontal range.

4) What happens to the time taken for the object to reach the ground and its horizontal range if the object is projected horizontally from the same height but with a lower horizontal velocity?

5) A billiard ball rolls off a table that is 0.75 m high with an initial horizontal velocity of 1.5 m/s. What is the horizontal distance between the edge of the table and the point where the ball lands? (g =10m/s^2)

Group B

1) Choose: An object is projected horizontally from a certain height with an initial velocity v. If the horizontal velocity is doubled while keeping the height constant, the time taken for the object to reach the ground:

A) Doubles B) Is reduced by half

C) Does not change D) Becomes four times greater

2) The horizontal projectile motion of an object launched from a certain height is characterized by:

A) Positive acceleration during the horizontal motion of the projectile

B) Negative acceleration during the horizontal motion of the projectile

C) Acceleration equal to the acceleration due to gravity during the vertical motion of the projectile

D) Acceleration equal to one-quarter of the acceleration due to gravity during the vertical motion of the projectile

3) An object is projected horizontally from a height h with an initial horizontal velocity v, neglecting air resistance. What happens to both the time taken for the object to reach the ground and its horizontal range if the height is increased to 4h, while keeping the initial horizontal velocity constant? Explain your answer.

4) The figure shows two coins, A and B. Coin A is projected horizontally with an initial velocity (v_0), while coin B is allowed to fall freely from the same height. Which coin reaches the ground first? Explain your answer.



5) An object is projected horizontally at a speed of 8 m/s from a height of 30 m above the ground. Assuming that the acceleration due to gravity is 10 m/s^2, find the following:

A) The time taken for the object to reach the ground, in seconds.

B) The horizontal range of the object, in meters.

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Group C

1) Choose: Reducing the initial horizontal velocity of a horizontally projected object to half its value while keeping the height constant will result in:

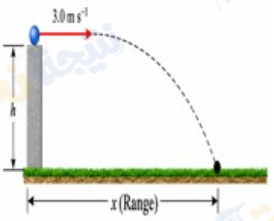
A) Reducing the time of flight by half
B) Doubling the time of flight
C) Reducing the horizontal range by half
D) Doubling the horizontal range

2) Choose: The horizontal projectile motion of an object launched from a certain height, while falling toward the ground, is characterized by:

A) Its horizontal velocity increases with time
B) Its horizontal velocity decreases with time
C) Its vertical velocity decreases with time
D) Its vertical velocity increases with time

3) A ball is kicked horizontally from a hill that is 22m high and lands 35m from the edge of the hill. What is the initial horizontal velocity of the ball? (g =10m/s^2)

4) What happens to the time taken for the object to reach the ground and its horizontal range if the object is projected horizontally from a greater height while keeping the initial horizontal velocity constant?



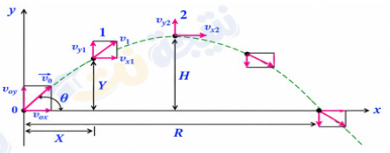
5) An object is projected horizontally at a speed of 3 m/s from a certain height and reaches the ground after 3 seconds. Find the horizontal range (x) and the height (h) (g =10m/s^2)

First Period — Week .....

Lesson (1.3) Projectile Motion at an Angle

Date: .....

1. The figure shows an object projected from the ground with an initial velocity (v_0) at an angle (θ) to the horizontal. Answer the following questions:



2. Write the formula for calculating the horizontal component of the initial velocity (v_{0x}).
3. Write the formula for calculating the vertical component of the initial velocity (v_{0y}).
4. Choose: At position (1) shown in the figure, write a formula for calculating each of the following:
   a) The horizontal component of the velocity (v_{x1}).
   b) The vertical component of the velocity (v_{y1}).
   c) The magnitude of the resultant velocity of the object (v_1).
   d) The horizontal distance (X) traveled by the projectile from the initial position until it reaches position (1).
   e) The vertical height (Y) traveled by the projectile from the initial position until it reaches position (1).

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5. Write the formula for calculating the maximum height (H) reached by the projectile.
6. Write the formula for calculating the horizontal range (R) of the projectile.
7. At position (2) shown in the figure, write a formula for calculating each of (v_{x2}) and (v_{y2}).

Homework Performances

1) Choose: The horizontal motion of an angled projectile is characterized by:

A) Constant acceleration B) Constant velocity

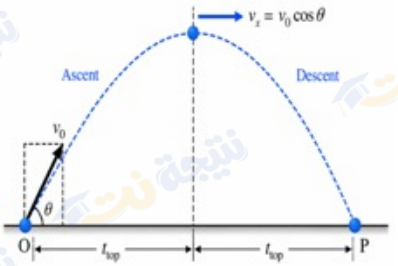
C) Increasing acceleration D) Increasing velocity

2) The horizontal acceleration of an angled projectile is equal to:

A) Zero B) Half the acceleration due to gravity

C) The acceleration due to gravity D) Twice the acceleration due to gravity

3) A small ball is projected from the ground with an initial speed of 15 m/s at an angle of 60° to the horizontal. The motion occurs under the effect of gravitational acceleration, g = 10 m/s², neglecting air resistance.If the ball returns to the same level from which it was launched, calculate:



A) The time required to reach the maximum height.

B) The total time of flight.

C) The horizontal range of the ball.

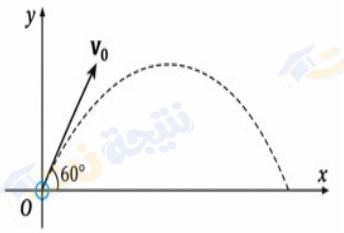
D) The maximum height reached by the ball.

Week ..... Second Period

Lesson (1.3): Projectile Motion at an Angle

Date: .....

The figure shows an object of mass (m) projected from the ground with an initial velocity (v_0) at an angle of 60° to the horizontal, neglecting air resistance. Answer the following questions:



1) Write two different ways to increase the total time of flight of the object.

2) Write two different ways to increase the maximum height reached by the object.

3) Write two different ways to increase the horizontal range reached by the object.

4) At what angle should the object be projected to achieve its maximum horizontal range, while keeping its initial velocity constant? Explain.

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5) At what angle should the object be projected, instead of the angle (60°), to achieve the same horizontal range shown in the figure, while keeping its initial velocity constant? Explain.

Homework Performances

1) Choose: The upward vertical motion of an angled projectile is characterized by:

A) Decreasing acceleration B) Decreasing velocity

C) Increasing acceleration D) Increasing velocity

2) At the maximum height, the vertical component of the velocity of an angled projectile is equal to:

A) Zero B) A maximum value

C) Half the initial vertical component of velocity

D) The same value as the initial vertical component of velocity

3) A small ball is projected from the ground with an initial speed of 20 m/s at an angle of 60° to the horizontal. The motion occurs under the effect of gravitational acceleration, g = 9.8 m/s^2, neglecting air resistance.



If the ball returns to the same level from which it was launched, calculate:

A) The time required to reach the maximum height.

B) The total time of flight.

C) The horizontal range of the ball.

D) The maximum height reached by the ball.

Week .....

Weekly Assessment

Date: .....

Group A

1) Choose: At the maximum height, the magnitude of the velocity of an angled projectile is equal to:

A) Zero

B) A maximum value

C) The same as the initial vertical component of velocity

D) The same as the initial horizontal component of velocity

2) Choose: An object is projected from the ground with a constant initial speed v_0 at an angle of 30° to the horizontal, neglecting air resistance. At what other angle should the object be projected with the same initial speed v_0 to achieve the same horizontal range?

A) 30° B) 45° C) 60° D) 75°

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3) The figure shows an object of mass (m) projected from the ground with an initial velocity (v_0) at an angle of 60° to the horizontal, neglecting air resistance.



Write one way to double the total time of flight of the object. Explain.

4) A football is kicked with an initial speed of 30 m/s at an angle of 60° to the vertical. Find the horizontal range of the ball.

5) The figure shows an object projected from the top of a building 50 m high with a speed of 15 m/s at an angle of 30°. What is the total time of flight until the object reaches the ground?



Group B

1) When an object is projected at an angle to the horizontal, neglecting air resistance, the vertical motion of the projectile is characterized by:

A) Constant velocity and zero acceleration

B) Variable velocity and constant acceleration

C) Increasing velocity and increasing acceleration

D) Constant velocity and constant acceleration

2) An object is projected from the ground with an initial speed v_0 at an angle θ to the horizontal, neglecting air resistance.

At what angle of projection θ is the maximum height reached by the object equal to the horizontal range of the projectile?

A) 24° B) 45° C) 76° D) 90°

3) The figure shows an object of mass (m) projected from the ground with an initial velocity (v_0) at an angle of 60° to the horizontal, neglecting air resistance. Write one way to double the maximum height reached by the object. Explain.



4) A football is kicked with an initial speed of 25 m/s at an angle of 45° to the horizontal. Find the time of flight.

5) The figure shows an object projected from the top of a building 50 m high with a speed of 15 m/s at an angle of 30°. What is the maximum height reached by the object above the ground?

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Group C

1) An object is projected with an initial speed v_0 at an angle θ to the horizontal, neglecting air resistance.

What happens to the vertical velocity of the projectile as it rises?

A) It increases continuously

B) It gradually decreases until it becomes zero at the highest point

C) It remains constant

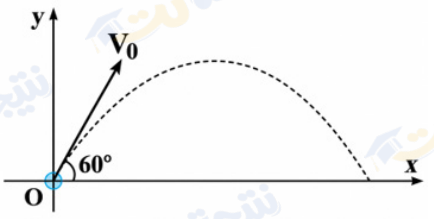
D) It becomes equal to the horizontal velocity

2) An object is projected from the ground with an initial speed v_0 at an angle θ to the horizontal, neglecting air resistance.

What angle of projection θ is required for the projectile to achieve its maximum horizontal range without changing the launch speed?

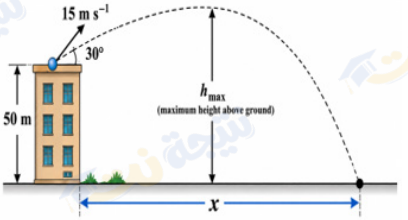
A) 30° B) 45° C) 60° D) 90°

3. The figure shows a body of mass (m) projected from the Earth's surface with an initial velocity v_0 at an angle of 60° to the horizontal. Neglecting air resistance, state a method for doubling the horizontal range of the body. Explain your reasoning.



4. A football is kicked with an initial speed of 20 m/s at an angle of 30° to the vertical. Determine the maximum height reached by the ball.

5. The figure shows a body projected from the top of a building 50 m high with a speed of 15 m/s at an angle of 30°. Determine the horizontal range x reached by the body.



First Period Week .....

Lesson (1-4): Moment of Force

Date: .....

Classroom Performances

1. Choose: The expression for the moment of a force when the force is perpendicular to the lever arm is:

A) M = F/d B) M = Fd C) M = F + d D) M = F – d

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2. Choose: The moment of a force is a measure of:

A) The magnitude of the force only

B) The turning effect of the force about a point

C) The speed of the body

D) The stored energy of the body

3. Choose: The SI unit of moment of force is:

A) Newton (N) B) Joule (J)

C) Newton. meter (N.m) D) meter per second (m/s)

4. A force of 5.0 N acts perpendicular to a lever arm of length 2 m from the pivot. Calculate the moment of the force.

Homework Performances

1. Choose: If the perpendicular distance is doubled while the force remains constant, the moment of the force

A) decreases to half B) increases to double

C) remains constant D) decreases to quarter

2. Choose: A door is opened more easily when it is pushed at the ……..

A) hinge directly B) handle farthest from the hinge

C) center of the door only D) There is no difference at any point

3. Choose: A moment of 12 N.m is produced by a force of 4.0 N acting perpendicular to the lever arm. The perpendicular lever-arm length equals ……

A) 3m B) 8m C) 48m D) 33m

4. A force of 3 N acts perpendicularly at the end of a horizontal rod 20 m from point O. Calculate the moment of the force about O.



First Period Week .....

Lesson (1-5): Equilibrium of Forces

Date: .....

Classroom Performances

1. A body is in a state of equilibrium when ……

A) Its speed is always zero

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B) It remains at rest or moves with constant velocity

C) Its speed changes continuously

D) Its mass becomes zero

2. Choose: The translational equilibrium condition for a body is written mathematically as …..

A) $\Sigma F = mg$ B) $\Sigma F = 0$

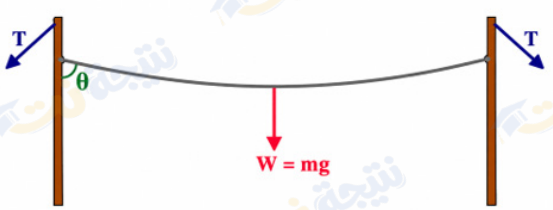
C) $\Sigma F = ma$, where $a \neq 0$ D) $\Sigma F = F_1 - F_2$ only

3. Choose: When resolving a force into two perpendicular components, the equilibrium equations are applied independently along …

A) One axis only B) The x- and y-axes, with $\Sigma Fx = 0$ and $\Sigma Fy = 0$

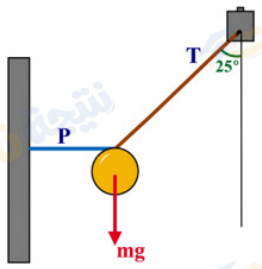
C) The angle θ only D) The mass only

4. In the figure, explain how the angle θ changes at the two points of support if the sag of the cable at its midpoint decreases. What is the expected effect of this change on the tension T?



Homework Performances

1. Choose: A lamp is suspended by a light cable fixed to the ceiling and a light horizontal rope fixed to a wall. The cable makes an angle of 25° with the vertical. The vertical component of the tension in the cable must be equal to ……



A) Zero B) the weight of the lamp

C) the tension in the horizontal rope D) half the weight of the lamp

2. Choose: A lamp of mass 0.6 kg is suspended by two identical cables, each making an angle of 30° with the horizontal. Taking $g = 9.8\ m/s^2$, the weight of the lamp is approximately …….

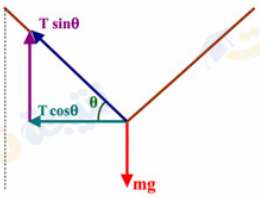
A) 0.6 N B) 58.8 N C) 4.29 N D) 5.88 N

3. Choose: If the angle made by each cable with the horizontal is increased (so that the cables become closer to the vertical), while the weight of the load remains constant, the tension in each cable:

A) Increases B) Decreases

C) Remains constant D) Becomes zero

4. In the figure, which of the two components—horizontal or vertical—is responsible for balancing the weight of the suspended body? Why can the other component be neglected when writing the vertical equilibrium equation?



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Week .....

Weekly Assessment

Date: .....

Group A

1. Choose: If the force is doubled while the perpendicular distance remains constant, the moment of the force …

   A) doubles B) halves

   C) remains constant D) cannot be determined

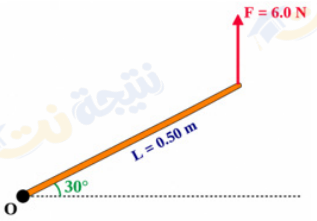
2. Choose: A wheel nut is loosened more easily if the spanner is:

   A) Shorter B) Longer

   C) Without a lever arm D) Its length has no relation to the ease of loosening

3. Compare the moment of a force acting perpendicular to its lever arm ($\theta = 90°$) with the moment of the same force acting at an angle smaller than 90° to the same lever arm, in terms of their magnitudes and the equation used in each case.

4. In the figure, state three different ways of increasing the moment of this force about the other end of the lever without changing the magnitude of the force.



Group B

1. Choose: A force of 4.0 N acts at the end of a 0.30 m lever arm at an angle of 45° to the lever arm. Calculate the moment of the force about the pivot. Use $\sin 45° \approx 0.71$.

   A) 0.85 N.m B) 1.2 N.m

   C) 1.7 N.m D) 6 N.m



2. Choose: A ruler is balanced about a pivot. One coin placed 15 cm to the right of the pivot balances n identical coins placed 5 cm to the left of the pivot. The value of n equals ……

   A) 1 B) 2

   C) 3 D) 5

3. Compare pushing a door at the handle far from the hinge and when pushing it near the hinge, in terms of the moment arm and the resulting moment, while the applied force remains constant.

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4. In the figure, explain without (numerical calculation). How the magnitude of the moment of the same force changes when the moment is calculated about points A, B, and C, although the force has the same magnitude and direction in all cases.



Group C

1. Choose: When using a torque wrench with a longer lever arm to produce the same required torque, the required force is ……

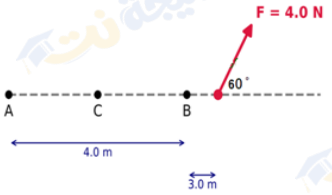
A) Greater B) Smaller C) the same D) Zero

2. A force of 6 N acts at the end of a 0.5 m lever at an angle of 30° to the lever. The moment of the force about the other end is approximately .. (Use sin 30° = 0.5.)

A) 1.5 N.m B) 0.3 N.m C) 0.5 N.m D) 0.9 N.m

3. A force F = 4 N acts at an angle of 60° at a point on a straight line 4m from A and 3m from B.

(Use sin 60° ≈ 0.87.)



Choose:

(A) The moment of the force about point A is approximately …….

A) 13.9 N.m anticlockwise B) 10.4 N.m clockwise

C) 13.9 N.m clockwise D) 4.0 N.m anticlockwise

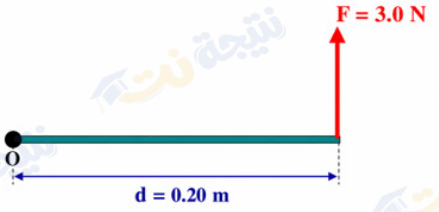
(B) The moment of the same force about point B is approximately …

A) 13.9 N.m anticlockwise B) 10.4 N.m clockwise

C) 10.4 N.m anticlockwise D) Zero

4. Compare positive torque and negative torque in terms of the direction of rotation represented by each.

5. In the figure, explain (without numerical calculation) how the moment of force F about O changes if the point of application of F moves along the rod toward O, while the direction and magnitude of the force remain constant.



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First Period | Week .....

Lesson (1-6): Power and Efficiency

Date: .....

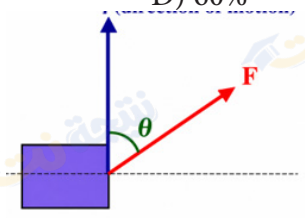
Classroom Performances

1. Choose: Power is a measure of ……..
   A) The amount of work done only
   B) The rate at which work is done or energy is transferred
   C) The magnitude of the force only
   D) The total displacement of the body
2. The mathematical expression for calculating average power from work and time is ……..
   A) $P = W \times t$ B) $P = \Delta W/\Delta t$ C) $P = W + t$ D) $P = W/t^2$
3. The SI unit of power is:
   A) Joule (J) B) Watt (W)
   C) Newton (N) D) Kilogram (kg)
4. In the figure, elevators A and B lift the same load through the same height but in different times. Identify which elevator has the greater power and which performs the greater useful work.



Homework Performances

1. When comparing two elevators that lift the same load through the same vertical height, but one completes the lift in a shorter time, this elevator has:
   A) Greater work B) Greater power
   C) Greater efficiency necessarily D) The same work and the same power
2. A device has an efficiency of 40%. If its total input energy is 250 J, the useful output energy is ……
   A) 100 J B) 250 J C) 62.5 J D) 400 J
3. Choose: A water heater receives an input power of 2400 W and produces a useful thermal power of 2040 W. Its efficiency is …….
   A) 85% B) 15% C) 117% D) 60%
4. The figure shows a force F acting at an angle θ to the direction of motion. Explain what happens to the power produced by the force as θ approaches 90°, compared with the case where the force acts in the direction of motion (θ = 0°).



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Week .....

Weekly Assessment

Date: .....

Group A

1. Choose: A rigid body is in equilibrium under the action of only three forces: F_1 = 10 N upward and F_2 = 6 N downward. The third force F3 required to satisfy the equilibrium condition (along the same vertical line) must be:

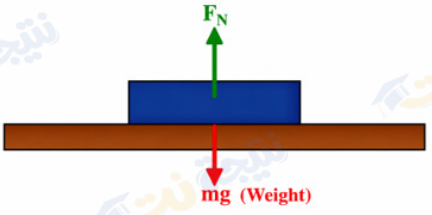
   A) 4 N upward B) 4 N downward

   C) 16 N upward D) 16 N downward

2. A lamp of mass 3 kg is suspended by a cable fixed to the ceiling and a light horizontal rope fixed to a wall. The cable makes an angle of 25° with the vertical. The weight of the lamp is approximately 29.4 N (g = 9.8 m/s²). The tension T in the cable is approximately …….

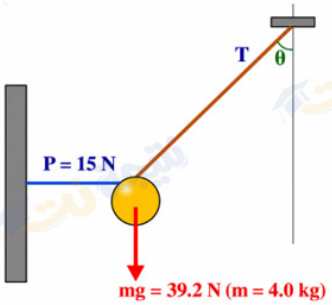
   A) 26.8 N B) 32.3 N C) 12.4 N D) 29.4 N

3. For a lamp in equilibrium suspended by two identical cables making the same angle with the horizontal, calculate the sum of the vertical components of the two tension forces.



4. In the figure, what changes in the diagram if another book of the same weight is placed on top of the book? State which of the two forces changes in magnitude and which remains unchanged in terms of its source.

5. In the figure, a lamp of mass 4 kg is suspended by a cable fixed to the ceiling and a horizontal rope. The tension in the horizontal rope is P = 15 N. Determine the angle θ that the cable makes with the vertical.



Group B

1. For a lamp in equilibrium suspended by two identical cables making the same angle with the horizontal, the horizontal components of the two tension forces …….

   A) are equal in magnitude and opposite in direction, so they cancel each other

   B) add together

   C) have no relation to equilibrium

   D) are equal to the weight

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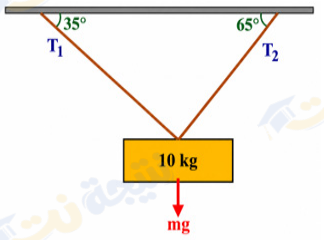
2. If the angle made by each cable with the horizontal is decreased (so that the cables become closer to the horizontal), while the weight of the load remains constant, the tension in each cable:

A) Increases B) Decreases

C) Remains constant D) Becomes zero

3. A metal object of mass 1.5 kg is at rest, suspended by two identical light springs. Each spring makes an angle of 40° with the vertical and has a spring constant of 60 N/m. Calculate the force F in each spring. Use cos 40° = 0.77.

4. In the figure, a shop sign of mass 10 kg is suspended by two light cables connected to a horizontal beam. The first cable makes an angle of 35° with the horizontal, and the second makes an angle of 65° with the horizontal. Determine the tension in each cable.



5. Compare the following two cases: a lamp suspended by two identical cables making the same angle, and another lamp of the same weight suspended by two cables making different angles, in terms of whether the tensions in the two cables are equal or different in each case.

Group C

1. If the angle made by each cable with the horizontal is increased (so that the cables become closer to the vertical), while the weight of the load remains constant, the tension in each cable:

A) Increases B) Decreases

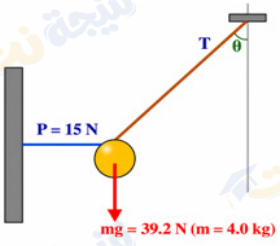
C) Remains constant D) Becomes zero

2. A metal object of mass 1.5 kg is at rest, suspended by two identical light springs. Each spring makes an angle of 40° with the vertical and has a spring constant of 60 N/m. The weight of the object (g = 9.8 m/s²) is approximately ……..

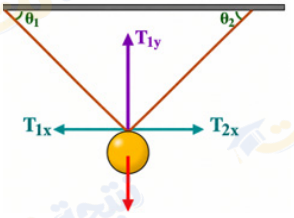
A) 1.5 N B) 14.7 N

C) 6 N D) 60 N

3. In the figure, a lamp of mass 4 kg is suspended by a cable fixed to the ceiling and a light horizontal rope fixed to a wall. The tension in the horizontal rope is P = 15 N. Calculate the tension T in the cable.



4. In the figure, explain how the diagram shows that the sum of the two vertical components of tension equals the weight of the lamp, while the two horizontal components cancel each other.



5. Compare the following two cases: a lamp suspended by two identical cables making the same angle, and another lamp of the same weight suspended by two cables making different angles, in terms of whether the tensions in the two cables are equal or different in each case.

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Revision

1. An airplane flies at a speed of 220 m/s relative to the air, traveling a distance of 3.6 × 105 m to the east and then returning the same distance to the west. A uniform wind blows at a speed of 20 m/s to the east throughout the entire journey.



a) Calculate the magnitude of the airplane's resultant velocity relative to the ground during the outbound and return trips.

b) Find the ratio of the return time to the outbound time.

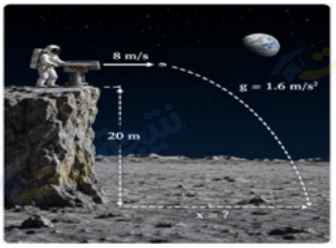
2. Two balls, A and B, were projected horizontally at the same moment from the same height, with a speed of 10 m/s for ball A and a speed of 20 m/s for ball B. Neglecting air resistance, which of the following statements is correct?

a) A arrives first, and their horizontal ranges are equal.

b) B arrives first, and its range is double the range of A.

c) They arrive together, and the range of B is double the range of A.

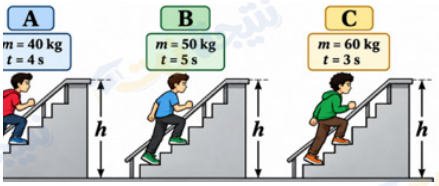
d) They arrive together, and their horizontal ranges are equal.



3. Choose: A rock sample was projected horizontally at a speed of 8 m/s from the edge of a cliff 20 m high on the surface of the Moon, where the gravitational acceleration is 1.6 m/s². What is the horizontal range of the sample?

a) 20 m b) 32 m c) 40 m d) 64 m

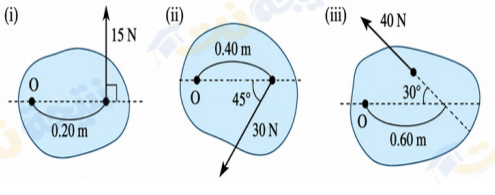
4) Choose: Three people climb the same stairs to the same height, as shown in the figure. Which person develops the greatest mechanical power?



A) m = 40 kg, t = 4 s B) m = 50 kg, t = 5 s

C) m = 60 kg, t = 3 s D) The three people develop equal power.

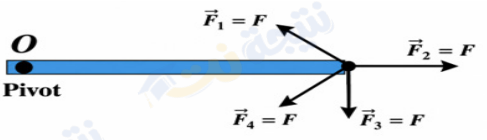
5) For each of the following figures, calculate the moment of the force about point O.



6) From the figure shown, the force that produces the greatest moment about point O is:

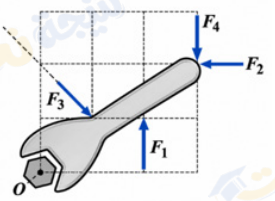
A) $\vec{F}_1$ B) $\vec{F}_2$

C) $\vec{F}_3$ D) $\vec{F}_3$



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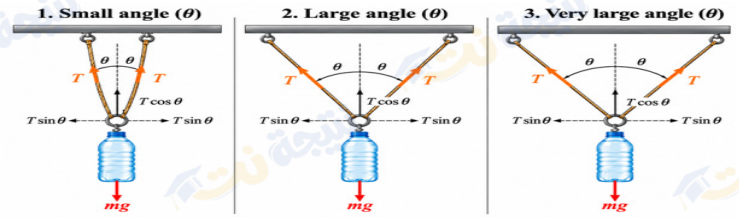
7) A wrench is used to turn a nut by applying forces of equal magnitude. Which forces produce the same torque?



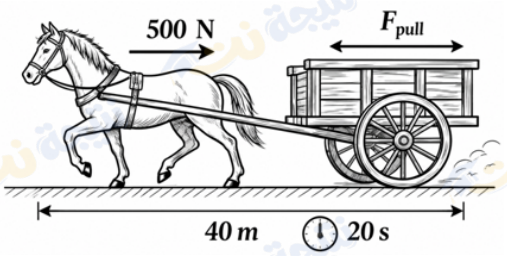
A) F_1, F_2 B) F_2 F_4

C) F_1, F_3 D) F_2, F_3

8) Although the weight of the bottle (mg) remains constant, the tension in the ropes increases. Why?



9) A horse pulls a cart with a force of 500 N and moves it through a distance of 40 m in 20 s. Calculate the average power.



10) Choose: A body is projected horizontally towards a wall and strikes the wall at point N. The points Y, K, L, M, N, and O are arranged vertically from top to bottom at equal intervals, and points O and Y are at the same level as the point of projection. If the horizontal projection speed is doubled, while the positions of the point of projection and the wall remain unchanged, at which point will the body strike the wall?

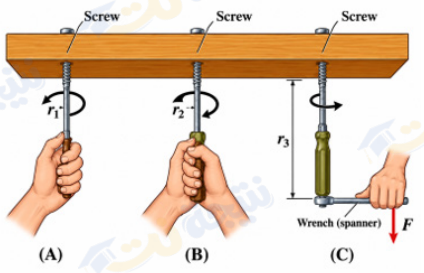


A) K B) L C) M D) O

11) In the figure, the same force F is applied in three different cases to loosen a screw using a screwdriver.

(a) Arrange the three cases in order according to the resulting moment of force, from greatest to least.

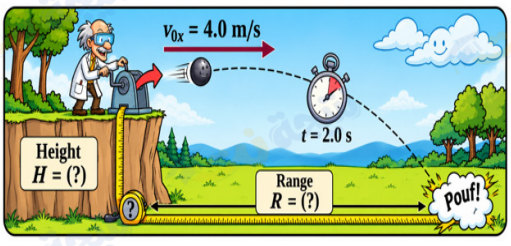
(b) Explain physically why case C is successful more easily, whereas case A fails.



12) A body is projected horizontally with a speed of 4.0 m s^{-1} from a certain height and reaches the ground after 2 s. Calculate:

a) the initial height of the body above the ground.

b) the horizontal range of the body.



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First Period

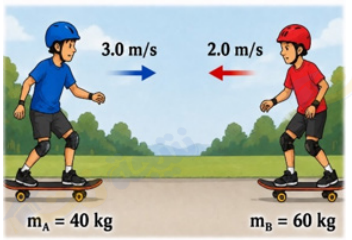
Week .....

Lesson (1-7): Momentum and Impulse]

Date: .....

Classroom Performances

1. Choose: Person (A), with a mass of 40 kg, moves east at a speed of 3.0 m/s, while person (B), with a mass of 60 kg, moves west at a speed of 2.0 m/s along the same straight line. Which one has the greater magnitude of momentum?



(A) Person (A)

(B) Person (B)

(C) They are equal

(D) It cannot be determined without choosing a positive direction

2. A phone falls from the same height once onto a hard floor and once onto a cushion, and comes to rest in both cases.





(A) Explain: Why is the average collision force on the cushion smaller even though the change in momentum is the same?

(B) What happens to the average force if the phone's stopping time is doubled?

3. A ball with a mass of 0.10 kg is moving east at 6 m/s. It is then hit and moves north at the same speed.

What are the magnitude and direction of the impulse?



(A) 0.6 N·s north

(B) N·s northwest

(C) 1.2 N·s northeast

(D) N·s southwest

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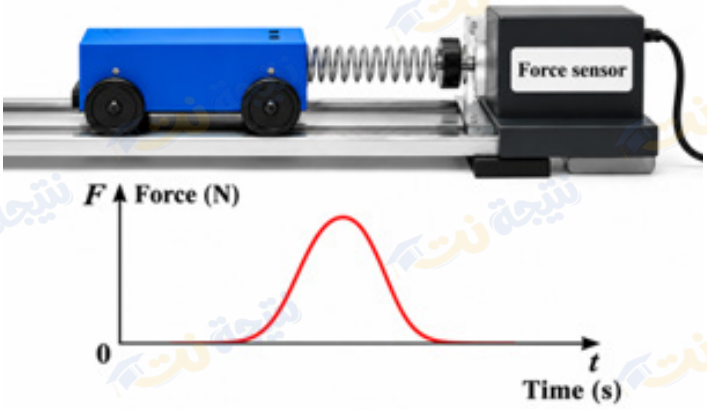
Homework Performances

1. Choose: If an airbag increases a passenger's stopping time to three times its original value, while the change in momentum remains constant, the average force becomes:



(A) Three times as large
(B) Half as large
(C) One-third as large
(D) Unchanged

2. A dynamics cart collides with a bumper connected to a force sensor and then rebounds in the opposite direction.



(A) Explain how the force–time graph is used to determine the impulse acting on the cart.
(B) How does the shape of the force pulse change when the bumper is replaced with a softer one, while the change in momentum remains constant?

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First Period Week .....

Lesson (1-8): Conservation of Momentum

Date: .....

Classroom Performances

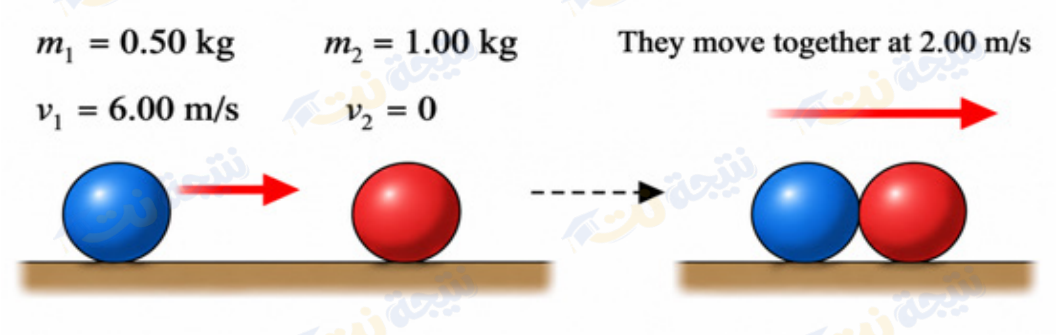
1. A passenger stands in the middle of a stationary boat on a calm lake and then slowly walks toward the front of the boat.



(A) Describe the total momentum of the system before the passenger begins walking.

(B) Explain why the boat moves in the opposite direction to the passenger's motion while the passenger is walking, stating the reason.

2. A moving object of mass m_1 = 0.5 kg and speed 6 m/s east collides with a stationary object of mass m_2 = 1 kg. They stick together and move together after the collision at a speed of 2 m/s.



(A) Compare the total momentum before the collision with the total momentum after the collision. What do you conclude?

(B) Does the total momentum of the system increase, decrease, or remain constant? Explain your answer.

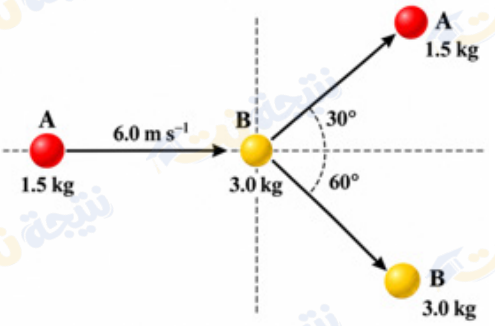
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Homework Performances

1. Choose: Object A, with a mass of 2.0 kg, moves at a speed of +6.0 m/s and collides with object B, with a mass of 4.0 kg, moving in the opposite direction at a speed of 2.0 m/s. If the two objects stick together after the collision, what are their speed and direction of motion?

(A) 0.67 m/s in the direction of A
(B) 0.67 m/s in the direction of B
(C) 2.0 m/s in the direction of A
(D) 2.0 m/s in the direction of B

2. On a smooth horizontal surface, object A, with a mass of 1.5 kg, moves at 6.0 m s^{-1} in the positive direction of the horizontal axis and collides with stationary object B, with a mass of 3.0 kg. After the collision, object A is deflected at an angle of 30° above the horizontal, and object B is deflected at an angle of 60° below the horizontal.



Find the final velocities of objects A and B after the collision.

Week .....

Weekly Assessment

Date: .....

Group A

1) Choose: If the mass of the ball is 0.15 kg, what is the magnitude of the impulse it receives?



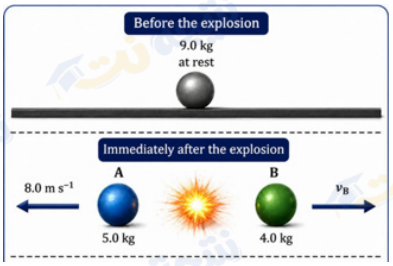
(A) 3.0 N.s
(B) 5.0 N.s
(C) 7.5 N.s
(D) 15 N·s

2) Choose: When the change in momentum is constant, if the collision time is doubled, the average force:

(A) Doubles
(B) Decreases by half
(C) Does not change
(D) Increases fourfold

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3) A stationary object with a mass of 9 kg explodes into object A, with a mass of 5 kg, and object B, with a mass of 4 kg. If object A moves to the left at a speed of 8.0 m s^{-1} after the explosion, find the speed and direction of motion of object B after the explosion.



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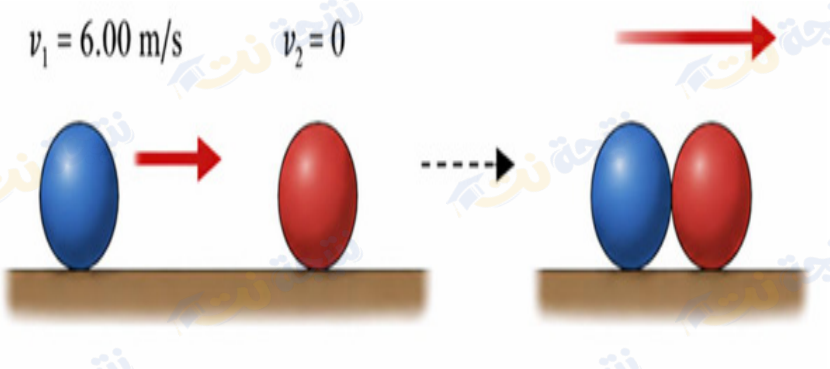
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4) A moving object of mass m_1 = 0.5 kg and speed 6 m/s east collides with a stationary object of mass m_2 = 1 kg, and they stick together and move together after the collision.

Calculate the speed of the two objects after the collision.

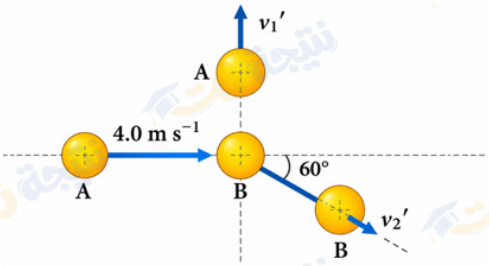
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5) On a smooth horizontal surface, object A, with a mass of 0.3 kg and moving at 4.0 m s^{-1}, collides with stationary object B, with a mass of 0.6 kg.

Find the final velocities of objects A and B after the collision, given that object A moves after the collision perpendicular to its original line of motion, while object B moves at an angle of 60° below the original line of motion.



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Group B

1) Choose: A ball with a mass of 0.2 kg moves east at 5 m/s. It is then hit and moves west at 3 m/s. What are the magnitude and direction of the impulse acting on the ball?

(A) 0.4 N.s west (B) 1 N.s east

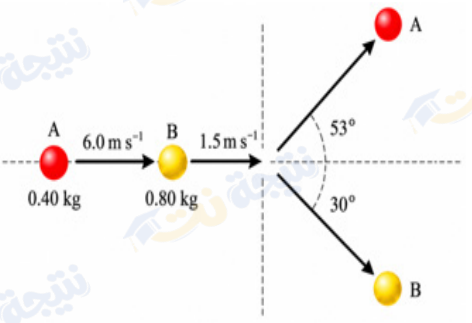
(C) 1.6 N.s west (D) 1.6 N.s east

2) Choose: When the change in momentum is constant, if the collision time is reduced to half its original value, the average force:

(A) Doubles (B) Decreases by half

(C) Does not change (D) Increases fourfold

3) On a smooth horizontal surface, object A, with a mass of 0.4 kg, moving at 6 m s^{-1}, collides with object B, with a mass of 0.8 kg, moving in the same direction at 1.5 m s^{-1}.



After the collision, object A is deflected at an angle of 53° above the original line of motion, while object B is deflected at an angle of 30° below the original line of motion.

Find the final velocities of objects A and B after the collision.

4) A cannon fires a projectile with a large mass from a cannon mounted on a horizontal surface. The projectile exits at a high horizontal speed toward the east.



(A) Describe the total momentum of the system before the projectile is fired.

(B) Explain the backward motion of the cannon after firing, including the relationship between the cannon's recoil speed and its mass.

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Group C

1) Choose: A ball with a mass of 0.1 kg moves at 8 m/s in a direction perpendicular to its initial direction of motion. It is then hit and moves at 6 m/s in the new direction.

What is the magnitude of the impulse acting on the ball?

(A) 20 N-s (B) 0.6 N-s (C) 1N-s (D) 1.4 N-s

2) Choose: When the change in momentum is constant, if the collision time becomes four times its original value, the average force:

(A) Doubles (B) Decreases by half

(C) Does not change (D) Increases fourfold

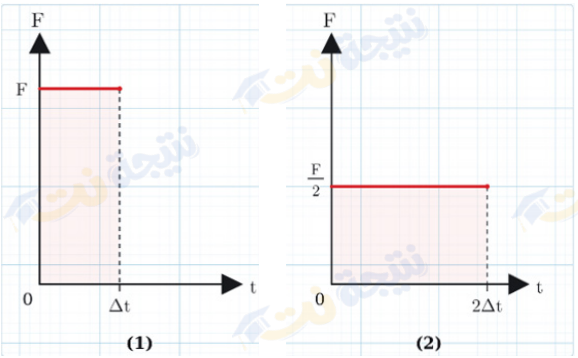
3) On a smooth horizontal surface, object A, with a mass of 0.3 kg, moves at 5 m s^{-1} and collides with object B, with a mass of 0.6 kg, moving in the same direction at 2 m s^{-1}.

If object A moves immediately after the collision at an angle of 90° to its original direction of motion, with a speed of 3 m s^{-1}, then the speed of object B after the collision and the angle (θ) that its direction of motion makes below the original line of motion are:

(A) 3.25 m s^{-1}, $\theta \approx 26.56°$ (B) 2.89 m s^{-1}, $\theta \approx 30.96°$

(C) 3.25 m s^{-1}, $\theta \approx 30.96°$ (D) 2.89 m s^{-1}, $\theta \approx 26.56°$

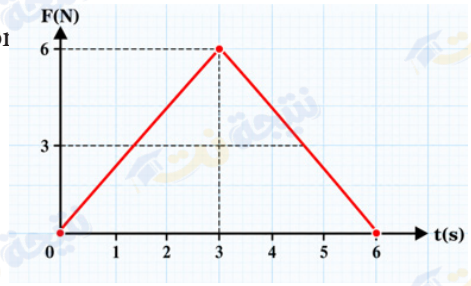
4) In the two graphs, 1–2, the graphical relationship between impulse force and time for two objects 1 and 2, Find the ratio between the impulses in the two cases.



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5) Choose: The graph shows the force acting on an object with a mass of 1.5 kg as a function of time fro
If the object's initial velocity is zero, what is its velocity at t = 6 s?



(A) 6.0m/s (B) 9.0m/s

(C) 12m/s (D) 18m/s

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First Period

Week .....

Lesson (1.9) Momentum and mechanical energy

Date: .....

Classroom Performances

1. In an inelastic collision involving an isolated system, which of the following statements is correct?

   A) Both momentum and kinetic energy are conserved.

   B) Momentum is not conserved, while kinetic energy is conserved.

   C) Momentum is conserved, while kinetic energy decreases.

   D) Both momentum and total energy decrease.

2. A car (A) of mass 1000 kg was moving at a speed of 20 m/s eastward when it collided with the rear of a stationary truck (B) of mass 3000 kg at a traffic light. The car and the truck stuck together immediately after the collision and moved as a single body.

   A) Calculate the velocity of the combined body (the car and the truck) immediately after the collision.

   B) Calculate the coefficient of restitution (e) for this collision, and determine the type of collision based on its value.

   C) Calculate the amount of kinetic energy lost as a result of this collision.

Homework Performances

1) Two balls collide and then separate after the collision, with a decrease in the total kinetic energy of the two balls. We can conclude that the collision is:

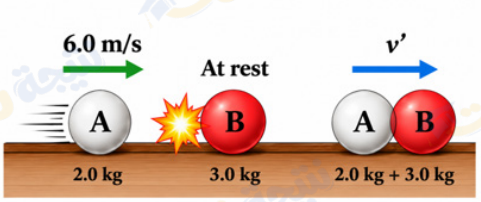
   A) Perfectly elastic because the two balls separate.

   B) Inelastic; the two objects are not necessarily required to stick together.

   C) Perfectly inelastic.

   D) Not subject to the conservation of momentum.

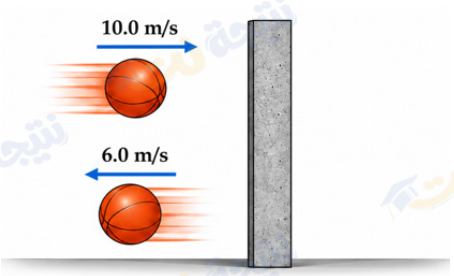
2) Ball A, with a mass of 2 kg, is moving at a speed of 6 m/s eastward and collides with stationary ball B, with a mass of 3 kg. The two balls stick together after the collision and move together in the same direction.



What is the decrease in the total kinetic energy as a result of the collision?

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3) A rubber ball collides vertically with a smooth wall. Its velocity before the collision was 10 m/s toward the wall, and it rebounded after the collision at a speed of 6 m/s in the opposite direction.



What is the value of the coefficient of restitution (e)?

Week ..... Second Period

Date: .....

Lesson 1-10: Uniform Circular Motion and Centripetal Force

Classroom Performances

1. Which of the following accurately describes uniform circular motion and the reason for the acceleration of an object moving in this way?

   A) The velocity vector is constant, so acceleration is zero.

   B) The magnitude of velocity changes while direction remains constant.

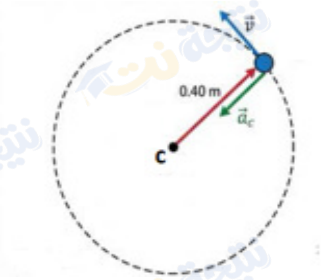
   C) The speed is constant, but the direction of velocity constantly changes towards the center.

   D) The object experiences an outward centrifugal force that causes tangential acceleration.

2. An object undergoes uniform circular motion, making 10 revolutions in 2.0 s on a circle of radius 0.40 m.

   a) Determine its period.

   b) Determine its angular velocity.



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3. A small ball of mass 0.50 kg attached to a thread of length 2.0 m undergoes uniform circular motion with angular speed 3.0 rad/s. Determine its centripetal acceleration.

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Homework Performances

1. An object undergoes uniform circular motion, making 20 revolutions in 5.0 s in a circle of radius 0.20 m.

   a) Determine the period.

   b) Determine the speed.

2. A small ball of mass 0.50 kg attached to a thread of length 2.0 m has angular velocity 3.0 rad/s.

   a) Determine its speed.

   b) Determine the magnitude of the force required to maintain the circular motion.

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3. A small ball of mass 0.50 kg is attached to a spring of natural length 0.10 m and spring constant 30 N/m, undergoing circular motion with angular velocity 6.0 rad/s. Determine the extension of the spring.

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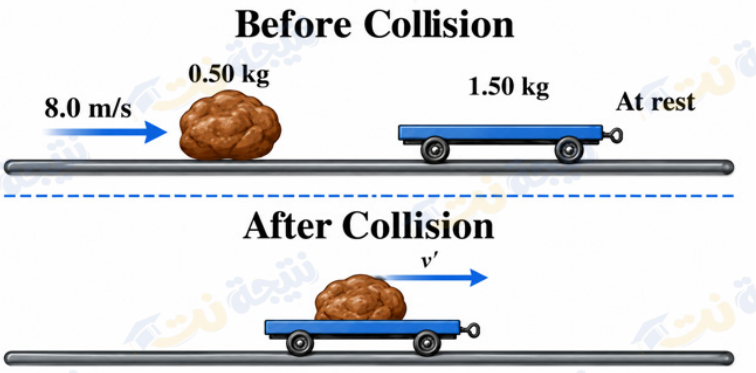
Week .....

Weekly Assessment

Date: .....

Group A

1) A lump of clay with a mass of 0.5 kg is moving at a speed of 8 m/s toward a stationary cart with a mass of 1.5 kg on a smooth horizontal surface. After the collision, the clay sticks to the cart, and they move together.



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Which statement correctly describes this collision?

(A) Both momentum and kinetic energy are conserved.

(B) Momentum is not conserved because the two objects stick together.

(C) The two masses move together at one common velocity after the collision.

(D) The cart rebounds in the opposite direction, while the clay remains separate.

2) Choose: A car collides with a barrier, causing its front end to deform and some of its parts to increase in temperature. The kinetic energy that was lost was mainly converted into:

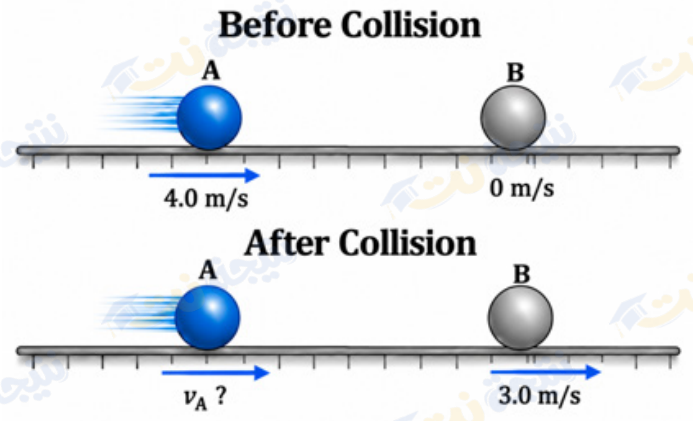
(A) Potential energy only

(B) Internal energy, sound, and deformation

(C) Additional momentum

(D) Additional mass of the car

3) Ball A is moving at 4 m/s in a straight line toward stationary ball B. After a direct collision, the speed of ball B is 3 m/s in the original direction of motion, and the coefficient of restitution is 0.50.



What is the speed of ball A after the collision?

(A) 0 m/s (B) 0.5 m/s (C) 1 m/s (D) 2 m/s

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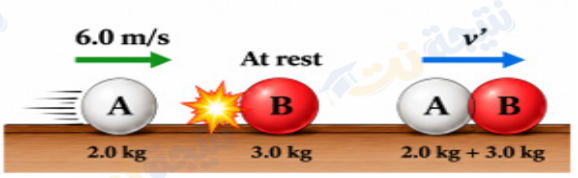
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Group B

1) Ball A, with a mass of 2 kg, is moving at a speed of 6 m/s toward the east and collides with stationary ball B, which has a mass of 3 kg. They stick together after the collision and move together in the same direction.



What is the magnitude of the decrease in the total kinetic energy as a result of the collision?

(A) 12 J (B) 18 J (C) 24 J (D) 30 J

2) Hearing a loud sound during an inelastic collision is evidence of:

(A) The destruction of some of the energy

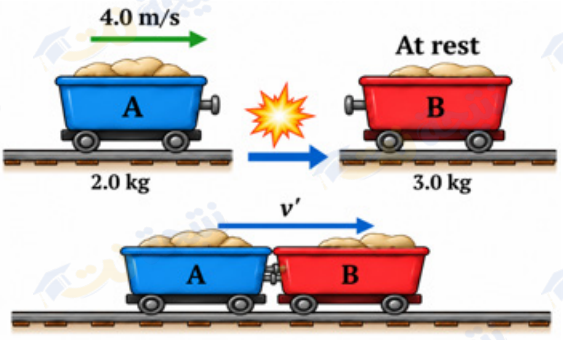
(B) Some of the kinetic energy being converted into sound energy

(C) Momentum not being conserved

(D) An increase in the total kinetic energy

Group C

1) Cart A, with a mass of 20 kg, is moving at a speed of 40 m/s toward the east and collides with stationary cart B, which has a mass of 3 kg. After the collision, the two carts stick together and move as one with a common velocity v.



What is the common velocity v after the collision?

(A) 2.6 m/s east (B) 2.0 m/s east

(C) 2.4 m/s east (D) 3.2 m/s east

2) If the total kinetic energy of two objects decreases by 30 J during an isolated collision, the

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most accurate interpretation is:

(A) 30 J of energy disappeared.

(B) 30 J was converted into other forms of energy within the system and its immediate surroundings.

(C) Momentum decreased by 30 kg.m/s.

(D) The mass of the system decreased.

Week .....

Weekly Assessment

Date: .....

Group A

1. Choose: The angular velocity (ω) of an object in circular motion is defined as the:

A) Linear displacement per unit time

B) Angular displacement per unit time

C) Total number of revolutions per second

D) Time taken to complete one full revolution

2. The centripetal force acting on an object of mass m moving in a circle of radius r at speed v is given by:

A) $F = m\ v\ r$ B) $F = m\ v^2 / r$

C) $F = m\ v / r^2$ D) $F = m^2\ v / r$

3. A horizontal disk rotates at a constant angular velocity of rad/s. Point A is located on its rim, 0.30 m from the center.

Calculate:

a) The period T b) The linear velocity of the point

4. Explain the physical mechanism that causes water to leave a spinning washing-machine drum through its perforations during the spin cycle.

5. An object of mass 3.0 kg moves in a circle of radius 2.0 m, making 1 revolution in 4.0 s ($\pi = 3.14$).

a) Determine the magnitude of the acceleration.

b) Determine the magnitude of the centripetal force required.

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Group B

1. Choose: The period (T) of an object in circular motion is defined as the time taken for:

   A) 1 revolution B) 2π revolutions

   C) 10 revolutions D) A fractional revolution per second

2. Choose: Which of the following statements correctly describes the net force acting on an object moving in uniform circular motion?

   A) An outward centrifugal force balances the inward force.

   B) There is no outward force; the net force is always directed toward the center.

   C) The net force acts tangentially in the direction of velocity.

   D) The net force is zero because the speed is constant.

3. Describe the trajectory of a whirled ball immediately after the string holding it is cut, and explain why it does not fly directly outward away from the center.

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4. What happens when:

   A. A string holding a ball in circular motion suddenly breaks?

   B. The radius of a circular path is increased while the object's angular velocity stays the same?

   .....

5. An object undergoes uniform circular motion, making 15 revolutions in 3.0 s in a circle of radius 0.30 m.

   a) Determine the period and frequency. B. Determine the linear speed.

   .....

Group C

1. The centripetal acceleration (ac) of an object moving in a circle can be calculated using:

   A) $ac = v^2 / r$ or $ac = \omega^2 r$ B) $ac = v r$ or $ac = \omega / r$

   C) $ac = v^2 r$ or $ac = \omega r^2$ D) $ac = v / r^2$ or $ac = \omega^2 / r$

2. A ball moves along the inside of a horizontal semi-circular ring as shown. The diagram is a view from above. Which arrow represents the direction of the average force on the ball?



A.



B.

C.

D.



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3. Explain why an object moving in a circle at a constant speed still has a non-zero acceleration.

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4. Give reasons for the following:

A. An object moving in a circle at constant speed is still said to be accelerating.

B. There is no such thing as an outward 'centrifugal force' acting on an object in circular motion.

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5. A ball of mass 0.40 kg moves in a horizontal circle of radius 0.50 m with a speed of 2.0 m/s.

A. Determine the centripetal acceleration.

B. Determine the centripetal force required.

First Period Week .....

Lesson 1-11: Circular Motion: Horizontal and Vertical

Date: .....

Classroom Performances

1. Choose: The minimum speed required at the top of a vertical circle of radius r for an object to maintain circular motion (where string tension T = 0) is given by:

A) vmin = $\sqrt{2gr}$ B) vmin = $\sqrt{gr}$

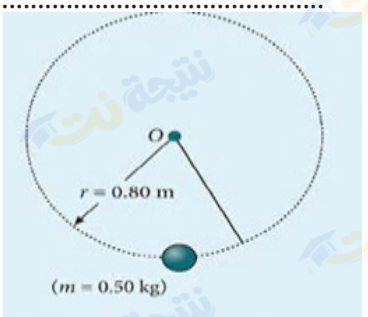
C) vmin = g r D) vmin = $\sqrt{g/r}$

2. Explain why water can remain inside a bucket swung in a vertical circle, even when the bucket is upside down at the top.

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3. A small ball of mass 0.50 kg is tied to a string and moved in a vertical circle of radius 0.80 m. At the lowest point its speed is 4.0 m/s. Determine the tension in the string at the lowest point.



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Homework Performances

1. A small ball moves in uniform circular motion at height h inside a conical container with a smooth inner surface, the cone's axis making angle θ with the generatrix.
   a) Determine the normal force N on the ball in terms of m, θ, and g.
   b) Determine the speed of the ball in terms of h and g.

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2. A small ball of mass 0.50 kg is tied to a string and moved in a vertical circle of radius 0.80 m. Determine the minimum speed needed at the top of the circle for the string to remain taut.

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3. Explain why the water in a whirled bucket experiment first begins to spill out near the top of the circle rather than at the bottom.

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Week ..... Second Period

Date: .....

Lesson 1-11: Circular Motion: Horizontal and Vertical

Classroom Performances

1. A small ball with a mass of 0.40 kg is attached to a string and moves in a vertical circle with a radius of
0.60 m. At the lowest point of the circle, its speed is 4.0 m/s. The tension force in the string at the lowest point is:
   a) 12.6 N b) 13.4 N c) 14.6 N d) 15.4 N
2. Describe the forces acting on the conical pendulum, and identify which component of the tension force provides the centripetal force.
3. A small ball moves in uniform circular motion along the smooth inner surface of a conical vessel, following a horizontal circular path of radius (r), such that the slanted side of the cone makes an angle (θ) with the horizontal plane.
   a) Write the equation for the vertical equilibrium of the ball.
   b) Write the equation (for the centripetal force) of the ball.

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Homework Performances

1. Choose: One end of a 1 m long string is attached to the ceiling, and a small ball of mass 0.5 kg tied to the other end undergoes uniform circular motion on a smooth horizontal plane. If the angle between the string and the vertical is 30° and the acceleration due to gravity is 9.8 m/s^2, the magnitude of the tension in the string is approximately:

   a) 4.90 N b) 5.66 N c) 2.54 N d) 9.80 N

2. One end of a string of length L is fixed to the ceiling, and a ball of mass m moves in a uniform circular motion in a horizontal plane, so that the string is inclined at an angle θ from the vertical line, and the angular velocity is .ω

   a) Determine the tensile strength of the thread.

   b) Determine the normal force acting on the ball if it also receives a normal force from a horizontal surface.

3. Explain why a car which barely maintains contact with the track at the top of a circular loop experiences a very large normal force at the bottom of the track.

Week .....

Weekly Assessment

Date: .....

Group A

1. Choose: At the highest point of a vertical circular path, the resultant of the tension force (T) and weight (mg) must be directed:

   A) Tangentially in the direction of motion

   B) Directly away from the center of the circle

   C) Directly toward the center of the circle

   D) Vertically upward balancing gravity

2. The tension in a string swinging an object in a vertical circle reaches its maximum value at the:

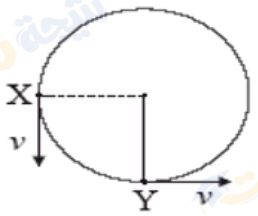
   A) Highest point of the path B) Lowest point of the path

   C) Horizontal position level with the center D) Point where velocity is zero

3. Evaluate and discuss the validity of the statement: 'The minimum speed at the top of a vertical circle occurs when the normal force (or tension) becomes infinite.'

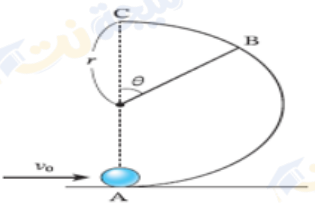
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4. A stone attached to a string is moving in a horizontal circle. The constant speed of the stone is v. The diagram below shows the stone in two different positions, X and Y.



Illustrate with drawing the direction of the change of velocity of the stone when moving from position X to position Y?

5. From the opposite figure, an object moves with an initial velocity v0 along a semi-circular path. If the radius of the path is halved while the initial velocity v0 remains constant, what will happen to the velocity at point B?



Group B

1. Choose: In a vertical circular motion, the minimum speed at the top of the loop is derived under the physical condition that the string tension T becomes:

   A) Equal to twice the weight
   B) Zero (T = 0)
   C) Equal to centripetal force alone
   D) Infinite

2. Choose: Real roller-coaster loops are designed in a clothoid (teardrop) shape rather than a perfect circle in order to:

   A) Increase the maximum speed at the top
   B) Gradually change the radius of curvature and control centripetal acceleration on riders
   C) Eliminate gravitational force completely
   D) Ensure string tension remains constant throughout

3. Analyze the forces in a conical pendulum and explain why it is the horizontal component of tension—not the vertical component—that provides the centripetal force.

4. What happens when:

   a) A bucket of water is swung in a vertical circle too slowly to maintain the required speed at the top?

   b) The angle of a conical pendulum's string with the vertical is increased while its angular velocity stays the same?

5. A ball of mass 0.60 kg is tied to a string of length 1.0 m and swung in a vertical circle. Determine the minimum speed at the top of the circle needed to keep the string taut.

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Group C

1. In a conical pendulum, the component of string tension that provides the required centripetal force is:

   A) T cos θ (vertical component) B) T sin θ (horizontal component)

   C) T tan θ D) The full tension T acting vertically

2. Explain why both the tension force and the gravitational force act in the same direction at the top of a vertical circular path.

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3. Critique the misconception that 'water spills from a bucket swung too slowly in a vertical circle due to an outward centrifugal force.' Provide the correct physical explanation based on inertia.

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4. Give reasons for the following:

   a) Roller-coaster loops are built as teardrop-shaped curves rather than perfect circles.

   b) The tension in a string swinging a ball in a vertical circle is greatest at the lowest point.

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5. A conical pendulum has a bob of mass 0.30 kg on a string of length 0.80 m, making an angle of 30° with the vertical.

   a) Determine the tension in the string. b) Determine the speed of the bob.

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First Period Week .....

Lesson 1-12: Kepler's Laws and Universal Gravitation

Date: .....

Classroom Performances

1. Choose: Newton's law of universal gravitation states that the magnitude of gravitational force between two identical masses separated by distance 1 m is given by:

   A) F = G (m2) B) F = G m

   C) F = G / m D) F = m / G

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2. Two objects, each of mass 60 kg, are placed 3.0 m apart. Using $G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}, determine the magnitude of the gravitational force between them.

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3. The semi-major axis of an asteroid's orbit is 9.0 astronomical units. Using the Earth's semi-major axis of 1.0 AU and orbital period of 1.0 year, determine the orbital period of the asteroid.

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Homework Performances

1. state gravitational field, and describe how it can be represented using field lines.

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2. Two objects, each of mass 40 kg, are 3.0 m apart. Using $G = 6.7 \times 10^{-11}$ N m^2 kg^{-2}, determine the gravitational force between them.

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3. When a comet's distance from the Sun at aphelion is 2.5 AU and at perihelion is 1.5 AU, determine the ratio of its speed at aphelion to its speed at perihelion.

Week ..... Second Period

Date: .....

Lesson 1-12: Kepler's Laws and Universal Gravitation

Classroom Performances

1. Choose: Kepler's Third Law states that for any satellite or planet orbiting a central body, the square of the orbital period (T^2) is directly proportional to:

a) the semi-major axis (r) b) the square of the semi-major axis (r^2)

c) the cube of the semi-major axis (r^3) d) the square root of the semi-major axis ($\sqrt{r}$)

2. The semi-major axis of an asteroid's orbit is 7.0 astronomical units (AU). Using Earth's values (where the semi-major axis is 1.0 AU and the orbital period is 1.0 year), determine the asteroid's orbital period.

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3. Explain why the orbital period of a geostationary satellite must be equal to the period of Earth's rotation about its axis.

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Homework Performances

1. According to Newton's law of universal gravitation, if the distance between two objects increases to three times the original distance while their masses remain constant, which of the following statements correctly describes the relationship between the gravitational force and the separation distance between the two objects?

a) It is directly proportional to the distance.

b) It is directly proportional to the square of the distance.

c) It is inversely proportional to the distance.

d) It is inversely proportional to the square of the distance.

2.Explain why the ratio T^2/r^3 is constant for Jupiter's four largest moons, even though they orbit in Orbits with different radii.

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3. Explain how Kepler's third law helps account for the differences in the orbital periods of planets and asteroids orbiting the Sun, clarifying why objects farther from the Sun take longer to complete a single orbit.

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Week .....

Weekly Assessment

Date: .....

Group A

1. Choose: According to Newton's law of universal gravitation, the attractive force between two point masses is:

A) Inversely proportional to the separation distance r

B) Directly proportional to the product of their masses and inversely proportional to r^2

C) Directly proportional to the sum of their masses

D) Independent of the distance between them

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2. Choose: The gravitational field strength g at a distance r from a spherical body of mass M is given by:

(Given that the radius of the Earth's planet = R)

A) $g = G M / r2$ B) $g = G M /(R + r)^2$

C) $g = G M^2 / r$ D) $g = G / (M r^2)$

3. Explain why planets with larger orbital radii have longer orbital periods according to Kepler's Third Law, contrasting this with simple uniform linear speed.

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4. A comet orbits the Sun in an elliptical path. If the distance between the comet and the Sun at the farthest point (aphelion) is five times the distance at the closest point (perihelion):

a) Calculate the ratio of the comet's speed at the farthest distance to its speed at the closest distance.

b) If the comet's speed at the closest distance is 30 km/s, what is its speed at the farthest distance?

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Group B

1. Choose: Kepler's Third Law states that the square of the orbital period T^2 of a planet is directly proportional to:

A) The orbital speed v B) The cube of the semi-major axis r^3

C) The mass of the planet m D) The inverse square of the orbital radius $1/r^2$

2. Choose: A satellite that orbits Earth in a circular equatorial orbit with a period of 24 hours, appearing stationary relative to an observer on the ground, is called a:

A) Polar satellite B) Geostationary satellite

C) Low Earth Orbit (LEO) satellite D) Elliptical satellite

3. Explain why newtons per kilogram (N/kg) is equivalent to m/s^2.

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4. What happens when:

a) The distance between two masses is doubled, according to Newton's law of gravitation?

b) A satellite is moved to a larger circular orbit around the Earth?

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5. Two objects, each of mass 80 kg, are 2.0 m apart. Determine the gravitational force between them, using $G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}.

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Group C

1. Choose: The gravitational field strength (g) at a point in space is defined as:
   A) The gravitational potential energy per unit volume
   B) The gravitational force exerted per unit mass at that point
   C) The total gravitational force between two planets
   D) The acceleration of gravity multiplied by mass
2. Choose: According to Kepler's first law, where is the Sun located in a planet's orbit?
   A) At the center of the circular orbit
   B) At one of the two foci of the elliptical orbit
   C) Completely outside the elliptical orbit
   D) At the midpoint of the orbit's minor axis
3. Two objects, each of mass 100 kg, are 5.0 m apart. Using $G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}, determine the gravitational force between them.

   .....
4. Give reasons for the following:
   a) A geostationary satellite appears to remain fixed above one point on Earth's surface.
   b) A comet moves fastest when it is nearest the Sun (at perihelion).

   .....
5. The semi-major axis of a planet's orbit around a star is 4.0 times that of a second planet orbiting the same star, whose period is 2.0 years. Determine the orbital period of the first planet.

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First Period | **Chapter [2]** | Week .....

Lesson (2 – 1)

Simple Harmonic Motion | Date: .....

Classroom Performances

1- A student carried out the exploration activity of the ruler shown: he fixed a steel ruler under a group of books on the edge of the table so that most of it protrudes outside the edge, then he displaced the free end downwards and left it to vibrate. He noticed that the pitch of the sound tones produced from the ruler remained almost constant throughout the time of the vibration, although the amplitude of the vibration (the distance covered by the end) was decreasing continuously because of the air resistance, until the ruler stopped completely at the end.



Based on this observation, what is the scientific explanation for the constancy of the pitch of the tone although the continuous decrease in the amplitude?

After that, the student moved the ruler so that the protruding part outside the edge became shorter than it was, and he repeated the experiment, and he noticed that the pitch of the note produced became higher (it became sharper). What is the explanation for that?

2- Choose: On the arrival of the end of the vibrating ruler at the point of maximum displacement, it stops from motion for one moment (v = 0). At this very moment, the restoring force and the acceleration are at their maximum value for them. What is the direct scientific reason for that?

a) Because the speed when it equals zero forces the acceleration and the force to reach their maximum value.

b) Because the restoring force depends on the magnitude of the displacement from the position of equilibrium, and the displacement is at its maximum value at this point.

c) That the energy of motion is at its maximum value at the point of momentary rest.

d) Because the mass of the ruler increases momentarily on stopping, which leads to the increase in.

Homework Performances

1. A student performed an experiment on a system (a mass m suspended from a spring with spring constant k), and recorded that the period of oscillation of this system is T_1 = 1.2 s.

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Answer the following.

(a) The student replaced the original mass with another mass that is four times the first mass (4m), while keeping the same spring unchanged. First, predict: Will the new period increase or decrease? Then, find the ratio between the new period T_2 and the original period T_1 without needing to know the numerical values of m and k.

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(b) Based on the ratio obtained in part (a), calculate the numerical value of the new period T_2.

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2. Can it be said that multiplying the mass by a certain factor leads to multiplying the period by the same factor? Explain your answer by referencing the mathematical form of the relationship between the period and the mass.

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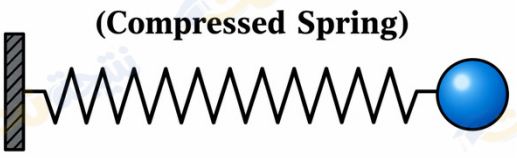
3. An object attached to a horizontal spring oscillates in simple harmonic motion, starting from the equilibrium position (x = 0) at time t = 0 moving toward the maximum positive displacement (+A) reached at time t = T/4. It then returns to x = 0 at time t = T/2, reaches maximum negative displacement (-A) at time t = 3T/4, and finally returns to x = 0 upon completion of a full period at time t = T.

Answer the following questions:

a) Graph the relationship between the displacement of the object and time over one complete cycle, labeling the positions of maximum displacement and equilibrium.

b) Identify the moments at which the speed of the object is at its maximum, and the moments at which its speed is zero.

4. A mass attached to a horizontal spring was displaced to the left until the spring reached maximum compression, and was then released from rest at this moment.



Choose: At this exact moment (the moment of release), the restoring force acting on the mass is:

a) Directed to the left, because the mass is about to move in this direction.

b) Directed to the right (toward the equilibrium position) and is at its maximum possible value at this precise moment.

c) Completely zero, because the mass is still at complete rest at the moment of release.

d) Directed to the right, but is at its minimum possible value at this precise moment.

5. A student suspended a mass of 0.9 kg from a vertical spring with a spring constant k = 40 N/m, and allowed it to oscillate in simple harmonic motion about its equilibrium position. The student then increased the amplitude of oscillation without changing the mass or the spring.

Which of the following statements is correct?

a) The period increases as the amplitude increases, and its value is approximately 0.94 s.

b) The period decreases as the amplitude increases, and its value is approximately 0.94 s.

c) The period does not change as the amplitude increases, and its value is approximately 0.94 s.

d) The period does not change as the amplitude increases, and its value is approximately 1.41 s.

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Period 2 Week .....

Lesson 2-1: Simple Harmonic Motion Continued

Date: .....

1. A small block of mass m = 0.5 kg is connected to a spring with a spring constant k = 20 N/m on a smooth horizontal track. When the block is displaced from the equilibrium position, a restoring force acts on it according to the relation F = -kx. Calculate the angular frequency of the oscillation using the formula ($\omega = \sqrt{m/k}$)

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2. Choose: A small block of mass m = 0.20 kg slides on a smooth horizontal track and is connected to a spring with a spring constant k = 80 N/m. A restoring force of magnitude F = -kx acts on the block when displaced by a distance x from the equilibrium position. Given that π = 3.14, find the period of oscillation using the formula $T = 2\pi\sqrt{m/k}$.

(a) 0.16 s (b) 0.31 s (c) 0.63 s (d) 1.26 s

Homework Performances

1. A mass-spring system has a mass m = 0.30 kg and a spring constant k = 30 N/m. Calculate the period T, taking π= 3.14, using the formula $T = 2\pi\sqrt{m/k}$

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2. An object moves in simple harmonic motion according to the relation x = A sin(wt). If the displacement is x = 0.15 m at time t = p/4 s, and the angular frequency is ω = 2 rad/s. Find the amplitude A.

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3. Choose: In a mass-spring system moving in simple harmonic motion, what is the kinetic energy KE at the equilibrium position x = 0?

(a) KE = 0 (b) KE = E/4 (c) KE = E/2 (d) KE = E

4. Choose: In an experiment on a small block connected to a spring on a smooth horizontal track, the spring constant was k = 20 N/m, and the period of oscillation was T = 1.256 s. Given the relation $T = 2\pi\sqrt{m/k}$ and taking π= 3.14, what is the value of the block's mass m?

a) 0.8 kg b) 1.0 kg c) 1.2 kg d) 1.6 kg

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Period 3 Week .....

Weekly Assessment

Date: .....

Group (A)

1. Choose: When a mass moving in simple harmonic motion reaches its maximum displacement from the equilibrium position, its speed is:
   a) At its maximum value b) Zero
   c) Constant and non-zero d) Equal to the acceleration

2. Choose: An object moves in simple harmonic motion with a period T = 0.25 s. What is its frequency f?

a) 0.25 Hz b) 2 Hz c) 4 Hz d) 8 Hz

3. If the displacement of an object moving in simple harmonic motion is given by the relation: x(t) = 0.06 sin(8p t) m, Find the amplitude A, period T, frequency f, and maximum speed v_{max}.

4. A small block of mass m = 0.2 kg attached to a smooth horizontal spring oscillates with a spring constant k = 80 N/m. Find the period T and the frequency f of the motion, given that π = 3.14.

5. An object of mass m = 0.5 kg moves in simple harmonic motion under the effect of a restoring force given by F = -kx, where k = 40 N/m. If its displacement is x = +0.1 m, find the restoring force F and the acceleration a, and specify the direction of each with respect to the equilibrium position.

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Group (B)

1. When an object moving in simple harmonic motion passes through the equilibrium position, its acceleration is:
   a) Zero b) At its maximum positive value
   c) At its maximum negative value d) Equal to the amplitude

2. If the frequency of an object moving in simple harmonic motion is f = 5.0 Hz, its period is equal to:

   a) 0.2 s b) 0.5 s c) 5 s d) 25 s

3. If the displacement of an object moving in simple harmonic motion is given by the relation: x(t) = 0.04 sin(10p t) m, find the amplitude A, period T, frequency f, and maximum speed v_{max}.

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4. A mass m = 0.4 kg attached to a spring with a spring constant k = 40 N/m moves in simple harmonic motion. Find the period T and the frequency f, given that π = 3.14.

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5. An object of mass m = 0.25 kg moves in simple harmonic motion under the effect of a restoring force given by F = -kx, where k = 20 N/m. If its displacement is x = -0.15 m, find the restoring force F and the acceleration a, and specify the direction of each with respect to the equilibrium position.

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Group (C)

1. When the displacement of an object in simple harmonic motion equals the amplitude in the positive direction, the restoring force is:

a) At its maximum value and directed toward the equilibrium position
b) Zero
c) At its maximum value and directed away from the equilibrium position
d) Constant in the direction of motion

2. Choose: An object moves in simple harmonic motion with a period T = 0.80 s. What is its frequency f?

a) 0.80 Hz b) 1.25 Hz c) 2.50 Hz d) 8.00 Hz

3. If the displacement of an object moving in simple harmonic motion is given by the relation: x(t) = 0.05 sin(5p t) m, find the amplitude A, period T, frequency f, and maximum speed v_{max}.

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4. A mass m = 0.9 kg attached to a spring with a spring constant k = 40 N/m oscillates in simple harmonic motion. Find the period T and the frequency f, given that π= 3.14.

.....

5. An object of mass m = 0.4 kg moves in simple harmonic motion under the effect of a restoring force given by F = -kx, where k = 32 N/m. If its displacement is x = +0.125 m, find the restoring force F and the acceleration a, and specify the direction of each with respect to the equilibrium position.

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Period 1 Week .....

[Lesson 2-2] [Spring Pendulum]

Date: .....

Classroom Performances

1. A mass of 0.2 kg is attached to a spring with a spring constant k = 80 N/m and oscillates in simple harmonic motion. Calculate the period of oscillation. Given: m = 0.2 kg, k = 80 N/m, π = 3.14

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2. For an object oscillating in simple harmonic motion on a spring, which of the following statements is correct regarding the period T?

a) It depends only on the acceleration due to gravity g.
b) T = 2p .
c) T = 2p , and it does not depend on the acceleration due to gravity g.
d) It increases only by increasing the amplitude A.

Homework Performances

1. In a vertical mass-spring system, the equilibrium position changes due to the weight of the mass. Explain why the period of oscillation is the same as that of a horizontal system with the same mass and spring constant, clarifying the role of the acceleration due to gravity.

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2. A mass is suspended from a vertical spring and begins to oscillate in simple harmonic motion about its equilibrium position. If the mass of the object is increased while keeping the spring constant unchanged, how does the period of oscillation change? Explain your answer using the mathematical relation for the period.

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3. A mass of 0.5 kg is suspended from a vertical spring with a spring constant k = 20 N/m, and is allowed to move in simple harmonic motion. Calculate the period of oscillation, taking π= 3.14.

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4. In a spring pendulum experiment, a mass of 0.4 kg is suspended from a spring with a spring constant of 40 N/m. If the mass is replaced by another mass of 0.8 kg while keeping the same spring, what is the ratio between the new period and the original period?

a) 1 : 2 b) 1 : c) : 1 d) 2 : 1

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Period 2 Week .....

[Lesson 2-3]

[Simple Pendulum]

Date: .....

Classroom Performances

1. In a simple pendulum, why is its motion considered approximately simple harmonic when the displacement angle is small?

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2. For a simple pendulum oscillating at a small angle, the period T depends mainly on:

(a) The mass of the bob and the amplitude of oscillation

(b) The length of the string and the acceleration due to gravity

(c) The mass of the bob and the length of the string

(d) The amplitude of oscillation and the mass of the bob

3. A simple pendulum has a string length L = 1.8 m, and the acceleration due to gravity g = 9.8 m/s^2.

Taking π = 3.14, calculate the period T to two decimal places, showing the formula and substitution.

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Homework Performances

1. If the length of the string of a simple pendulum is increased while the acceleration due to gravity remains constant, how does the period of the pendulum change? Explain the reason.

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2. Explain a suitable practical method to measure the period of a simple pendulum with greater accuracy, clarifying the role of measuring the time for a large number of oscillations.

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3. A simple pendulum took 14.0 s to complete 10 full oscillations. Calculate the period for a single oscillation, then state the relationship connecting the measured time, the number of oscillations, and the period.

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4. If the length of the string of a simple pendulum is increased to four times its original value while the acceleration due to gravity remains constant and the angle of oscillation is small, the period becomes:

(a) Half its value

(b) Double its value

(c) Four times its value

(d) Remains unchanged without modification

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Period 3 Week .....

Weekly Assessment

Date: .....

Group (A)

First: Choose the correct answer

1. A simple pendulum of length 1.0 m oscillates at small angles. If the length of the string is increased to 4.0 m while g remains constant, the period becomes:

a) T/4 b) T/2 c) 2T d) 4T

2. A mass of 0.5 kg is connected to a spring with a spring constant of 20 N/m. The period of the spring pendulum depends on:

a) The mass and the spring constant b) Amplitude only
c) Acceleration due to gravity only d) Weight of the object only

Second: Answer the following questions

3. Briefly explain: Why does the period of a simple pendulum, at small angles, not depend on the mass of the bob?

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4. Calculate: Find the period of a simple pendulum of length 0.4 m, if g = 9.8 m/s^2 and π = 3.14, writing down the formula, substitution, and unit.

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5. In two or three lines, compare the factors affecting the period of a simple pendulum with those affecting the period of a spring pendulum.

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Group (B)

First: Choose the correct answer

1. Two simple pendulums are at the same location; the length of the first is 0.25 m and the length of the second is 1 m. The ratio between their periods T_2/T_1 is:

a) 1/4 b) 1/2 c) 2 d) 4

2. If the mass of an object suspended from a vertical spring is doubled while the spring constant remains unchanged, the period:

a) Decreases to half b) Does not change
c) Increases by a factor of $\sqrt{2}$ d) Quadruples

Second: Answer the following questions

3. State an important condition that makes the motion of a simple pendulum approximately simple harmonic, and state the effect of increasing a small amplitude on the period approximately.

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4. Calculate: An object of mass 0.2 kg is connected to a horizontal spring with a spring constant of 80 N/m. Find the period of oscillation, using π = 3.14, showing the solution steps.

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5. Analyze the following situation: A simple pendulum is moved to a location where the acceleration due to gravity decreases. Does the period increase or decrease? Explain using the mathematical relation.

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Group (C)

First: Choose the correct answer

1. If the spring constant becomes four times its original value while the mass remains constant, the period of the spring pendulum becomes:

a) 4T b) 2T c) T/2 d) T/4

2. Which of the following changes has almost no effect on the period of a simple pendulum at small angles?

a) Increasing the length of the string b) Changing the acceleration due to gravity

c) Changing the mass of the bob d) Using another location on Earth

Second: Answer the following questions

3. Explain: When a mass is suspended from a vertical spring, the equilibrium position changes, but the period does not depend on the magnitude of the static extension.

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4. A simple pendulum of length 0.9 m oscillates at small angles, with g = 9.8 m/s^2 and π= 3.14. Find the period.

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5. Comparison: If we want to double the period, what should we do to the length of a simple pendulum? And what should we do to the mass of a spring pendulum while keeping the spring constant unchanged? Mention the formulas used.

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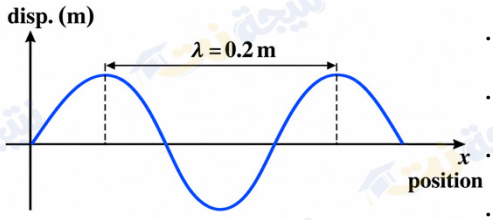
Period 2 Week .....

Lesson (2 – 4) Sine Waves

Date: .....

Classroom Performances

1. A vibrating body completes one vibration in a periodic time of 0.2 s. Find its frequency.



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2. A sinusoidal wave whose wavelength is 0.2 m and whose frequency is 0.3 Hz. Calculate the speed of the wave.

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Homework Performances

Choose the correct answer

1. Which of the following is transferred by means of the mechanical wave during its travelling through the medium?

a) the matter b) the energy

c) the particles of the medium d) the total displacement

2. A wave whose periodic time equals 0.25 second. What is its frequency?

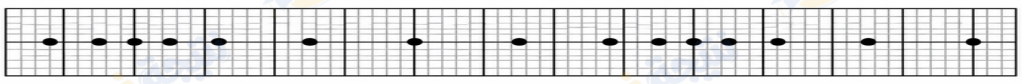
a) 0.25 Hz b) 2.5 Hz c) 4 Hz d) 0.4 Hz

3. A wave travels through a string, its periodic time is 0.1 s and its wavelength is 1.5 m. Calculate the speed of the wave.

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4. A wave pulse travels through a rope with a speed of 4 m/s and a wavelength of 0.8 m. Find its frequency and its periodic time.

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3. The opposite figure shows the vibration of the particles of the material medium for a longitudinal wavemotion:

Use the scale of the drawing shown in the figure, calculate the wavelength of the longitudinal wave?

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Period 2 Week .....

Lesson (2 – 4) Sine Waves

Date: .....

Classroom Performances

1. A sinusoidal wave whose wavelength is 0.6 m, and the periodic time equals 0.2 s. Calculate:
a) the frequency b) the speed of the wave

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2. A wave source vibrates with a periodic time of magnitude 0.25 s, so it produces a wave whose wavelength is 1.2 m. Calculate the speed of the wave.

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Homework Performances

Choose the correct answer

1. Which of the curves (the graphs) is used to determine each of the amplitude and the wavelength of a wave motion made by a vibrating body directly?

a) the displacement – time curve (y–t) b) the displacement – position curve (y–x)
c) the speed – time curve d) the frequency – periodic time curve

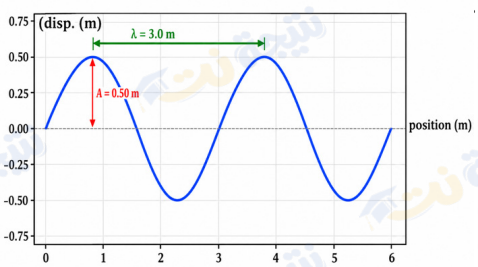
2. In the longitudinal wave, the particles of the medium vibrate:

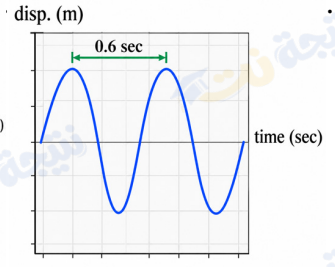
a) perpendicularly to the direction of the propagation of the wave
b) in a manner parallel to the direction of the propagation of the wave
c) in circular paths opposite to the direction of the transfer of the energy
d) with a constant speed equal to the speed of light

1. A sound wave travels through the air with a speed of 340 m/s and with a frequency of 500 Hz. Calculate its wavelength.

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2. The graph (the displacement – the position) shows a sinusoidal wave whose wavelength is 3 m and whose amplitude is 0.5 m. And the graph (the displacement – the time) shows a periodic time of magnitude 0.6 s, so find the speed of the wave.





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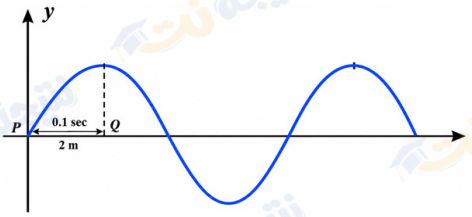
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3. The opposite figure represents a sinusoidal wave motion. If the distance between the two points (P and Q) was 2 m in a time interval of 0.1 sec, calculate:

a) the wavelength

b) the speed of propagation of the wave



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Period 2 Week .....

Lesson (2 – 5) Interference of Waves and Standing Waves

Date: .....

Classroom Performances

1. Two coherent sources in phase emit waves whose wavelength is 4 cm. At a point P, the path length from the first source was 10 cm and from the second source 16 cm.

a) Calculate the path difference.

b) Determine the number of half wavelengths and state whether the interference at P is constructive or destructive.

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2. Two coherent sources S_1 and S_2, the distance between them is 8 cm, vibrate in the same phase and emit waves whose wavelength is 2 cm. Determine the number of the lines of destructive interference lying between S_1 and S_2.

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Homework Performances

1. Two coherent sources in phase emit waves whose wavelength is λ. Constructive interference occurs at the points at which the path difference is equal to:

a) $(m + 1/2)\ \lambda$ b) $m \times \lambda$ c) $(2m + 1)\ \lambda / 2$ d) $\lambda / 4$

2. The principle of superposition states that the resultant displacement at a point at which two waves interfere equals:

a) the product of multiplying their two displacements

b) the vector sum of their two individual displacements

c) the difference between their two frequencies

d) the average of their two amplitudes

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3. Two coherent sources in phase produce waves whose wavelength is 5 cm and whose amplitude is 1 cm. At the point P, S_1P = 30.0 cm and S_2P = 37.5 cm. Calculate the resultant amplitude at the point P when:
a) the two sources vibrate in the same phase.
b) the two sources vibrate in two opposite phases.

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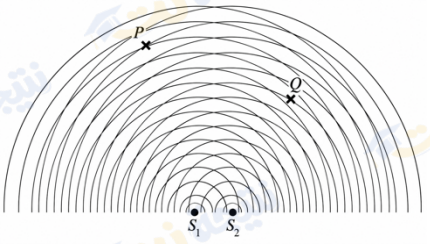
2. Two waves whose wavelength is 6 cm and whose amplitude is 0.4 cm are emitted in the same phase from the two sources S_1 and S_2. For the point P where S_1P = 20 cm and S_2P = 35 cm, calculate:

a) the path difference.

b) the resultant amplitude at P

.....

3. The opposite figure shows two waves propagating in the same phase from the two sources S_1 and S_2
What is the result of the superposition of the two waves at the two points (P, Q)? Justify your answer



Period 2 Week .....

Lesson (2 – 5) Interference of Waves and Standing Waves

Date: .....

Classroom Performances

1. Two coherent sources produce waves whose wavelength is 6 cm and whose amplitude is 0.5 cm. At the point P, S_1P = 28 cm and S_2P = 37 cm. Determine the path difference and the number of the half wavelengths that it contains.

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2. Two coherent and in-phase sources separated by a distance of 10 cm emit waves whose wavelength is 2.5 cm. At the point P, the path difference was 5 cm. Determine whether the point P is a point of constructive or destructive interference, and mention the number of the half wavelengths.

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Homework Performances

Choose the correct answer

1. Two coherent sources vibrate in the same phase with a wavelength of magnitude 4 cm. If the path difference to the point P equals 6 cm, then the path difference contains:

a) 1.5 wavelength b) 2 wavelength c) 1 wavelength d) 0.5 wavelength

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2. The node in the standing wave is defined as a point which is:
a) the maximum displacement
b) a displacement equal to zero
c) the maximum amplitude and energy
d) a variable frequency

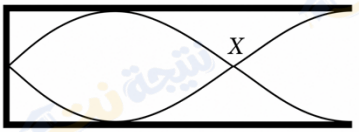
3. Two coherent and in-phase sources produce waves whose amplitude is 0.4 cm and whose wavelength is 3 cm. At the point Q, the path difference was 9 cm. Calculate the resultant amplitude at Q.

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4. Two coherent sources vibrate in two opposite phases and produce waves whose wavelength is 4 cm. At the point R, the path difference was 8 cm. Determine whether the point R is subject to constructive or destructive interference.

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5. The opposite figure shows a standing wave formed inside a pipe open at one of its two ends. Explain the nature of the vibration of the particles of the air near the point X



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Revision

1. What happens to the speed of a transverse wave pulse traveling through a taut string if the tension in the string increases?
a) Decreases
b) Increases
c) Remains unchanged
d) Becomes zero

2. Increasing the amplitude of a wave while keeping its frequency constant leads to:
a) Increasing the wave speed
b) Increasing the energy transmitted by the wave
c) Decreasing the wavelength
d) Increasing the wave's period

3. Electromagnetic waves can travel in a vacuum, while mechanical waves cannot because...
a) Electromagnetic waves have an infinite wavelength
b) Electromagnetic waves do not require material mediums
c) Electromagnetic waves are longitudinal waves
d) Electromagnetic waves travel slower than mechanical waves

4. During earthquakes, primary seismic waves (P-waves) reach the monitoring station before secondary waves (S-waves) because:
a) P-waves are transverse and travel faster
b) P-waves are longitudinal and travel faster than S-waves
c) S-waves only travel through liquids
d) S-waves carry more energy than P-waves

5. Which of the following pairs contains only transverse waves?
a) Sound waves and light waves
b) Light waves and waves through a stretched string
c) Waves through a taut string and sound waves
d) Water surface waves and sound waves

6. Destructive interference occurs when two interfering waves reach a point with a phase difference of:
a) 0° (in phase)
b) 180° (out of phase / opposite phase)
c) 360°
d) 90°

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7. In a two-wave interference experiment, the formation of regions where the resulting displacement is maximum is due to:

a) Destructive interference
b) Constructive interference
c) Refraction of waves
d) Reflection of waves

8. A standing wave is formed as a result of the interference of two traveling waves characterized by:

a) Different frequencies traveling in the same direction
b) The same frequency and amplitude traveling in opposite directions
c) Different amplitudes traveling in opposite directions
d) The same wavelength traveling in perpendicular directions

9. The distance between two consecutive nodes (or two consecutive antinodes) in a standing wave is equal to:

a) A full wavelength
b) Half a wavelength
c) A quarter of a wavelength
d) Two wavelengths

10. If two coherent and in-phase sources produce waves with amplitude A, the maximum resultant amplitude at a point of constructive interference is:

a) A b) 0 c) 2A d) 4A

11. What happens to the distance separating adjacent nodal lines in a ripple tank experiment when the vibration frequency of the two sources increases?

a) Increases b) Decreases c) Remains unchanged d) Becomes zero everywhere

12. What happens to the speed of a wave pulse traveling through a taut rope when the tension force in the rope increases?

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13. What happens to the energy transmitted from a vibrating source emitting wave motion when the wave's amplitude doubles while its frequency remains constant?

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14. What happens to the periodic time (period) of a simple harmonic oscillator if its frequency doubles?

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15. What happens to the speed of a sound wave when it travels from a material medium into a vacuum?

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16. What happens to the observed wave speed if the frequency of the wave source doubles while the properties of the medium remain unchanged?

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17. What happens to the amplitude of a particle in a medium when a wave passes through it, in terms of the total displacement of the particle after the wave passes and the medium stabilizes?

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18. What happens to the pitch (sharpness/frequency) of a musical note emitted from a stretched string when the tension force in the string increases?

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19. What happens to the amplitude of vibration at a node on a starched string upon which a standing wave is formed?

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20. What happens to the locations of constructive and destructive interference if the state of two coherent sources vibrating in phase is changed to vibrate in opposite phases (phase difference of 180°)?

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21. A tuning fork produces a wave with a frequency of 250 Hz traveling at a speed of 340 m/s in the air. Find the wavelength and the period of the sound wave.

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22 A wave source produces 120 complete waves in 30 seconds through a stretched spring. If the distance between two consecutive crests is 0.5 m, find:

a) The frequency. b) The period.

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23. A wave source produces 100 complete waves in 20 seconds through a stretched spring. If the distance between two consecutive crests is 0.4 m, calculate the wave speed.

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24. Two loudspeakers separated by a distance of 2.0 m emit coherent and in-phase sound waves with a wavelength of 0.50 m. A listener stands at a location where the path difference is 1.25 m. Determine whether the listener hears a loud sound (constructive interference) or a faint sound (destructive interference).

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25. Two coherent and in-phase sources emit waves with a wavelength of 5.0 cm. At point P, the path difference was 12.5 cm. Determine whether P is a point of constructive or destructive interference and justify your answer

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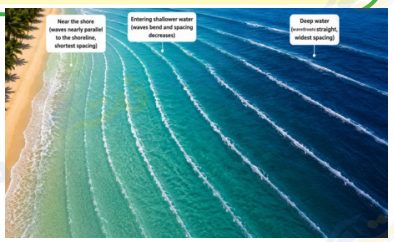
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Period 2 Week .....

Lesson (2 – 6) Wave Refraction

Date: .....

Classroom Performances



Q1: The figure illustrates the change in the shape, direction, behavior, and characteristics of sea waves as they move from deep water to shallow water near the beach.

Based on the diagram and what you have learned about the properties of waves:

Explain the changes that occur to each of the following:

a. (wave speed, wavelength, and direction of propagation) when they move from deep water to shallow water.

b. Explain why waves are deflected and their direction is adjusted to become parallel to the coastline near the shore.

c. Prove the physical concept described by this phenomenon, providing its definition in your own words.

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Q2 Choose: Which of the following changes occur to sea waves as they move from deep water to shallow water?

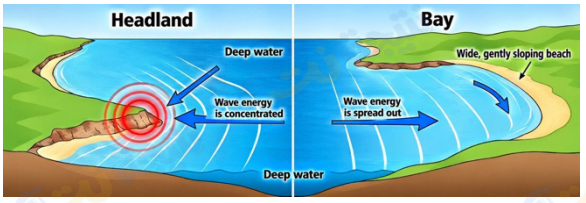
a) Its speed increases, its wavelength increases, and it continues in a straight line without any deviation.

b) Its speed decreases, its wavelength decreases, and its direction deviates to become parallel to the coastline.

c) Its speed remains constant, its wavelength decreases, and it deflects completely away from the coastline.

d) Its speed decreases, its wavelength increases, and it reflects completely back towards the deep water.

Homework Performances



Q1: The figure illustrates the phenomenon of refraction of sea waves at different coastal forms. If you know that the depth of the water at the headland is less than its depth at the bay. Put a table and compare the characteristics of water waves at "Headland" and at "Bay" in terms of:

a) Wave speed (v). b) Wavelength (λ) c) Wave frequency (f).

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Q2: Which of the following statements correctly describes what happens to a light wave or water wave when it refracts as it travels at an inclined angle from one medium to another with different properties?

a) The frequency of the wave changes, while its speed and wavelength remain constant.

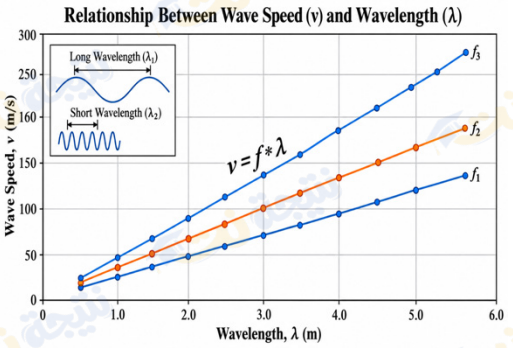
b) The wave's speed and wavelength change, while its frequency remains constant.

c) The wave's speed, wavelength, and frequency increase.

d) The wave speed, wavelength, and frequency decrease.

Q3: The graph illustrates the relation between the wave speed (v) and its wavelength (λ) for three waves from different sources when the wave propagates through media with different properties.

Which frequencies have the highest value? with the explanation.



Q4: When a wave propagates through a vacuum or a medium, the geometric locus of all points vibrating in the same phase is called …..

a) Wave frequency b) Wavelength c) Wave velocity d) wave front

Q5: A wave crosses a boundary between two media as shown in the figure.

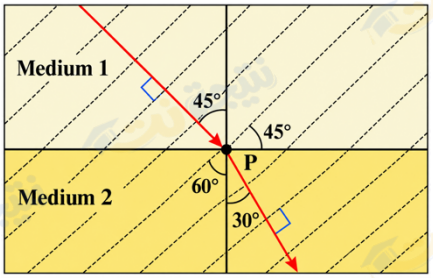
Calculate the following: -

1- The ratio between $\frac{\upsilon_1}{\upsilon_2}$ = ...

2- The ratio between $\frac{\lambda_1}{\lambda_2}$ = ...

.....

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Q6: A wave with a frequency 50 Hz propagates in medium (1) at a speed 300 m/s. When it passes into medium (2), its speed changes to 600 m/s. Which of the following statements is incorrect?

a) The frequency of the wave in medium (2) is 50 Hz.

b) The wavelength of the wave in medium (1) is half its value in medium (2).

c) The angle of incidence of the wave in medium (1) is equal to half the angle of refraction in medium (2).

d) The refractive index of medium (1) is twice the refractive index of medium (2).

Q7: A ray of light travels at an inclined angle from medium (1) to medium (2). If you know that the absolute refractive index of medium (1) is greater than the absolute refractive index of medium (2), i.e., ($n_1 > n_2$). Which of the following physical changes correctly explains what happens to the light ray when it enters medium (2)?

a) The ray refracts as it approaches the normal, and its speed and wavelength decrease.

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b) The ray refracts away from the normal, and its speed and wavelength increase.
c) The ray refracts away from the normal, its speed increases, and its frequency decreases.
d) The ray propagates in a straight line without deviation, and its speed and wavelength remain constant.

Q8: A light ray passes from material (A) to material (B) such that the angle of incidence in material (A) is equal to 30° and the angle of refraction in material (B) is equal to 45°. Which of the following statements correctly describes the behavior of light and the physical properties of the two materials?

a) The refractive index of material (A) is greater than that of material (B), and the speed of light in material (A) is less than that in material (B).
b) The refractive index of material (A) is lower than that of material (B), and the speed of light in material (A) is higher than that in material (B).
c) The refractive index of material (A) is greater than that of material (B), and the speed of light in material (A) is greater than that in material (B).
d) The refractive index of material (A) is equal to that of material (B), and the frequency in material (A) is doubled in material (B).

Period 2 Week .....

Lesson (2-7) Interference of Sound Waves

Date: .....

Classroom Performances

Q1: When you walk slowly across a wide courtyard while a continuous tone or a tone from two sources is playing, what characteristics do you notice about the loudness of the sound you hear?

a) Hearing the same sound at the same intensity throughout the courtyard.
b) A gradual and continuous decrease in intensity as you move away from the source.
c) A recurring pattern of high and low volume.
d) Complete loss of sound as soon as one moves a few steps away from the source.

Q2: Compare between the constructive interference and the destructive interference of sound waves emitted by two coherent sources vibrating in the same phase in terms of:

a) Sound intensity b) Path difference

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Homework Performances

Q1: Explain the following:

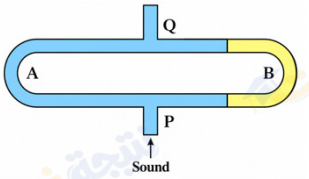
When designing national theaters and large concert halls, sound engineers noticed that there are certain spots in the seating area where the volume of the musical pieces is very low and muffled, despite the presence of large, highly efficient speakers on both sides of the stage.

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Q2: The figure illustrates a device used in physical measurements:

What is the scientific principle on which the idea of the device's operation is based?

Briefly explain how the device works.



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Q3: Students are conducting an experiment in physics labs to investigate the phenomenon of sound wave interference using speakers and sensitive microphones. The students turned on one speaker and slowly moved the microphone across the courtyard, then repeated the experiment with both speakers on at the same time and with the same tone.

Which of the following correctly represents the change in sound intensity measured by the microphone when moving across the courtyard in both cases?

a) When one speaker is playing, the volume is exactly the same. When both speakers are playing, the volume increases exponentially and consistently in all locations.

b) When one speaker is playing, the loudness decreases gradually with distance. When both speakers are playing, a repeating pattern of loudness increases and decreases occurs.

c) When one speaker is turned on, the sound is completely cut off, and when both speakers are turned on, the sound is loud at only one point and faint in the rest of the courtyard.

d) When one or two speakers are turned on, the volume level remains constant and does not change at any point.

Q4 Choose: Destructive interference occurs between waves emitted from two coherent sources vibrating in the same phase, when the path difference (Δd) between them is equal to .....

a) λ b) 1.5 λ c) 2 λ d) 3 λ

Q5: Two coherent sound sources vibrate in the same phase, the wavelength of the waves emitted by each of them is 2 m. Constructive interference between the waves emitted by them occurs when the path difference (Δd) between them is equal to ....

a) 1 m b) 2 m c) 3 m d) 5 m

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Period 3 Week .....

Weekly Assessment

Date: .....

(Group A)

1) A light ray travels from medium (X) with a refractive index of $n_1 = 1.33$ to medium (Y) with a refractive index of $n_2 = 1.5$ Given that the speed of light in medium (X) is v_1 and in medium (Y) is v_2, and the wavelength in medium (X) is λ_1 and in medium (Y) is λ_2. Which of the following relationships correctly expresses the behavior of light during this transition?

a) $v_1 > v_2$, $\lambda_1 > \lambda_2$ b) $v_1 < v_2$, $\lambda_1 < \lambda_2$

c) $v_1 > v_2$, $\lambda_1 < \lambda_2$ d) $v_2 = v_1$, $\lambda_1 > \lambda_2$

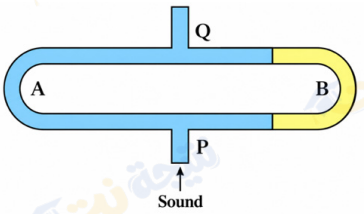
2) Constructive interference occurs between waves emitted from two coherent sources vibrating in the same phase, when the path difference (Δd) between them is equal to .....

a) 0.5λ b) λ c) 1.5λ d) 2.5λ

3) What happens to the speed, wavelength, and direction of propagation of sea waves when they travel at an inclined angle from deep water to shallow water near the shore? along with the scientific explanation for each.

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4) The figure shows the Quincke tube. The incoming sound at P is split into two paths and recombined at Q. When tube B is fully inserted, the lengths of the two paths are equal. As tube B is slowly pulled out, the first minimum in sound intensity occurs when the tube is pulled out by X = 10 cm, and the speed of sound is 330 m/s. Calculate:



a) The wavelength of sound, in meters.

b) Sound frequency, in hertz.

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5) Explain Why are the positions of minimum intensity of a wave, and not the positions of maximum intensity, the strongest evidence that sound is a wave?

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(Group B)

1) Ultrasound is used in medical examinations to monitor the fetus and internal organs. When an ultrasound wave passes from a soft tissue (such as muscle) to another tissue of higher density (such as bone), part of the wave is reflected and the other part is refracted within the bone. Which of the following physical changes occur to the refracted part of the wave as it enters the bones?

a) Its frequency increases and its speed increases, while its wavelength decreases.

b) Its frequency remains constant, while its speed and wavelength increase.

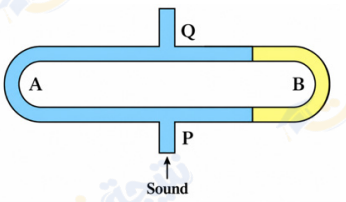
c) Its frequency and speed decrease, while its wavelength increases.

d) Its speed and wavelength remain constant, while the frequency increases.

2) Two coherent sound sources vibrating in the same phase, the wavelength of the waves emitted by each of them 4 m. Destructive interference between the waves emitted by them occurs when the path difference (Δd) between them is equal to ....

a) 2 m b) 4 m c) 8 m d) 12 m

3) The figure shows the Quinck´s tube. The incoming sound at P is split into two paths and recombined at Q. When tube B is fully inserted, the lengths of the two paths are equal. As tube B is slowly pulled out, the first minimum in sound intensity occurs when the tube is pulled out by X = 12 cm, and the sound frequency is 1000 Hz. Calculate:



a) The wavelength of sound, in meters.

b) Speed of sound, in meters/second.

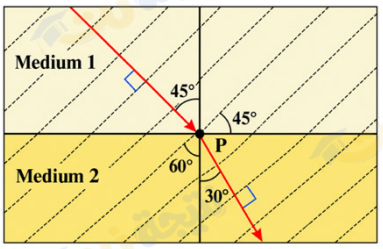
.....

4) Briefly explain how noise-canceling headphones work.

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5) A wave crosses a boundary between two media as shown in the figure. Calculate the following ratio of $\frac{\lambda_1}{\lambda_2}$ = ...



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(Group C)

1) A light wave with a frequency 6×10^{14} Hz propagates in the first medium at a speed of 3×10^{8} m/s. When it refracts and passes into the second medium, its speed becomes 2×10^{8} m/s. Which of the following statements is incorrect?

a) Frequency of the wave in the second medium = 6×10^{14} Hz

b) The wavelength of the wave in the first medium = 1.5 × its wavelength in the second medium.

c) Refractive index of the first medium = 1.5 × Refractive index of the second medium.

d) Sine of the angle of incidence in the first medium = 1.5 × Sine of the angle of refraction in the second medium.

2) Constructive interference occurs between waves emitted from two coherent sources vibrating in the same phase, when the path difference (Δd) between them is equal to .....

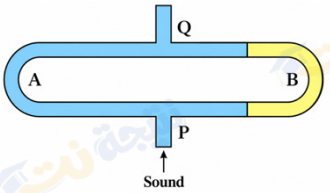
a) An odd number of a quarter wavelength

b) An even number of quarter wavelengths

c) An odd number of half wavelengths

d) An even number of half wavelengths

3) The figure shows the Quincke tube. The incoming sound at P is split into two paths and recombined at Q. When tube B is fully inserted, the lengths of the two paths are equal. As tube B is slowly pulled out, the first minimum in sound intensity occurs when the tube is pulled out by X, the frequency of the sound is 1200 Hz and the speed of sound is 360 m/s. Calculate:



a) The wavelength of sound, in meters.

b) The distance X, in meters.

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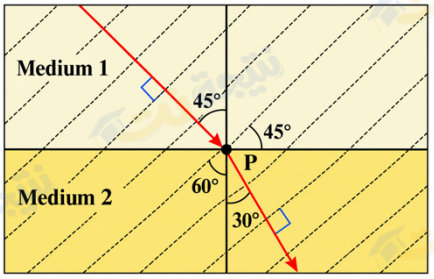
4) Explain: Why do noise-canceling headphones reduce the hum of a steady engine more effectively than a sudden sound, such as a door slamming?

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5) A wave crosses a boundary between two media as shown in the figure. Calculate the following

the ratio between $\frac{n_1}{n_2}$ = ...



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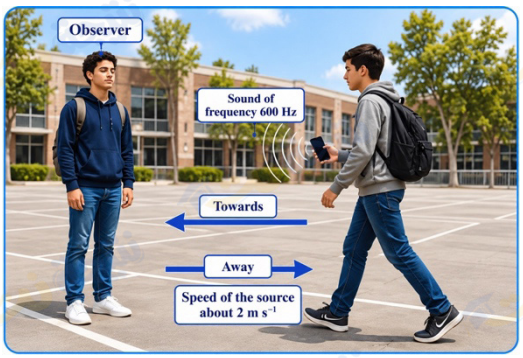
Period 1 Week .....

Lesson 2- 8: The Doppler Effect

Date: .....

Classroom Performances

Q1: The figure shows a student carrying a phone emitting a constant frequency tone (f) moving towards/away from another stationary student (the listener). Based on the figure and what you have learned about the properties of waves:
Explain the changes in pitch as an object approach and recedes, as perceived by the listener.



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Q2: The student holding the phone moves faster (faster pace) at about 4m/s instead of 2m/s towards the stationary student. Which of the following changes occur to the properties of the sound wave as recorded by the stationary student (listener) compared to the first situation?

a) The apparent frequency decreases and the pitch increases.

b) The perceived frequency increases and the pitch become higher.

c) The apparent frequency remains constant and only the speed of sound increases.

d) The apparent frequency decreases and the pitch of the sound increase.

Homework Performances

Q1: As a student carrying a phone emitting a constant-frequency tone moves quickly toward a stationary student, which of the following changes occur to the apparent wavelength (λ) of the sound waves in front of the phone and as received by the stationary student?

a) The wavelength increases due to the increase in the source's velocity.

b) The wavelength decreases due to the convergence of the wave fronts in front of the moving source.

c) The wavelength remains constant because the original frequency of the phone is constant.

d) The wavelength doubles because the speed of sound in air increases.

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Q2: When a car emitting a whistle at a constant frequency f approaches a person standing on the side of the road at a constant speed, then passes him and moves away from him: How does the apparent frequency of the sound (f) perceived by the person change at the moment the car passes directly in front of him compared to the moment it approaches and the moment it moves away?

a) The frequency is as highest during approach, equal to the original frequency f at the moment of passing, and less than f during recession.

b) The frequency is as low as possible during approach, equal to the original frequency f at the moment of passage, and increases during departure.

c) The frequency remains consistently higher than the original frequency f at all times.

d) The frequency remains equal to the original frequency f throughout the vehicle's motion.

Q3: A police car emitting a siren with a constant frequency f is moving steadily and at a constant speed v towards a vertical mountain wall. What does the driver of the car observe regarding (the frequency of the direct sound emitted by the car) and (the frequency of the sound reflected off the mountain that he hears after it reflects)?

a) The direct frequency is equal to f, and the reflected frequency is less than f

b) The direct frequency increases above f, and the reflected frequency equals f

c) The direct frequency is equal to f, and the reflected frequency increases above f

d) The direct frequency is less than f, and the reflected frequency is less than f

Q4: A girl is standing by the roadside and hears the siren of an ambulance speeding by. The girl noticed that the tone of the sound was very high-pitched as the car approached her, but as soon as the car passed by and moved away, she noticed that the tone of the sound suddenly became deep.

a. How does the physics of relativistic motion explain this sudden change in pitch as the car passes the listener?

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b. What change occurs in the speed of sound traveling through air during this entire process? Explain your answer.

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Period 2 Week .....

Lesson 2- 8: The Doppler Effect

Date: .....

Classroom Performances

Q1: In an experiment to simulate the Doppler effect of light in an astronomical laboratory, two observatories represented the spectral state of two stars, (X) and (Y):

1. The first instrument found that the spectral line of star (X) had increased its wavelength by an amount of ($\Delta\lambda$).
2. The second instrument found that the spectral line of star (Y) had its wavelength decreased by ($\Delta\lambda$).

a) Identify which one represents a "redshift" and which one represents a "blueshift".

b) Explain how astronomers use these spectral changes to infer the speed and direction of stars motion in the universe.

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Q2: When observing light emitted from a distant galaxy, a shift of its spectral lines towards red is observed. What is the physical cause of this shift based on the Doppler effect?

a) The galaxy moving away from Earth causes the wavelength to increase.

b) The galaxy's approach to Earth causes the wavelength to increase.

c) The galaxy's moving away from causes the wavelength to decrease.

d) The galaxy remaining stationary in its position leads to an increase in wavelength.

Homework Performances

Q1: The spectrum of hydrogen atom obtained in the laboratory shows a spectral line at a wavelength λ = 656 nm. When the same spectral line is observed in light emitted by a moving galaxy, it is found that the amount of wavelength shift $\Delta\lambda$ = 1.312 nm

Calculate the radial velocity (v) of the galaxy relative to the observer, given that the speed of light c = 3×10^8 m/s

Q2: When a galaxy moves towards Earth at high speed, the apparent frequency of light recorded by astronomers is:

a) Higher than the original frequency, and the lines shift towards blue.

b) Less than the original frequency, and the lines shift towards red.

c) Higher than the original frequency, and the lines shift towards red.

d) Lower than the original frequency, and the lines shift towards blue.

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Q3: What happens to the speed of light (c) in a vacuum when it is emitted from a star moving very fast toward an observer?

a) Remains constant.

b) increases by an amount equal to the speed of the approaching star.

c) decreases by an amount equal to the velocity of the approaching star.

d) It changes depending on the apparent frequency of the observed light.

Q4: A car traveling east at a speed 15 ms^{-1} emits a sound with a frequency 600 Hz, and a motorcycle traveling west at a speed 20 ms^{-1} passes by it. Determine the frequency of the sound heard by the motorcyclist after they pass each other.

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Q5: The phenomenon in which the observed frequency differs from the source frequency due to the relative motion between the source and the observer is called .....

a) Wave interference b) Doppler effect. c) Wave diffraction d) Wave refraction

Period 3 Week .....

Weekly Assessment

Date: .....

(Group A)

1) An ambulance with a siren emitting a constant frequency sound is moving at a steady speed toward a person standing on the side of the road. What happens to the loudness (amplitude) and pitch (frequency) of the sound as perceived by a stationary person as the car approaches them?

a) The loudness of the sound increases, and the perceived pitch of the sound increases.

b) The loudness of the sound increases, and the perceived pitch of the sound decreases.

c) The loudness decreases, and the perceived pitch increases.

d) Both the loudness and frequency of the sound remain constant and unchanged.

2) The figure illustrates the observation of light emitted by a galaxy; a redshift of its spectral lines is observed compared to the same spectrum in the laboratory. What is the physical cause of this shift based on the Doppler effect?

a) The galaxy moving away from Earth causes the wavelength to increase.

b) The galaxy's approach to Earth causes an increase in wavelength.

c) The galaxy's recession from Earth results in a decrease in wavelength.

d) The stability of the galaxy in its position leads to an increase in wavelength

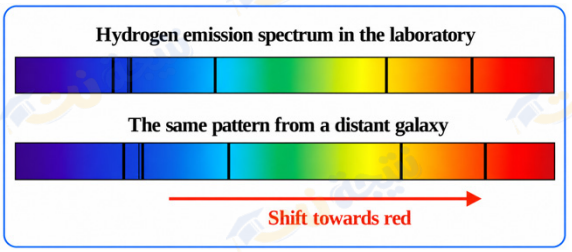
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3) A sound source moving at a speed of 25 ms^{-1} approaches a stationary observer while emitting a sound with a frequency 600 Hz. Find the frequency of the sound heard by the observer, knowing that the speed of sound in air is 340 ms^{-1}

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Q4: When light observed from a far galaxy, scientists noticed that all the colors of its spectrum were some shifted toward red. What can we conclude from this observation about the motion of the galaxy? Explain the reason of this shift based on the Doppler effect of light.



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Q5: You notice an increase in the pitch of a speeding train's whistle as it approaches the station, while the pitch decreases as soon as it passes the station and moves away from it. Explain this observation based on the concept of the Doppler effect.

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(Group B)

1) When an ambulance emitting a constant-frequency siren passes a beach where a listener is standing and begins to move away from him at a constant speed: How do the pitch (apparent frequency) and the loudness of the sound, as measured by the listener, change as the vehicle moves away?

a) The apparent frequency decreases, and the loudness decreases.

b) The apparent frequency increases, and the loudness increases.

c) The apparent frequency decreases, and the loudness increases.

d) The apparent frequency increases, and the loudness decreases.

2) If the wavelength of an observed spectral line of a galaxy is (λ') and the reference wavelength in the laboratory is (λ), then the condition that expresses the galaxy approaching at a radial velocity (v) is:

a) $\lambda' < \lambda$ and the spectral lines shift towards blue.

b) $\lambda' > \lambda$ and the spectral lines shift towards the red.

c) $\lambda' < \lambda$ and the spectral lines shift towards the red.

d) $\lambda' > \lambda$ and the spectral lines shift towards blue.

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3) A sound source moving at a speed 20 ms^{-1} moves away from a stationary observer while emitting a sound with a frequency 600 Hz.
Find the frequency of the sound heard by the observer, knowing that the speed of sound in air is 340 ms^{-1}.

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Q4: When observing the electromagnetic spectrum of light emitted from a far galaxy, an astronomer noticed that the absorption spectrum lines of sodium had shifted towards the lower frequencies (red).
What conclusion does the astronomer draw about the direction of motion of this galaxy relative to Earth? Explain your answer.

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Q5: An ambulance approaches a person standing on the side of the road with its siren on, then passes him and drives away. Compare the pitch (intensity) of the sound a person hears as an ambulance approaches them, and the pitch of the sound after it passes them and moves away.

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Group C

1) When an ambulance approaching a person standing on the side of the road emits a siren with a constant frequency f, the apparent wavelength (λ) of the sound waves received by the person compared to the original wavelength (λ) of the wave in air is:
   a) Larger; due to the accumulation of sound waves behind the source.
   b) Smaller; because the sound waves are compressed in front of the source.
   c) Equal because the frequency of the source's sound does not change.
   d) Smaller because the speed of sound propagation in air increases

2) The spectral shift of galactic light towards longer wavelengths is known as:
   a) Redshift, indicating that the galaxy is moving away from Earth.
   b) Blue shift, indicating that the galaxy is moving away from Earth.
   c) Redshift, indicating that the galaxy is approaching Earth.
   d) Blue shift, indicating that the galaxy is approaching Earth.

3) A car moving east at a speed 15 ms^{-1} emits a sound with a frequency 600 Hz, and a motorcycle moving west at a speed 20 ms^{-1} passes by it. Find the frequency of the sound heard by the motorcyclist before passing them.

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4) A person standing on the side of the road hears a fire engine's siren at a high (sharp) frequency as it approaches, but the same siren is heard at a low (deep) frequency after it passes and moves away.

State the name of the physical phenomenon responsible for this observation.

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5) When observing the light spectrum emitted by two different galaxies (A) and (B), it was noted that the spectral lines of galaxy (A) were shifted towards the red color, while the spectral lines of galaxy (B) were shifted towards the blue color. Explain the motion of each galaxy relative to the observer.

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Period 1

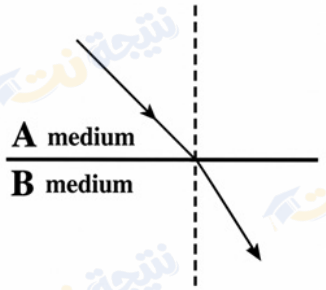
Lesson (2-9)

Refraction and Total Internal Reflection

Week .....

Date: .....

Classroom Performances



1. The opposite diagram shows a light ray passing between two media, A and B. When the ray moves from medium A to medium B, what happens to the speed of light and the wavelength?

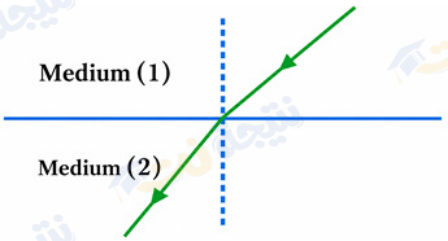
2. The absolute refractive index (n) of a transparent medium is given by the relation:

a) $n = \frac{\upsilon}{c}$ b) $n = \frac{c}{\upsilon}$ c) $n = c \cdot \upsilon$ d) $n = \frac{\lambda}{\upsilon}$

Home Performances

1. A light ray falls from water onto glass at an angle of 55° in the water. If the relative refractive index between water and glass is 1.15, calculate the angle of refraction of the light in the glass.
2. Compare between the optically denser medium and the optically less dense in terms of (the speed of light in two media - A bsolute refractive index)
3. If the speed of light in air is 3×10^8 m/s and its speed in glass is 2×10^8 m/s, calculate the absolute refractive index of glass
4. If a light ray transfers from optically less dense to optically denser medium, so....
   a) Both of the frequency and the wavelength decrease.
   b) the frequency increases and the wavelength decrease.
   c) the frequency remains constsnd and the wavelength increases.
   d) the frequency remains constsnd and the wavelength decreases.

5. A light ray passes from Medium (1), whose absolute refractive index is 1.3, into Medium (2), whose absolute refractive index is 1.5, as shown in the figure. Which choice correctly describes what happens to the wavelength and speed of light in Medium (2)?



Choice	Speed of light	Wavelength
(A)	increases	increases
(B)	increases	decreases
(C)	decreases	increases
(D)	decreases	decreases

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Period 2 Week .....

Lesson (2-9)

Total Internal Reflection

Date: .....

Classroom Performances

1. Essay: When light travels from an optically denser medium to an optically less dense medium, what is the maximum value of the angle of refraction in the less dense medium?

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2- Choose: To calculate the critical angle between two media ($n_1 > n_2$), use the relation:

a) $\sin \theta c = \frac{n_1}{n_2}$ b) $\sin \theta c = \frac{n_2}{n_1}$ c) $\cos \theta c = \frac{n_2}{n_1}$ d) $\tan \theta c = \frac{n_2}{n_1}$

Homework Performances

1. Explain the scientific reason: The outer core of an optical fiber is made of a material whose refractive index is lower than that of the inner core.

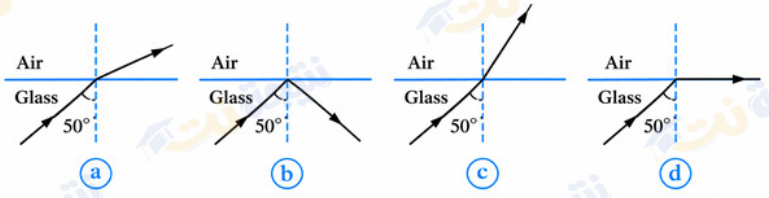
2. What happens when a narrow beam of light is directed upward through the side of a cup of water toward the water–air surface, while the angle of incidence is gradually increased?

3. If the refractive index of the core of an optical fiber is 1.6 and that of the cladding is 1.4, then $\sin \theta c$ between them is:

a) $\frac{1.4}{1.6}$ b) $\frac{1.6}{1.4}$ c) $\frac{1}{1.6}$ d) $\frac{1}{1.4}$

4. Total internal reflection occurs when light travels from a:
   a) less optically dense medium to a more optically dense medium
   b) more optically dense medium to a less optically dense medium
   c) medium of equal optical density
   d) opaque medium to a transparent medium

5. If the refractive index of glass is 1.5, which of the following diagrams shows the correct path of a light ray incident on the glass–air interface at an angle of 50°?



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Period 3 Week .....

Weekly Assessment

Date: .....

(Group A)

1. An optical fiber has a core refractive index of 2.1 and is covered with an outer layer of cryolite. The refractive index of the outer layer that makes the critical angle between the two layers equal to 32° is ……..

a) 1.11 b) 2.25 c) 3.96 d) 4.32

2. In an experiment using a disc to block light, if the water is replaced by another liquid with a higher refractive index, the area of the disc required for blocking the light ……..

a) increases b) decreases c) does not change d) becomes zero

3. Explain the scientific reason: A light ray bends away from the normal when it travels from water to air.

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4. What happens when a light ray travels from a more optically dense medium to a less optically dense medium with an angle of incidence equal to the critical angle?

5. Light has speed C in vacuum. It enters two media A and B, where its speed in A is 0.8C and its speed in B is 0.6C. Calculate the critical angle when light travels between the two media.

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Group B

1. A light ray is incident on the interface between two media whose absolute refractive indices are n_1 and n_2, respectively, where $n_1 > n_2$.

Which choice correctly states the condition required for total internal reflection?

a) The ray must be incident in medium n_1 at an angle greater than the critical angle.
b) The ray must be incident in medium n_2 at an angle greater than the critical angle.
c) The ray must be incident in medium n_1 at an angle less than the critical angle.
d) The ray must be incident in medium n_2 at an angle less than the critical angle.

2. A light ray is incident on a plane-parallel glass slab at an angle of incidence of 60°. If the absolute refractive index of glass is $\sqrt{3}$, the angle of refraction of light is:

a) 90° b) 60° c) 30° d) 45°

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3. What happens when a light ray travels from a more optically dense medium to a less optically dense medium with an angle of incidence greater than the critical angle?

4. Compare between the more optically dense medium and the less optically dense medium in terms of: the speed of light in the medium and the absolute refractive index.

5. Explain the scientific reason:

The reflected ray inside water does not disappear when light travels from water to air; instead, it becomes brighter as the angle of incidence increases.

6. A light ray travels from a material into air. If the angle of incidence is 30° and the angle of refraction is 50°, calculate the refractive index of the material.

(Group C)

1. If a light ray travels from a less optically dense medium to a more optically dense medium, the ratio of the wavelength of the incident light to the wavelength of the refracted light is:

a) less than 1 b) greater than 1 c) equal to 1 d) zero

2. When light travels from a more optically dense medium to a less optically dense medium, the maximum value of the angle of refraction in the less dense medium is:

a) 180° b) 90° c) 42° d) 45°

3. Compare between the transmission of light from air to water and its transmission from water to air in terms of frequency and wavelength.

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4. Explain the scientific reason: The radius of the disc required to block the light from a point source below the surface of a liquid decreases as the refractive index of the liquid increases.

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5. The critical angle for glass with air is 42°, while the critical angle for water with air is 49°. Which is optically denser? Give a mathematical justification.

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Period 1 Week .....

Lesson (2-10)

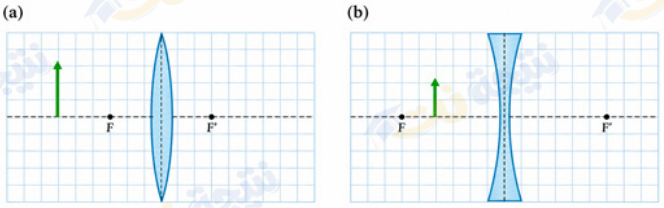
Lenses and Images

Date: .....

Classroom Performances

1. What is the name of the lens that is thicker at its center than at its edges?

2. Suppose the object is represented by the arrow in the figure and the lens has two focal points, F and F′. Draw the image formed by the lens in each case shown in the figure.



3. The point at which rays parallel to the principal axis converge after refraction by a convex lens is called:

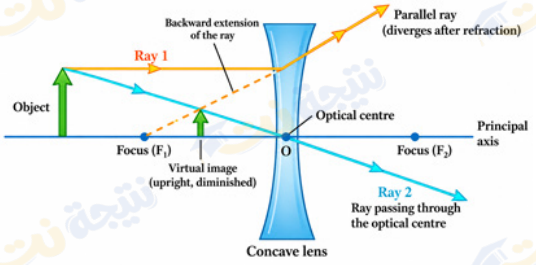
a) optical center b) principal focus c) center of curvature d) pole of the lens

4. The straight line passing through the optical center of the lens and perpendicular to its plane is called:

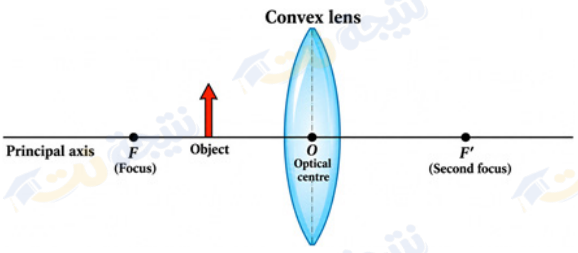
a) focal length b) principal axis c) radius d) incident ray

Homework Performances

1. Using the ray diagram in the figure, explain why the image formed by a concave lens is always virtual, upright, and diminished.



2. Draw the ray path for a magnifying (convex) lens used to view an object at a short distance (inside the focal length), showing the ray passing through the optical center, the ray parallel to the principal axis, and how their extensions meet.



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3. An object is placed at a distance (a) from a convex lens, forming a virtual image. The lens is replaced by a concave lens with the same focal length f, without moving the object, and another virtual image is formed. If the distance between the positions of the first and second images is equal to the focal length f, find the object distance (a) in terms of f.

4. If an object is placed at a distance much greater than twice the focal length (2F) of a convex lens, its image is:

a) real, inverted, and diminished.
b) real, inverted, and magnified
c) virtual, upright, and diminished
d) real, inverted, and the same size as the object

5. If the magnification is M = 0.5, this means that the image is:

a) magnified by a factor of 2
b) the same size as the object
c) half the size of the object
d) always inverted

Period 2 Week .....

Lesson 2-11

Young's Double-Slit Experiment

Date: .....

Classroom Performances

1. The wavelength λ of any monochromatic light in Thomas Young's double-slit experiment is determined from the relation:

a) $\lambda = \frac{\Delta y R}{d}$ b) $R = \frac{\Delta y d}{\lambda}$ c) $\Delta y = \frac{\lambda d}{R}$ d) $d = \frac{\lambda \Delta y}{R}$

2. In the Young double-slit experiment shown in the figure, if the distance between two successive bright fringes is 5 mm, calculate the wavelength of the light used.



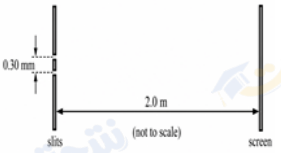
3. In Thomas Young's experiment, a monochromatic ray is incident on a double slit whose separation is d_1. The double slit is then replaced by another double slit whose separation is half the original separation. The distance between two consecutive fringes of the same type in the second case equals .....

a) $\Delta y_2 = \frac{\Delta y_1}{2}$ b) $\Delta y_2 = \Delta y_1$ c) $4\Delta y_1 = \Delta y_2$ d) $4\Delta y_1 = \Delta y_2$

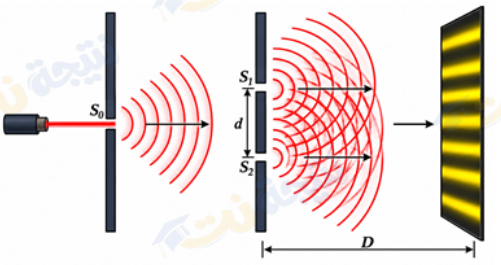
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Homework Performances

1. Monochromatic light of wavelength 450 nm passes through two parallel slits separated by 0.3 mm. Bright fringes are observed on a screen 2 m away. Calculate the distance, in millimeters, between two consecutive fringes of the same type.



2. The figure represents Young's double-slit experiment. When both slits are open, will the wall show two bright spots, one for each slit, or a series of many bright fringes? Where is the intensity greatest?



3. Monochromatic light of wavelength 600 nm is used in Young's experiment. Interference fringes are formed on a screen 1.2 m away. If the separation between consecutive bright fringes is 2.4 mm, calculate the separation d between the two slits.

4. Which of the following methods can increase the fringe spacing in Young's double-slit experiment when using a monochromatic green-light source?

a) Decrease the distance between the screen and the two narrow slits.
b) Increase the distance between the source and the two narrow slits.
c) Increase the separation between the two narrow slits.
d) Replace the light source with a monochromatic red-light source.

5. In Thomas Young's experiment, when the distance between the double-slit screen and the screen used to receive the fringes is doubled, the distance between every two consecutive fringes of the same type:

a) doubles and the fringe visibility decreases.
b) doubles and the fringe visibility increases.
c) halves and the fringe visibility increases.
d) halves and the fringe visibility decreases.

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Revision

1. An optical fiber has a core refractive index of 2.1 and is covered with an outer layer of cryolite. The refractive index of the outer layer that makes the critical angle between the two layers equal to 32° equals …….

A) 1.11 B) 2.25 C) 3.96 D) 4.32

2. In an experiment using a disc to block light, if the water is replaced by another liquid with a higher refractive index, the area of the disc required for blocking the light …….

A) increases B) decreases C) does not change D) becomes zero

3. Explain the scientific reason: A light ray bends away from the normal when it travels from water to air.

4. What happens when a light ray travels from a more optically dense medium to a less optically dense medium with an angle of incidence equal to the critical angle?

5. Light has speed c in vacuum. It enters two media A and B, where its speed in A is 0.8c and its speed in B is 0.6c. Calculate the critical angle when light travels between the two media.

6. A light ray is incident on the interface between two media whose absolute refractive indices are n_1 and n_2, where $n_1 > n_2$. Which choice correctly states the condition required for total internal reflection?

a) The ray must be incident in medium n_1 at an angle greater than the critical angle.
b) The ray must be incident in medium n_2 at an angle greater than the critical angle.
c) The ray must be incident in medium n_1 at an angle less than the critical angle.
d) The ray must be incident in medium n_2 at an angle less than the critical angle.

7. A light ray is incident on a plane-parallel glass slab at an angle of incidence of 60°. If the absolute refractive index of glass is 1.5, the angle of refraction of light is:

A) 90° B) 60° C) 30° D) 45°

8. What happens when a light ray travels from a more optically dense medium to a less optically dense medium with an angle of incidence greater than the critical angle?

9. Compare the more optically dense medium and the less optically dense medium in terms of the speed of light in the medium and the absolute refractive index.

10. Explain the scientific reason:

The reflected ray inside water does not disappear when light travels from water to air; instead, it becomes brighter as the angle of incidence increases.

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11. light ray travels from a material into air. If the angle of incidence is 30° and the angle of refraction is 50°, calculate the refractive index of the material.

12. If a light ray travels from a less optically dense medium to a more optically dense medium, the ratio of the wavelength of the incident light to the wavelength of the refracted light equals …

a) less than 1 b) greater than 1 c) equal to 1 d) zero

13. When light travels from a more optically dense medium to a less optically dense medium, the maximum value of the angle of refraction in the less dense medium is

a) 180° b) 90° c) 42° d) 45°

14. Explain the scientific reason: The radius of the disc required to block the light from a point source below the surface of a liquid decreases as the refractive index of the liquid increases.

15. Compare:

The transmission of light from air to water and from water to air in terms of frequency and wavelength.

16. If the critical angle for glass with air is 42° and the critical angle for water with air is 49°, which is more optically dense, and why? Give a mathematical justification.

17. A convex lens has a focal length of 10 cm and an object is placed 15 cm from it. The image formed is:

a) virtual and magnified b) real and magnified

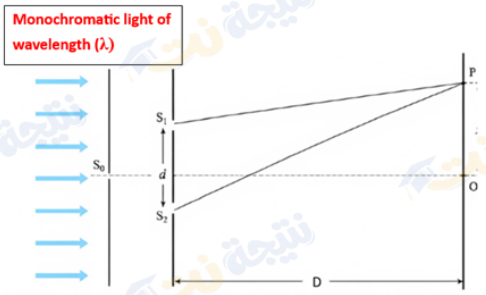
c) real and diminished d) real and the same size

18. Four students are given a choice of different light sources with different wavelengths, different double-slit separations, and a suitable screen distance for performing a double-slit experiment. Which student's experiment will have the greatest fringe visibility?

Wavelength	slit separation	screen distance
nm 500	2d	m 0.5
nm 400	d	m 1
nm 600	3d	m 1.5
nm 450	0.5d	m 1.1

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19. A student performs a double-slit interference experiment as shown in the figure, but finds that the interference fringes observed on the screen are very close to one another and cannot be distinguished. What change could help the student distinguish the fringes? (Two changes are sufficient)



20. An object of height h is placed between a screen and a convex lens. When the lens position is changed, two positions are found that produce a sharp image on the screen. If the magnification at the first position is $M_1 = 4$ and at the second position is $M_2 = 0.25$, calculate the heights of the first and second images.

21. How can you increase the fringe spacing in Young's double-slit experiment when using a monochromatic green-light source?

22. An image is formed on a wall by a lens. If the distance between the lens and the wall is 30 cm and the magnification is M = 2, the type of lens and the object distance are …… , ……

A) concave lens, a = 15 cm B) convex lens, a = 60 cm

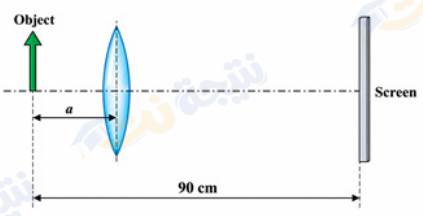
C) convex lens, a = 15 cm D) concave lens, a = 60 cm

23. In a Young's double-slit interference experiment, the slit separation is 0.2 mm and the wavelength of the monochromatic light used is 600 nm. If the distance between the slits and the screen is 1 m, the distance between two consecutive fringes of the same type is:

a) 3 mm b) 6 mm c) 30 mm d) 1 m

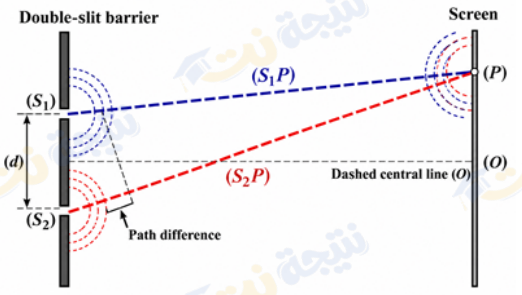
24. A convex lens produces a virtual, upright image magnified four times for an object placed in front of it. The object is moved 6 cm farther from the lens, and the image becomes real, inverted, and magnified four times. Calculate the focal length of the lens.

25. The figure shows a screen placed 90 cm from an object. A convex lens with a focal length of 20 cm is moved between the object and the screen. Find all possible values of the distance a between the lens and the object for which a sharp image is formed on the screen.



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26. The figure shows the paths of two waves from slits S_1 and S_2 meeting at point P. If the wavelength is y and the path length S_1P exceeds S_1P by 1.5y, what type of fringe is formed at point P? Explain why.



27. When red light is used instead of blue light in Young's experiment, the distance between the fringes …….

a) increases because the wavelength of red light is greater.

b) decreases because the wavelength of red light is smaller.

c) does not change.

d) the fringes disappear.

28. A concave lens has a focal length of 20 cm and an object is placed 20 cm from it. The image is ……

a) at infinity

b) virtual, upright, and diminished

c) real and the same size as the object

d) virtual and magnified

29. In a double-slit experiment, monochromatic light of wavelength 6000 Å is used and fringes are formed on a screen at a distance R from the double slit. The distance between two consecutive bright fringes is Δy_1. If monochromatic light of wavelength 4000 Å is then used and the distance between the double slit and the screen is doubled, giving a new fringe spacing Δy_2, calculate the ratio $\Delta y_1 / \Delta y_2$.

30. An object is placed farther than 2F from a convex lens and then moves toward the focus F with a uniform speed v. Prove that the speed of the image is variable and increases as the object approaches the focus.

31. Explain the scientific reason: The central fringe in Young's double-slit experiment is always a bright fringe.

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