Ministry of Education and Technical Education
Central Administration for General Education
Science Consultant office



Biosphere



Atmosphere

INTEGRATED SCIENCE

2026/2027

First Academic Term

1st Year of Secondary stage



Geosphere



Hydrosphere

Review
د/ حسين عبد الرحمن بخات

Preparation
أ/ عبد المسيح حزين
أ/ عمرو مالي احمد

رئيس الإدارة المركزية التعليم العام
والمشرف على مستشاري المواد الدراسية
د/ هالة عبد السلام خفاجي

مستشار العلوم
د/ عزيزة رجب خليفة

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Homework

First: Choose the correct answer

1) **Salmon are born in freshwater, migrate to the sea, and then return to rivers upon reaching sexual maturity. What is the biological classification of this behavior and its purpose?**

A) A behavioral adaptation aimed to reproduction, species preservation, and utilizing available resources
B) A structural adaptation aimed to increasing the surface area for oxygen absorption
C) A physiological adaptation to increase urea concentration in the blood during swimming
D) A functional adaptation for the direct elimination of excess salts via the gills cells

2) **How do deep-sea fish physiologically adapt to overcome the severe and drastic – depletion of dissolved Oxygen levels in ocean depths?**

A) Increasing cellular metabolic rates to generate kinetic energy that accelerates swimming speed
B) Swallowing massive volumes of water to stimulate direct cutaneous gas exchange across the skin
C) Slowing down their basal metabolic rate (Metabolism) and increasing hemoglobin concentration in their blood
D) Storing large quantities of urea in the bloodstream to elevate arterial blood pressure

3) **Bony fish possess a specialized anatomical structure known as a "swim bladder" or (air bladder). What is the core physiological role of this structure in their aquatic existence?**

A) Filtering excess salts from arterial blood and excreting them into the surrounding medium
B) Assisting the fish in buoyancy regulation, vertical depth control, and maintaining hydrostatic balance
C) Storing vital atmospheric gases for respiration during periods of dormancy on the ocean floor
D) Secreting a lubricating mucous layer to reduce friction and defend the body against parasites

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4) **Which of the following represents a correct application of the concept of "behavioral adaptation" in aquatic organisms?**

A) Modification of arterial and venous walls to become highly flexible and durable to withstand hydrostatic pressure

B) Increasing the specific density of hemoglobin inside erythrocytes to extract oxygen under low concentrations

C) Possessing an advanced gas-filled bladder to regulate specific gravity during vertical buoyancy

D) Migrating seasonally between aquatic habitats or emitting distinct vocal patterns to communicate and utilize resources

5) **If samples of clams (mollusks) and shrimp (crustaceans) are placed in an aquatic tank saturated with extremely high concentrations of carbon dioxide gas, what are the expected changes regarding their exoskeletons؟**

A) The chitinous exoskeleton of the shrimp erodes, while the shell of the clam thickens due to collagen deposition

B) Both structures disintegrate at identical rates because their chemical composition is similarly based on calcium phosphate

C) Neither organism is affected because carbonic acid H_2CO_3 acts as a protective barrier preventing skeletal dissolution

D) The clam shell, composed of calcium carbonate, erodes, whereas the chitinous exoskeleton of the shrimp is less affected

6) **What is the underlying scientific reason why cold waters are significantly richer in dissolved vital gases compared to warm waters؟**

A) The complete absence of salt concentrations and salinity within cold water masses

B) The inverse relationship between temperature and gas solubility; solubility increases as temperature drops

C) The absolute inhibition of photosynthetic processes under low thermal conditions

D) The capacity of cold water to convert calcium carbonate molecules into organic collagen proteins

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7) **Which of the following aquatic organisms will NOT experience a direct destructive effect on its external structure when insoluble calcium carbonate is converted into highly soluble calcium bicarbonate؟**

A) Coral reefs (Cnidarians)
B) Sea urchin (Echinoderms)
C) Oysters (Mollusks)
D) Shrimp (Crustaceans)

8) **Based on the biological analysis of the Icefish and the Viperfish, what is the shared anatomical strategy utilized to withstand the high hydrostatic pressure of the deep sea؟**

A) Possessing laterally compressed bodies to dissipate and distribute the impact of high water pressure
B) Relying on highly developed cranial blowholes to breathe direct atmospheric air
C) Utilizing cellular contractile vacuole mechanisms to discharge excess water dynamically
D) Inhabiting low-pressure freshwater river estuaries permanently

Second: Essay Questions

Q9: Give reasons for: Why do living organisms inhabiting freshwater environments face a continuous physiological threat of cellular swelling and lysis (bursting)؟

Q10: Explain the physiological mechanisms performed by marine bony fish to overcome the dual osmotic challenge (the risk of continuous water loss and the accumulation of excess salts in tissues)

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Q11: What would happen if the hemoglobin concentration in the blood of the deep-sea Viperfish decreased to match that of surface-dwelling fish؟

Q12: Compare the excretory and physiological role of the kidney in a freshwater fish versus its role in a marine bony fish.

Q13: : Explain how the three forms of adaptation (structural, behavioral, and physiological) integrate to secure the continuity of the salmon's life cycle

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Q14: Are aquatic plants themselves affected by a deficiency of dissolved (CO_2) gas in terms of their internal energy production? Explain your answer.

Q15: Give reasons for: The lower solubility of vital gases (O_2, CO_2) in the Red Sea environment compared to the Nile River at a constant temperature

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Q16: Fish cease their vital activities, such as hunting and swimming, when deprived of dissolved oxygen (O_2). Explain this phenomenon physiologically

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Assessment

Model (A)

First: Choose the correct answer

1) When an Amoeba cell is transferred from a pure freshwater environment to an aquatic environment with a very high osmotic concentration exceeding its internal cellular concentration, what is the expected physiological change in the activity of the contractile vacuole?

A) The rate of movement of the contractile vacuole toward the cell membrane increases to prevent cell bursting
B) The contractile vacuole swells and bursts inside the cytoplasm
C) The contractile vacuole transforms into specialized gill cells for salt secretion
D) The activity of the contractile vacuole stops or decreases as a result of the cessation of inward osmotic water flow

2) A sample of freshwater from a lake contains a specific volume of dissolved vital gases at a temperature of 20°C. If an identical sample in volume and conditions is transferred to saline ocean water, what is the approximate expected percentage decrease in the solubility of O_2 and CO_2 gases?

A) Their solubility decreases dramatically by a factor of 500%.
B) The absolute solubility rates fall by a flat margin of 50%.

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C) Solubility drops by an approximate range of 20% to 30% due to the effect of dissolved salts

D) Solubility rises by 20% due to the emergence of ionic attractive forces

3) How do the chemical consequences resulting from an increase in dissolved carbon dioxide concentration (acidification) in the aquatic medium directly affect both clams and tilapia fish

A) It hinders calcification and dissolves clam shells, while causing a physiological imbalance in calcium equilibrium that suppresses tilapia growth

B)) It enhances calcification efficiency in the clam shell and multiplies the biomass of tilapia by 500 times

C)) It transforms the structural composition of the clam into chitin, while mutating tilapia bones into collagenous cartilage

D) The effect is completely absent for both organisms due to the lack of chemical interaction between salts and gases

Second: Essay Questions

Q4: Explain physiologically: Why do sharks retain very high concentrations of organic urea within their tissues and body fluids؟

Q5: Compare the structural (anatomical) adaptation of the Icefish and the Viperfish in resisting the severe hydrostatic pressure of abyssal depths.

Q6: Give reasons for: Why is the phenomenon of "ocean acidification" considered a direct cause for the drastic decline in the survival rates of echinoderm and mollusk larvae؟

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Model (B)

First: Choose the correct answer

1) **Dolphins differ from bony fish in the organ and anatomical mechanism utilized for gas exchange (respiration), despite sharing the same aquatic habitat. Which of the following options accurately describes this adaptation in dolphins؟**

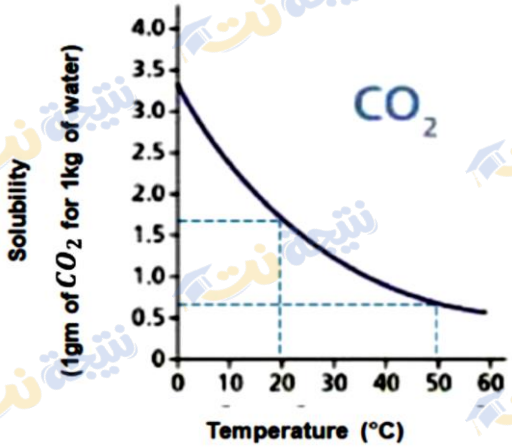
A) Possessing specialized gills covered with insulating mucous plates to filter dissolved gases.
B) Possessing blowholes (respiratory openings) at the top of the head instead of a nose, allowing direct breathing of atmospheric air.
C) Relying on massive pulmonary contractile vacuoles to expel excess water via reverse osmotic mechanisms.
D) Possessing highly advanced air sacs connected to the outer skin to absorb ambient gases.

2) **How does an elevation in dissolved carbon dioxide levels in water negatively affect the internal physiology of aquatic vertebrates such as tilapia and ray fish؟**

A) Stimulating dense deposition of collagen protein within the fin tissues.
B) Inducing a direct physiological imbalance in calcium homeostasis and metabolism, thereby inhibiting standard growth rates.
C) Accelerating glucose oxidation pathways to generate biological energy exceeding normal thresholds.
D) Converting the internal skeletal framework entirely into a flexible chitinous structure to maximize resistance.

3) **From the corresponding figure: What occurs to the quantity of dissolved gas CO_2 when the water mass temperature is raised from 0°C to 60°C?**

A) Solubility rates increase proportionally from 0.07 g to 50 g
B) Solubility values remain entirely constant at the reference baseline of 1.5 g
C) Solubility values decrease inversely from approximately 3.35 g at 0°C to 0.5 g at 60°C



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D) **Dissolution drops completely to absolute zero upon reaching a temperature of 10°C**

Second: Essay Questions

Q4: **Identify the adaptation (structural, behavioral, or physiological) represented by each of the following biological phenomena:**

A- The dynamic, effective regulation of arterial blood pressure in deep-sea fish to match external pressure:

The structural flexibility of the skeletal framework and vertebral column in the Viperfish:

Q5: **Give reasons for: Abyssal deep-sea fish, such as the Icefish, possessing exceptionally large eyes relative to their body size, alongside a compressed body structure.**

Q6: **Construct a scientific table comparing the supportive system (skeleton/shell) of a clam versus a tilapia fish, specifying: (Location of support and Main chemical component).**

Point of comparison	Support System in Clams (Mollusks)	Support System in Tilapia (Bony Fish)
Location of support	---	---
Main chemical component	---	---

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Model (C)

First: Choose the correct answer

1) **The physiological role of gills in marine bony fish is not restricted to respiratory gas exchange; it extends to other systemic functions. What additional osmo-regulatory physiological function do gills perform in this marine environment؟**

A) Absorbing freshwater molecules actively across the cellular membrane against the concentration gradient

B) Synthesizing nitrogenous urea compounds and pumping them directly into the bloodstream.

C) Collecting internal excess freshwater and discharging it through specialized pores.

D) Excreting accumulated excess salt ions from the body via highly specialized secretory cells.

2) **In a laboratory simulation experiment, the concentration of dissolved carbon dioxide gas CO_2 was reduced in a tank containing primary producers (algae and phytoplankton). What direct consequence will this have on the higher consumer trophic levels of the marine food chain؟**

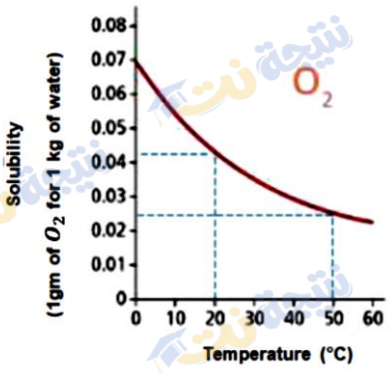
A) Conversion of dissolved calcium bicarbonate into calcium carbonate, doubling the shell thickness of mollusks

B) A decline in the rate of photosynthetic reactions responsible for synthesizing sugars (like glucose), reducing the chemical energy available to consumers

C) Acceleration of larval and egg division rates due to an un-regulated sharp increase in ambient pH values

D) Immediate stimulation of glucose oxidation through the respiratory catabolic pathways of fish.

3) **From the corresponding figure: What occurs to the solubility of oxygen gas when the water mass temperature decreases from 60°C to 0°C?**



A) The solubility value increases proportionally from 0.02 g to reach

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approximately 0.07 g per kilogram of water

B) Solubility rates flatten out horizontally, stabilizing firmly at the at 0.03 g. marker

C) Solubility values drop inversely from the 0.07 g range to settle at 0.02 g

D) Dissolution diminishes progressively until it vanishes entirely, hitting zero at a temperature of 40°C

Second: Essay Questions

Q4: Explain the biological (behavioral) significance of whales emitting specific acoustic and vocalization patterns within the ocean environment.

Q5: Explain physiologically: The capacity of abyssal deep-sea fish to survive without experiencing vascular collapse or the crushing of their blood vessels (arteries and veins) under extreme hydrostatic pressure

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Q6: Compare collagen protein and chitin in terms of their anatomical location and structural function within marine organisms.

	collagen protein	chitin
anatomical location	---	---
structural function within marine organisms	---	---

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*** End of Questions ***

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