The following is given:

$\sin 30^\circ = \frac{1}{2}$ $\cos 30^\circ = \frac{\sqrt{3}}{2}$

$\sin 45^\circ = \frac{\sqrt{2}}{2}$ $\cos 45^\circ = \frac{\sqrt{2}}{2}$

$\sin 60^\circ = \frac{\sqrt{3}}{2}$ $\cos 60^\circ = \frac{1}{2}$

$\sin 37^\circ = \frac{3}{5}$ $\cos 37^\circ = \frac{4}{5}$

$\sin 53^\circ = \frac{4}{5}$ $\cos 53^\circ = \frac{3}{5}$

$\pi \approx \frac{22}{7}$ $\sqrt{2} = 1.414$

$\sqrt{3} = 1.732$ $\sqrt{5} = 2.236$

$\sqrt{7} = 2.646$ $\sqrt{10} = 3.162$

Acceleration due to gravity = 10 m/s^2

Atmospheric pressure = 1 atm = 10^5 Pa = 760 mmHg

Density of water = 1,000 kg/m^3

Density of mercury = 13,600 kg/m^3

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Instructions :

1. Each question carries a different score, as indicated at the end of the question.
2. Students must select only the one best answer for each question.

1. The students observed plant epidermal cells that had been placed in a concentrated sucrose solution for 30 minutes.

Consider the following statements:

A. The cell surface membrane is partially permeable.

B. This experiment involves a hypotonic solution.

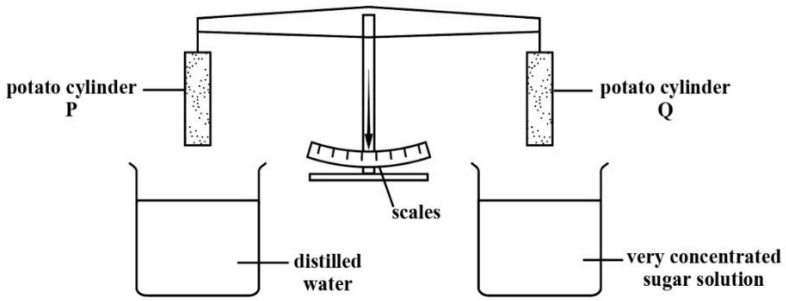
C. Water moves out of the cell more than it moves into the cell.

D. The vacuole will lose water and become larger.

Which statements are correct? (1.25 marks)

1. A and B
2. A and C
3. C and D
4. A, B, and D

2. A student investigated the process of osmosis in potatoes. He set up the apparatus as shown. (1.25 marks)



At the beginning, the potato cylinders were exactly balanced. He immersed the cylinders into the liquids for 4 hours, after which the cylinders were lifted out of the liquids. Cylinder P was now heavier than cylinder Q. Which statement best explains what happened?

1. Water moved into both cylinders.
2. Water moved out of both cylinders.
3. Water moved into the cylinder in the distilled water and out of the cylinder in the sugar solution.
4. Water moved out of the cylinder in the distilled water and into the cylinder in the sugar solution.

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3. The student used a dye made from a plant to test some substances. The results are given in the table below.

Substance tested	Colour change (if any)
Vinegar	Red
Baking soda	Yellow
Salt solution	No change
Toothpaste	Yellow
Rainwater	Red

What can infer from the test results? (1.25 marks)

1. The dye will turn red if placed in hydrochloric acid.
2. The dye will turn yellow if placed in pure water.
3. The dye will turn red if placed in sodium hydroxide solution.
4. The dye turns yellow in acidic substances and red in alkaline substances.

4. A 100-N crate is placed on a rough surface with a coefficient of static friction between the crate and the surface of 0.25. When a 20-N force is applied to push the crate to the right, what is the direction and the resulting static friction force acting on the crate? (1.25 marks)

1. 20 N to the right
2. 20 N to the left
3. 25 N to the right
4. 25 N to the left

5. An opened large tank contains mercury to a height of 1 m and water to a height of 6.4 m. What is the total pressure at the bottom of the tank? (1.25 marks)

1. 200 kPa
2. 250 kPa
3. 300 kPa
4. 350 kPa

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6. Which of the following best explains why the oxygen produced during photosynthesis is considered a waste product for the plant, even though the plant relies on other parts of the photosynthetic process for its survival and growth? (1.25 marks)

1. Oxygen is toxic to plant cells if accumulated in large amounts, so it must be expelled quickly.

2. The plant's primary goal in photosynthesis is to create sugar, and oxygen is simply a byproduct of splitting water molecules to get electrons for this process.

3. Oxygen is primarily needed by animals for respiration, so plants release it to support the ecosystem, not for their direct internal use from this specific process.

4. The plant uses all the produced oxygen immediately for its own cellular respiration, leaving no excess for storage or other internal uses.

7. Consider the process of transpiration in small plants occurring at night and resulting from osmosis:

A. Water from dew gathers on the surface of plant leaves.

B. Positive pressure generated in the roots pushes water out of the xylem in the leaves.

C. Water accumulates in the leaves because evaporation happens slower than transpiration.

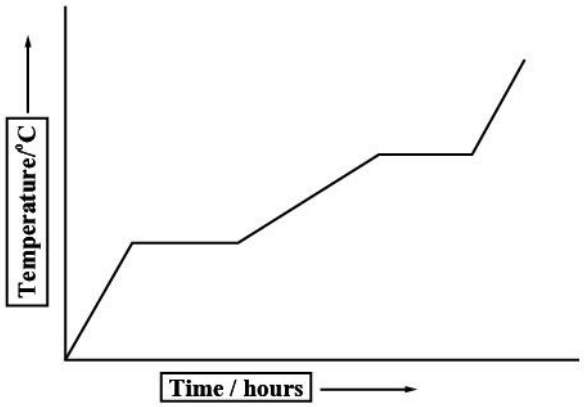
D. Water is pulled up in large quantities to leaves because of an increase in solute concentrations in the leaves.

Which of the above statements are incorrect regarding the process of transpiration?
(1.25 marks)

1. A only
2. B only
3. A, B, and C
4. A, C, and D

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8. The diagram shows how the temperature of a particular substance changes when it is heated at a uniform rate, from below its freezing point to above its boiling point.



Consider the following statements:

A. The heat capacity of the solid form of the substance is greater than that of its liquid form.

B. The heat capacity of the vapor is greater than that of the liquid.

Which of the following statements is correct? (1.25 marks)

1. Both statement A and statement B are correct.
2. Statement A is correct, while statement B is incorrect.
3. Statement A is incorrect, while statement B is correct.
4. Both statement A and statement B are incorrect.

9. From the following statements:

A. In projectile motion, the speed of the object at its highest point is zero.

B. When the first object is dropped freely from a table, and at the same time, the second object is launched horizontally from the same table with an initial velocity, both objects will hit the ground at the same time.

Which statement is/are correct? (1.25 marks)

1. A
2. B
3. All of the above
4. None of the above

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10. Element A is a solid at room temperature, does not conduct electricity, and does not react with water or acids. However, when combined with oxygen, it forms a water-soluble oxide. A solution of this oxide turns blue litmus paper red. Which group of the periodic table does this element belong to? (1.25 marks)

1. Group IA
2. Group IIA
3. Group VIA
4. Group VIA

11. The table below shows the colour changes of bromophenol blue when used in acidic and alkaline solutions.

Indicator	pH value at which colour change takes place	Colour change at pH 4
Bromophenol blue	4.0	Yellow to blue

Solutions Q and R were tested with a few drops of bromophenol blue. Solution Q turned the indicator yellow and solution R turned the indicator blue. What can you conclude on the two solutions? (1.25 marks)

1. Solution R is more acidic than solution Q.
2. Solution Q has a higher pH than solution R.
3. Solution Q is more alkaline than solution R.
4. Solution R has a lower concentration of hydrogen ions than solution Q.

12. A 30% (w/v) NaOH solution with a volume of 300 cm^3 is given. If 200 cm^3 of this solution is taken and diluted by adding 50 cm^3 of water, what is the concentration (w/v) of the resulting NaOH solution? (1.25 marks)

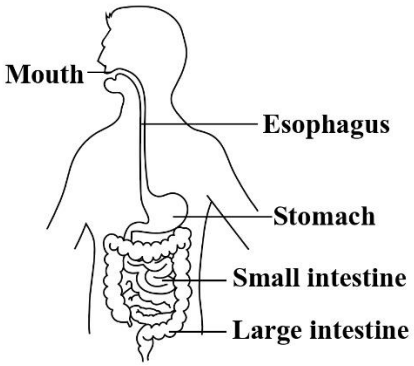
1. 20%
2. 24%
3. 30%
4. 35%

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13. If there is a blockage in a Coronary Artery, how would it affect heart function and the body? (1.25 marks)

1. The heart muscle would be deprived of oxygen and nutrients, leading to reduced pumping efficiency and potentially heart failure.
2. Less blood would flow to the lungs, leading to insufficient oxygen supply to the body.
3. Blood pressure in the body would drop rapidly, leading to fainting.
4. The body would quickly create new blood vessels to replace them, resulting in no long-term effects.

14. The diagram below represents parts of a human organ system.



Consider the following statements:

A. Food is mixed with saliva to form a soft mass called a bolus.
B. Hydrochloric acid kills most bacteria and denatures proteins.
C. The jejunum is the first and shortest part of the small intestine, where chyme mixes with digestive juices from the pancreas and liver.
D. The inner surface is folded into villi and microvilli to efficiently absorb digested nutrients into the bloodstream and lymphatic system.
E. Food is converted into a semi-liquid mixture in the stomach called chyme.

Which of the above statements are incorrect? (1.25 marks)

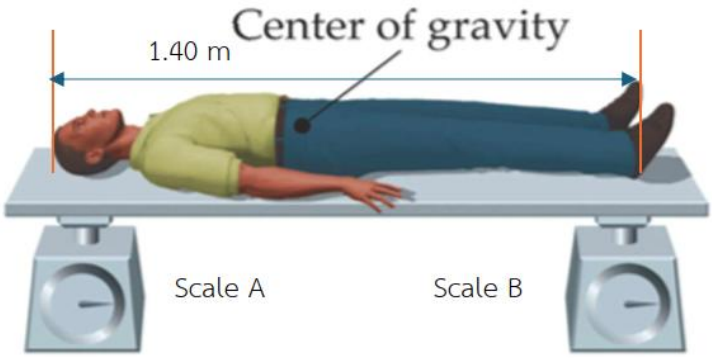
1. A only
2. C only
3. B and D
4. C and E

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15. A stone is dropped from the top of a very tall building. A second stone is dropped 0.6 s later. How far apart are the two stones when the first one has a speed of 16 m/s?
(2.5 marks)

1. 6.5 m
2. 7.2 m
3. 7.8 m
4. 8.0 m

16. The center of mass of an object can be determined by having a person lie on a very light board which is placed on two scales positioned 1.40 m apart, as shown in the figure.



If the man weighs 560 N and his center of mass is 91 cm from his feet, what would be the reading on scale A? (2.5 marks)

1. 327.0 N
2. 345.8 N
3. 364.0 N
4. 382.2 N

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17. A 1.00-m-tall container is filled to the brim - partly with mercury and the rest of the way with water. The container is open to the atmosphere. What must the depth of the mercury be so that the absolute pressure at the bottom of the container is twice the atmospheric pressure? (2.5 marks)

1. $\frac{3}{7}$ m
2. $\frac{5}{7}$ m
3. $\frac{5}{14}$ m
4. $\frac{9}{14}$ m

18. The table shows the temperature and water vapor content in the air at different altitudes on the mountain during one day.

Altitudes (meter)	Air temperature (°C)	Total amount of vapor that can exist in the air (g/m^2)	Actual amount of water vapor in the air (g/m^2)
0	30	30.3	25.0
500	25	27.5	25.0
1,000	20	17.3	25.0
1,500	15	12.8	25.0

Based on the data above, at what altitude do clouds begin to form on this mountain, and why? (2.5 marks)

1. At 0 meters, because the air is still hot and humid.
2. At 500 meters, because the amount of water vapor in the air is approaching the maximum that the air can hold.
3. At 1,000 meters, because the amount of water vapor in the air is higher than the maximum that the air can hold.
4. At 1,500 meters, because the temperature is the lowest, water vapor condenses most easily.

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19. When 20 grams of hot water at 90 °C is poured and mixed with 120 cm3 of water at 30 °C, and heat transfer occurs, what will be the final temperature of the mixture.
(2.5 marks)

1. 28.57 °C
2. 33.57 °C
3. 38.57 °C
4. 48.57 °C

20. Article: Tsunami Risk in Southeast Asia and Future Assessment

In Southeast Asia, particularly in the Indian Ocean region, lies the Sunda Trench, located within the subduction zone where the Indo-Australian Plate is subducting beneath the Eurasian Plate. This area is well-known for the devastating earthquake and tsunami on December 26, 2004, which caused immense damage in many countries, including Thailand. Analysis of geological data and historical earthquake records indicates that large earthquakes in this region occur in a seismic cycle, which can take hundreds of years to accumulate energy.

Scientists continue to closely monitor the accumulation of energy in subduction zones. Even though the 2004 event released a significant amount of energy, the tectonic plates continue to move, causing new energy to accumulate. However, predicting the exact timing of future earthquakes and tsunamis remains impossible. Therefore, developing and improving tsunami warning systems, educating the public, and planning evacuation in at-risk areas are crucial for minimizing potential damage from future tsunamis.

The article states that the Indian-Australian subduction zone is still storing energy even after the major earthquake and tsunami in 2004. Which conclusion is most consistent with this information? (2.5 marks)

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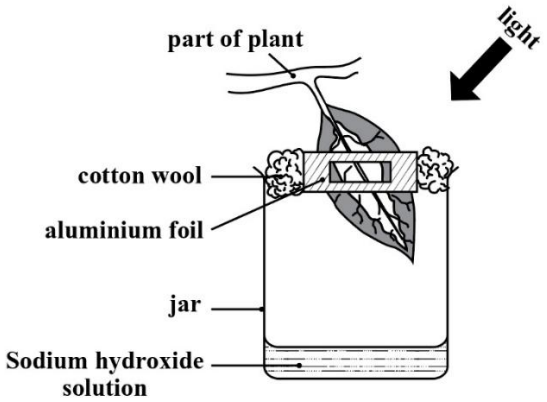
1. The amount of newly generated energy is so small that it will not affect the generation of a large tsunami in the future.

2. There is no chance that a tsunami will occur in this area for hundreds of years because all the energy has been released.

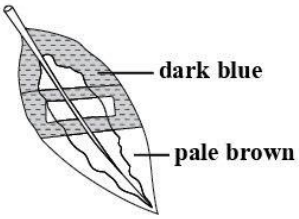
3. There is a possibility that some parts of the fault line will generate large earthquakes and tsunamis in the future, although the exact timing is not yet known.

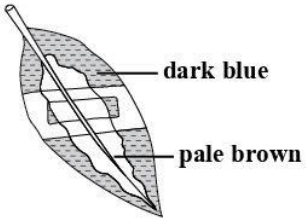
4. Predicting the likelihood of future tsunami is scientifically impossible and is not useful for preparing for them.

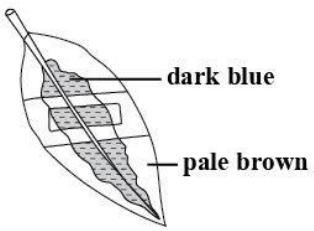
21. A student conducted an experiment on photosynthesis as shown below.

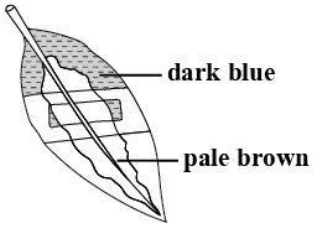


The plant was de-starched two days before the experiment by keeping it in the dark. The middle part of the leaf was covered with aluminum foil, leaving an opening so that the leaf can receive sunlight for several hours. The leaf was then removed and treated with iodine solution. Which diagram represents the result of the test? (2.5 marks)

1. 

2. 

3. 

4. 

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22. Which of the following statements best differentiates between the primary goals of genetic engineering and reproductive cloning in biotechnology? (2.5 marks)

1. Genetic engineering aims to create genetically identical copies of an entire organism, while reproductive cloning focuses on altering specific genes within an organism.
2. Genetic engineering primarily involves inserting, deleting, or modifying genes within an organism's DNA, whereas reproductive cloning aims to produce a genetically identical organism from a somatic cell.
3. Both genetic engineering and reproductive cloning involve the precise removal of a nucleus from a cell, but only genetic engineering results in a viable organism.
4. Reproductive cloning is used to produce therapeutic proteins, while genetic engineering is used for gene therapy in humans.

23. In the split second when a car accident occurs, the driver's safety depends on the airbag. Immediately upon collision, the airbag rapidly inflates to help reduce the impact force and slow the driver down smoothly, preventing them from crashing directly into the steering wheel or windshield. According to the Federal Motor Vehicle Safety Standards, an airbag must be able to withstand an acceleration up to 60 times the acceleration due to gravity (60g), and it operates within 1/20 of a second. To prevent the driver from hitting the steering wheel directly, what is the minimum compression distance the airbag should have in order to safely stop the driver's body under these conditions? (2.5 marks)

1. 0.25 m
2. 0.50 m
3. 0.75 m
4. 1.00 m

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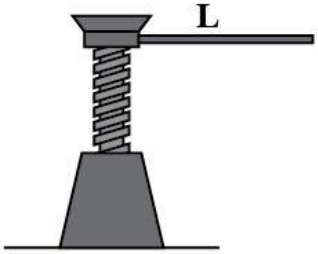
24. A solution contains 300 g of water and 80, 220, and 250 g of substances A, B, and C, respectively. If 120 g of this solution is evaporated at 100 °C.

substances	Solubility of substances (g/H_2O 100 g)			
	0 °C	20 °C	60 °C	100 °C
A	35	36	38	40
B	70	80	95	120
C	120	140	160	190

which substances will crystallize, and what are the masses of each that crystallize? (2.5 marks)

1. A = 8 grams
2. A = 8 grams, B= 4 grams
3. A = 16 grams, C = 10 grams
4. B =10 grams, C= 92 grams

25. From the picture below,



If a screw has 4 threads per centimeter and the radius (L) is 21 cm, what is the mechanical advantage of this screw? (2.5 marks)

1. Mechanical advantage is 22
2. Mechanical advantage is 33
3. Mechanical advantage is 44
4. None of the above

26. A 45-g golf ball is hit at an upward angle of 30.0° from the top of a 35-m-building with a speed of 30 m/s, and the air resistance is negligible. What will be its speed when it strikes the ground in a projectile motion? (2.5 marks)

1. 25 m/s
2. $20\sqrt{3}$ m/s
3. 40 m/s
4. $35\sqrt{3}$ m/s

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27. Liquids A_1, A_2, B_1, and B_2 were subjected to chromatography using alcohol as the solvent, with the solvent traveling at an equal distance. The experimental results are shown below.

Sample color	Separated color	Distance traveled by the substance (cm)	Rf
A_1	Green	11.50	0.70
	Blue	9.30	0.62
A_2	Green	3.00	0.20
	Blue	9.30	0.62
B_1	Purple	3.75	0.25
	Red	18.00	1.20
B_2	Red	20.80	1.32
	Yellow	7.00	0.35

Consider the following statements and answer the question:

A. A_1 and A_2 contain the same substance.

B. The blue color in A_1 is more soluble in alcohol than the green color in A_1.

C. The blue compound present in A_1 and A_2 is a different substance.

D. The R_f value of the red color in B_1 and B_2 is unlikely.

Which of the following statements is correct? (5 marks)

1. A, B
2. B, C
3. A, B, and D
4. D only

28. The human heart is a powerful organ that functions like the body's water pump. Every day, the heart pumps approximately 8,000 liters of blood to various parts of the body. Suppose the work done by the heart is equivalent to lifting the blood to a height equal to the height of a man, which is 1.80 meters, and given that the density of blood is 1,050 kilograms per cubic meter, calculate the power the heart uses in one day (g = 10.0 m/s^2).
(5 marks)

1. 1.75 W
2. 42.0 W
3. 1750 W
4. 42000 W

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29. A student is exploring how different types of sugar affect gas production by bacteria during fermentation. Four 250 mL conical flasks (labeled A to D) are prepared, each containing 100 mL of nutrient broth medium. To each flask, the student adds 5 grams of a specific sugar: glucose in Flask A, sucrose in Flask B, fructose in Flask C, and starch in Flask D. In addition, 5 mL of bacteria culture (with an optical density at 600 nm of 0.6) is added to each flask. All flasks are sealed with stoppers connected to a gas collection apparatus and are incubated at same temperature (as shown in Figure 1).

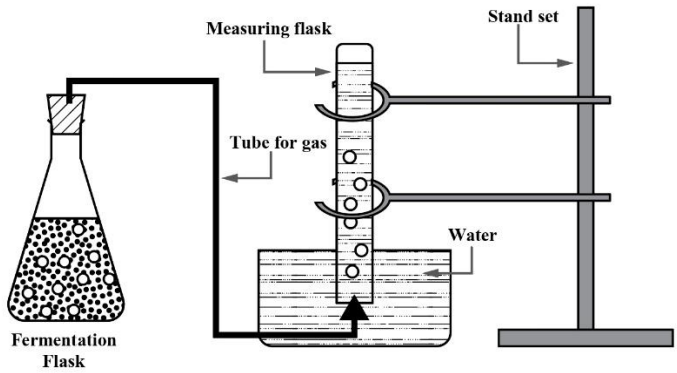


Figure 1. Experimental setup for sugar fermentation by bacteria.

After two days of incubation, the student measures the volume of gas produced in each flask using a water displacement method and records the results in milliliters (mL), as shown in Figure 2.

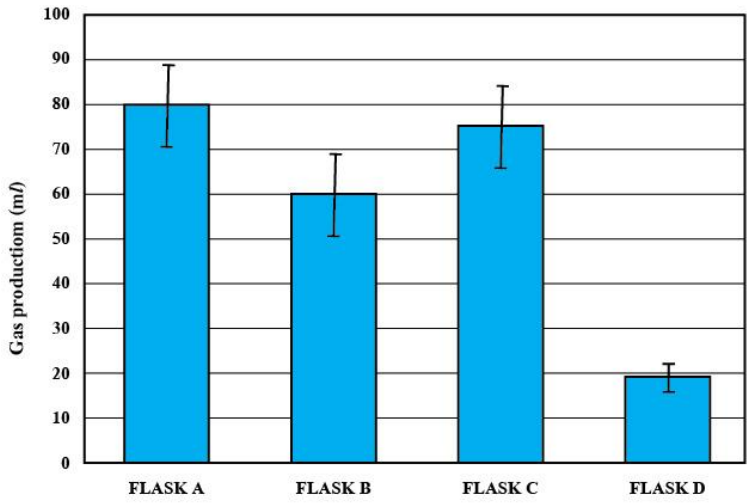


Figure 2. Results of the sugar fermentation experiment

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Which of the following statements is correct based on the experimental setup and results? (5 marks)

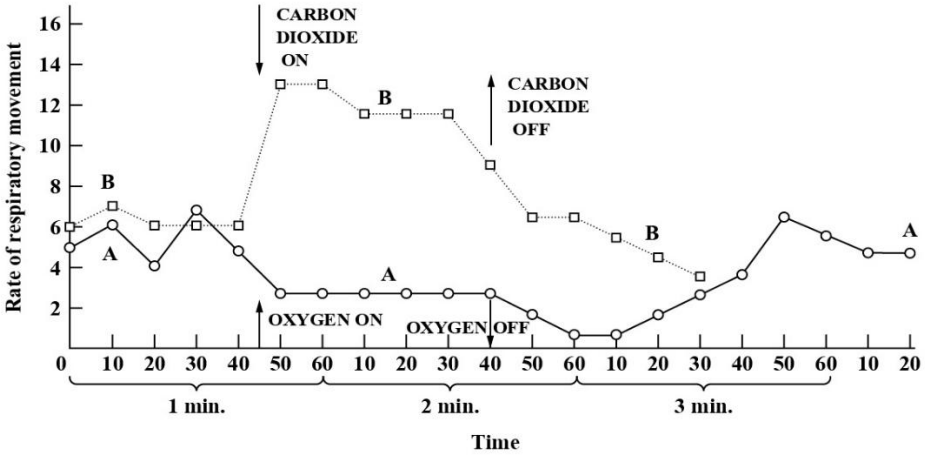
1. The higher gas production in Flask A is caused by complexity of sugar used by bacteria.

2. The experiment could be improved by using different incubation temperatures for each sugar to match their optimal breakdown conditions.

3. The results indicate that glucose in Flask A led to the highest gas yield, likely because it is a simple sugar, requiring fewer enzymatic steps than more complex sugars.

4. The dependent variable in this experiment is the type of sugar used, while the independent variable is the volume of gas produced.

30. The graph below represents the rate of respiratory movements in a rat.



Line A represents the rat's respiratory movement, measured initially during the flow of normal air, and then subjected to a stream of 100% oxygen for a short period of time.

Line B represents the breathing rate in normal air and when the rat was subjected to a stream of carbon dioxide gas that stopped after a short period of time.

Consider the following information:

A. The stream of oxygen affects the rat’s breathing rate, causing it to decrease. The higher concentration of oxygen in the lungs and blood reduces the body’s demand for oxygen. Carbon dioxide diffuses out of the blood into the alveolar air rapidly due to the presence of 100% oxygen. The decreased carbon dioxide level in the blood leads to a reduced breathing rate.

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B. Returning to normal air after oxygen exposure affects the breathing rate. The rate continued to decrease for 2-3 seconds before increasing. It takes some time for the carbon dioxide level in the blood to increase and for the oxygen level to decrease, resulting ultimately in an increased breathing rate.

C. Increased carbon dioxide gas affects the breathing rate. Breathing rate decreases. More carbon dioxide diffuses into the bloodstream.

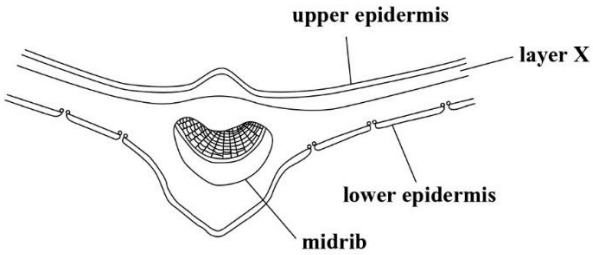
D. Returning to normal air after carbon dioxide exposure causes the breathing rate to increase, and the carbon dioxide level in the blood decreases.

E. Assuming that the respiratory rate of humans is affected in the same way, and a large number of people were confined in a small room for a long period of time, their breathing rates would increase due to an increase in blood carbon dioxide levels.

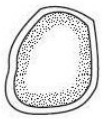
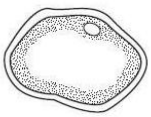
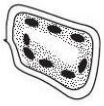
Which of the following is correct? (5 marks)

1. A and B only
2. B and C only
3. B, C, and D only
4. A, B, and E only

31. The diagram shows a cross-section of part of a leaf.

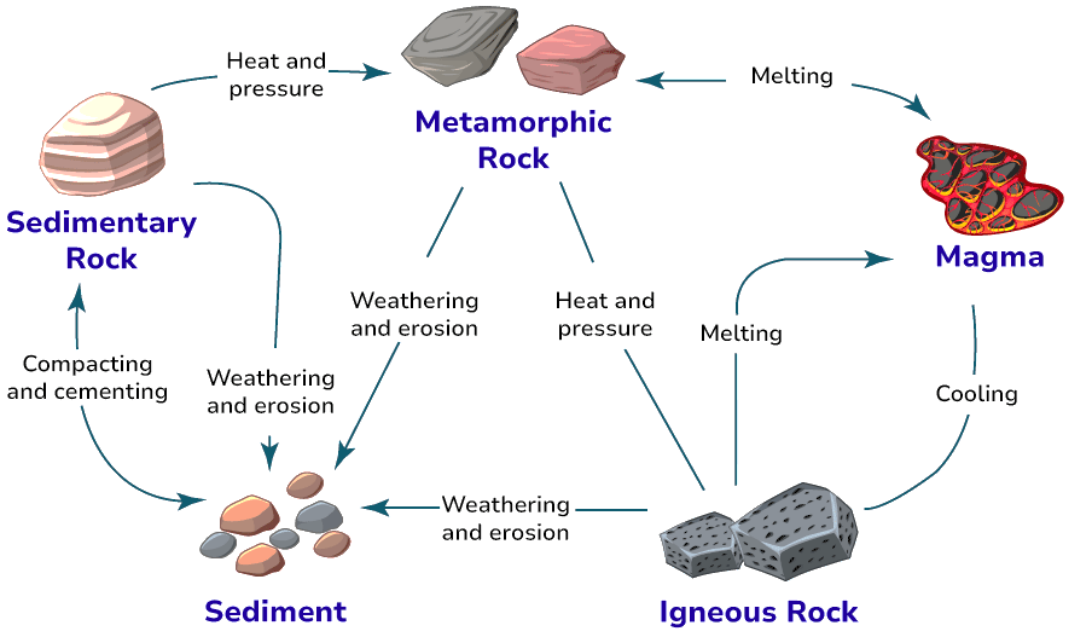


Which type of cell is found in layer X? (1.25 marks)

1. 
2. 
3. 
4. 

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32. The rock cycle diagram shows the relationship between three main types of rocks.



Which of the following geological processes describe how igneous rock can become sedimentary rock? (1.25 marks)

1. Weathering, erosion, and mass wasting.
2. Weathering, erosion, transportation, and tectonic processes.
3. Weathering, erosion, transportation, deposition, and metamorphism.
4. Weathering, erosion, transportation, deposition, compaction, and diagenesis.

33. The wood frog has the amazing ability to survive winter in a frozen state. Ice crystals touching the frog can trigger the freezing of its body fluids. Most of the water moves out of their cells and into body cavities, where it turns into solid ice. Their cells are protected from dehydration and frostbite by the anti - freezing effect of their cells absorbing extremely high concentrations of sugar. When these frogs freeze, they stop breathing, their heart stops beating, and they enter a state of dormancy that can last several months. In spring, the frogs thaw, and the excess sugar moves out of their cells. The frogs resume normal activities in less than 24 hours.

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A wood frog's body systems' responses to ice crystals touching it in winter and to the conditions in the spring can best be explained by (2.5 marks)

1. the differentiation of mature body cells during development
2. a response of their cells to changing environmental conditions
3. the enzymatic breakdown of water as the frog freezes
4. a response of the immune system to excess sugar levels

34. A scientist examines two rock samples:

Sample A : An outcrop of granite found on a rocky shore, known for the rounded granite dome shapes and fractures, or joints, that run parallel to the exposed surface. The rocky shore experiences large temperature fluctuations between day and night.

Sample B : An outcrop of limestone found near a forest cave, with rough surface marked by small pits. The rainfall in this area is slightly acidic due to dissolved carbon dioxide.

Based on the data, which of the following is the most accurate conclusion about the dominant weathering process affecting each rock sample? (2.5 marks)

1. Sample A is influenced by erosion, while Sample B is affected by deposition.
2. Both Sample A and Sample B are primarily affected by biological weathering.
3. Both samples are unaffected by weathering processes in their respective environments.
4. Sample A is primarily affected by mechanical weathering, while Sample B is affected by chemical weathering.

35. If you use water instead of mercury in a barometer, what is the height of the water column when the pressure is 1 atm? (2.5 marks)

1. 9.700 m
2. 9.667 m
3. 10.300 m
4. 10.336 m

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36. A 55-year-old patient, Mr. Henderson, arrives at the emergency room complaining of severe shortness of breath and extreme fatigue, especially after even minimal exertion. Medical tests reveal that his right ventricle is struggling to pump blood effectively. This weakness is significantly impacting the flow of blood to his lungs. Due to this impaired pumping action, blood is backing up in the veins leading to his heart and is not efficiently traveling through the pulmonary arteries. As a result, his blood is not picking up enough oxygen in the lungs before it returns to the left side of his heart and is then pumped out to the rest of his body. This lack of oxygen delivery to his body's tissues is causing his symptoms.

Considering Mr. Henderson's condition and the pathway of blood in the human body, what is the most direct consequence of his right ventricle struggling to pump blood effectively to his lungs on the overall efficiency of oxygen delivery to his body's tissues?
(2.5 marks)

1. Oxygen-rich blood from the left atrium is unable to reach the systemic arteries, leading to a build-up of deoxygenated blood in the brain.
2. Deoxygenated blood accumulates in the pulmonary veins, preventing fresh oxygen from entering the bloodstream from the lungs.
3. The pressure in the vena cava increases, causing less deoxygenated blood to enter the right atrium, thus reducing the amount of oxygenated blood pumped to the body.
4. Deoxygenated blood cannot efficiently move from the right ventricle into the pulmonary arteries, resulting in less oxygenated blood returning to the left atrium and subsequently being pumped to the body.

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37. A student is investigating how glucose concentration, temperature, and pH influence the growth rate of anaerobic bacteria during fermentation. The experiment is designed using five sealed conical flasks (labeled A–E), each containing 100 mL of nutrient broth medium and inoculated with 5 mL of anaerobic bacterial culture (adjusted to OD600 = 0.10 at the start of the experiment).

Each flask is set to a specific combination of glucose concentration, incubation temperature, and pH, as shown in the table below. The student measures optical density (representing the turbidity of bacteria culture or bacteria growth) at 600 nm (OD600) at regular intervals to monitor bacterial growth. The growth rate of the bacteria is inferred as the increase in OD600 for over 10 hours.

All other variables such as flask volume, bacterial strain, nutrient composition, inoculum volume, and measurement intervals are kept constant to ensure a fair test.

Flask	Glucose (%)	Temperature (°C)	pH	Initial OD600	Final OD600 (10 h)
A	1.0	30	6.0	0.10	0.46
B	1.0	37	6.0	0.10	0.67
C	1.0	37	7.0	0.10	0.75
D	3.0	37	7.0	0.10	0.98
E	5.0	37	7.0	0.10	0.85

Which of the following statements about the experiment are correct? (5 marks)

1. The increased bacterial growth observed in Flask C compared to Flask B is solely due to the higher glucose concentration.

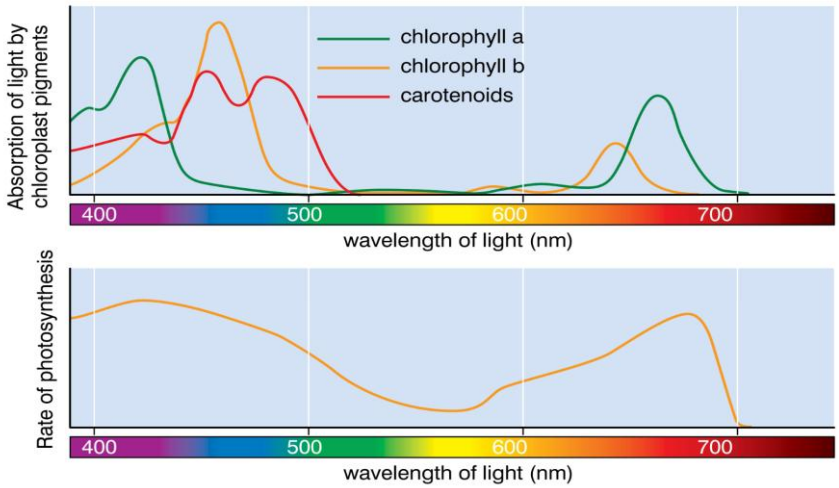
2. The lower final OD600 in Flask E compared to Flask D indicates that 5% glucose is more efficient for bacterial growth than 3% glucose.

3. The only variable affecting the difference between Flask A and Flask B is pH, since both used 1% glucose and had the same initial OD600.

4. Flask D shows the highest bacterial growth, suggesting that both optimal pH and increased glucose concentration positively influenced the fermentation rate.

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38. At GreenTech Academy, Nina is testing how different light wavelengths affect plant growth and photosynthesis. She uses blue (~450 nm), green (~550 nm), and red (~660 nm) LED lights to grow identical plants under controlled conditions—same temperature (22°C), soil, water, nutrients, and light duration (12 hours/day). She then analyzes a scientific graph showing light absorption by chlorophyll a, chlorophyll b, and carotenoids, alongside a photosynthesis rate curve. She identifies which wavelengths are responsible for the highest and lowest photosynthesis rates.



Which of the following statements best reflects the relationship between light wavelength, pigment absorption, and photosynthesis rate as shown in the experiment? (5 marks)

1. Although chlorophyll b shows high absorption in the blue region, the photosynthesis rate remains low in that range, suggesting that pigment absorption does not influence photosynthetic efficiency.

2. The green wavelength (~550 nm) is absorbed strongly by carotenoids, which results in the highest photosynthesis rate under green light conditions.

3. The red and blue regions correspond to the high rate of absorption by chlorophyll a and b and align with peaks in the photosynthesis diagram, indicating that efficient pigment absorption enhances photosynthesis.

4. Since all pigments absorb some light at all wavelengths, there is no wavelength that leads to a significant reduction in the rate of photosynthesis, making all light colors equally effective.

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39. A student is conducting an experiment to investigate how different glucose concentrations affect bacterial fermentation and growth. Among other sugar types, glucose was identified as the most effective sugar for fermentation. In this experiment, the student uses four 250 mL conical flasks (labeled E to H), each containing 100 mL of nutrient broth medium. The glucose concentrations used are 1%, 3%, 5%, and 10% for Flasks E, F, G, and H, respectively. Each flask is inoculated with 5 mL of the same bacterial culture (optical density at 600 nm = 0.6), and the flasks are incubated at a constant temperature of 37°C for two days. All other variables, including flask volume, temperature, bacterial strain, and nutrient medium, are kept constant to ensure a fair test.

After the incubation period, two parameters are measured:

- Gas production (mL): measured using a water displacement method connected to fermentation bungs.
- Turbidity (on a 0–5 scale): a parameter for bacterial growth, evaluated visually or using a spectrophotometer.

The experiment results are shown in the table below.

Flask	Glucose concentration (%)	Gas production (mL)	Turbidity (0-5 scale)
E	1	30	2.5
F	3	60	3.9
G	5	85	5.4
H	10	78	4.5

Which of the following is the most appropriate hypothesis for the experiment on glucose concentration and bacterial fermentation? (5 marks)

1. Increasing glucose concentration will always result in more gas production due to more sugar being available.
2. If the glucose concentration increases, gas production and turbidity will also increase up to a point, after which they may decline due to metabolic limitations.
3. Bacterial fermentation remains consistent regardless of glucose levels, provided that environmental and incubation conditions are uniform.
4. As glucose concentration increases, gas production will steadily decline due to osmotic stress on bacterial cells at higher sugar levels.

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40. A table outlines the atmospheric conditions required for the formation of a typical thunderstorm.

Condition	Description
Moisture	Sufficient water vapor in the lower and middle atmosphere
Instability	Atmosphere cools rapidly with height, allowing warm, moist air to rise
Lifting Mechanism	A trigger that forces air to rise (e.g., strong heating, fronts, mountains)

Based on this data, which of the following scenarios is least likely to result in a thunderstorm? (5 marks)

1. A desert region with very dry air, even during an extremely hot day.
2. A cold front passing through a region with warm, moist air.
3. A hot and humid afternoon in a coastal area, with a strong sea breeze.
4. A warm, humid air mass experiencing a significant temperature decrease at higher altitudes.

---------- End of Questions ----------

Please check your answers before submitting the answer sheet.

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คำตอบวิชาวิทยาศาสตร์ ชั้นมัธยมศึกษาปีที่ 2

ข้อ	คำตอบ	ข้อ	คำตอบ
1	2	21	4
2	3	22	2
3	1	23	3
4	2	24	2
5	3	25	2
6	2	26	3
7	4	27	4
8	4	28	1
9	2	29	3
10	3	30	4
11	4	31	1
12	2	32	4
13	1	33	2
14	2	34	4
15	3	35	4
16	3	36	4
17	2	37	4
18	3	38	3
19	3	39	2
20	3	40	1

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