



UNICUS  
OLYMPIADS

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## Sample Paper



**Class 10**

## Unicus Global Science Olympiad (UGSO)

Time: 60 minutes

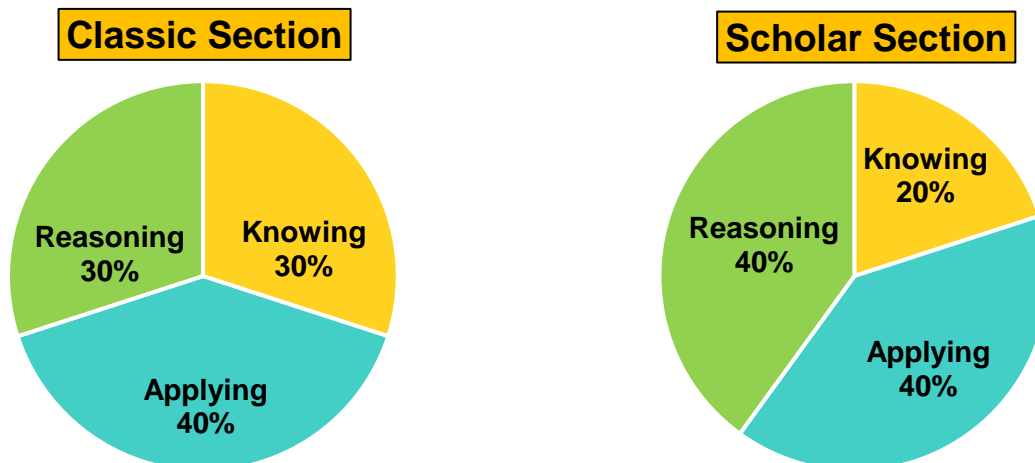
Pattern and Marking Scheme			
Section	Total Questions	Marks per Question	Total Marks
Classic Section	30	1	30
Scholar Section	15	2	30
Grand Total	45		60

## Unicus Global Science Olympiad (UGSO)

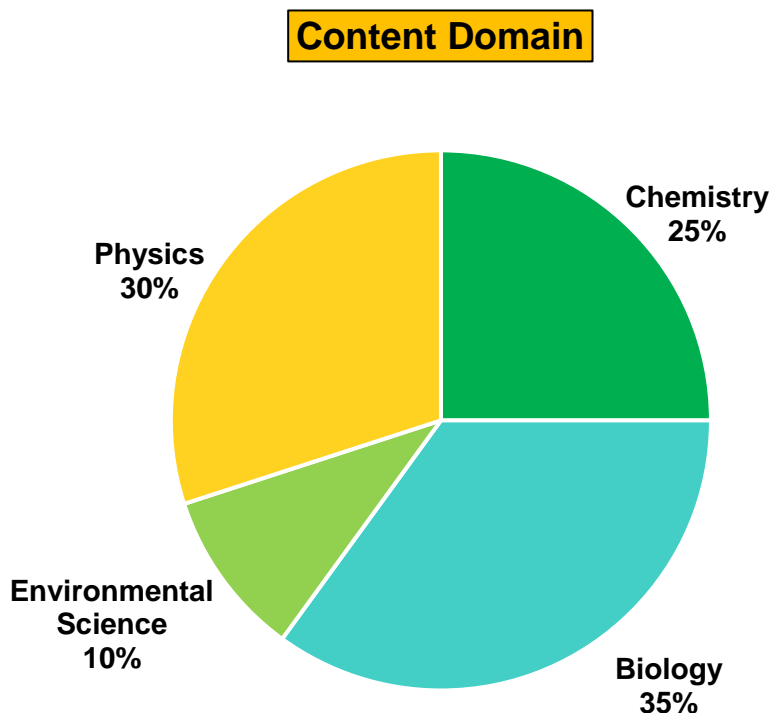
The **Unicus Global Olympiad** is organised around two dimensions:

1. Content dimension, specifying the subject matter domains to be assessed
2. Cognitive dimension, specifying the thinking processes to be assessed

### Target percentages of the question paper devoted to cognitive domains



### Target percentages of the question paper devoted to content domains

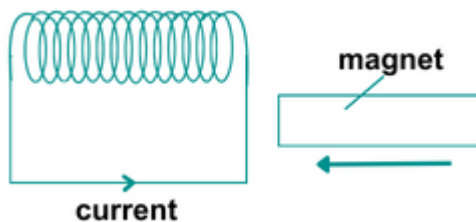


For more details, visit <https://www.unicusolympiads.com/>.



<b>Cognitive Domain: Reasoning</b>	<b>Content Domain: Physics</b>
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4. A magnet is pushed slowly into a coil and there is current in the coil in the direction shown. The magnet is then pulled out quickly from the same end of the coil. What happens to the size and direction of the current?



- |   |  |
|---|--|
| a. Size - Decreased, Current - Reversed | b. Size - Decreased, Current - Unchanged |
| c. Size - Increased, Current - Reversed | d. Size - Increased, Current - Unchanged |

<b>Cognitive Domain: Applying</b>	<b>Content Domain: Physics</b>
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5. In many cold countries, a night storage heater is used to heat up rooms. It contains a large block of material that is heated electrically during the night to store heat in the blocks for use in the day. During the day the block cools down, releasing thermal energy into the room. What heat capacity of the block and what night-time temperature increase will cause the most energy to be stored by the block?



- |  |  |
|--|--|
| a. Heat capacity of the block – Small, Night-time temperature increase - Small | b. Heat capacity of the block – Large, Night-time temperature increase - Small |
| c. Heat capacity of the block – Small, Night-time temperature increase - Large | d. Heat capacity of the block – Large, Night-time temperature increase - Large |

<b>Cognitive Domain: Reasoning</b>	<b>Content Domain: Physics</b>
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6. 30 g of water at 50°C is poured into a vessel containing 60 g of water at 10°C. The final temperature of the mixture is 20°C. Taking the specific heat capacity of water as 4.2 Jg<sup>-1</sup>K<sup>-1</sup>, calculate the heat capacity of the vessel.

- |                         |                         |
|-------------------------|-------------------------|
| a. 126 JK <sup>-1</sup> | b. 306 JK <sup>-1</sup> |
| c. 504 JK <sup>-1</sup> | d. 640 JK <sup>-1</sup> |

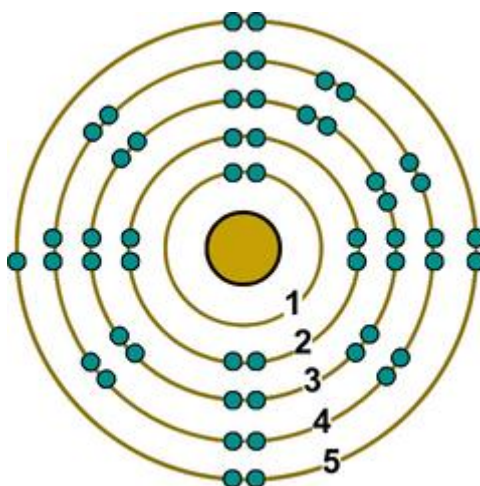


**Unicus Global Science Olympiad (UGSO)**

- a. position 1 - converging, position 2 - converging, position 3 - converging
- b. position 1 - converging, position 2 - converging, position 3 - diverging
- c. position 1 - diverging, position 2 - converging, position 3 - diverging
- d. position 1 - diverging, position 2 - diverging, position 3 - diverging

<b>Cognitive Domain: Knowing</b>	<b>Content Domain: Chemistry</b>
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10. The electron arrangement of an element is shown in the picture below. In which group of the periodic table should this element be placed?



- a. Group 17
- b. Group 14
- c. Group 7
- d. Group 3

<b>Cognitive Domain: Applying</b>	<b>Content Domain: Chemistry</b>
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11. Consider the following diagrams that represent different arrangements of particles. Which diagram best represents a mixture of Group 0 elements?

a.

b.

c.

d.

## Cognitive Domain: Applying

## Content Domain: Chemistry

12. The addition of water to citric acid ( $C_6H_8O_7$ ) and sodium hydrogen carbonate ( $NaHCO_3$ ) results in a reaction that is responsible for the fizz in soda pop. The balanced chemical equation for this reaction is:



A student wants to make their own soda using 20.0 g of citric acid. To ensure all the citric acid reacts, what is the minimum mass of sodium hydrogen carbonate needed?  
(Relative atomic masses: H = 1; C = 12; O = 16; Na = 23)

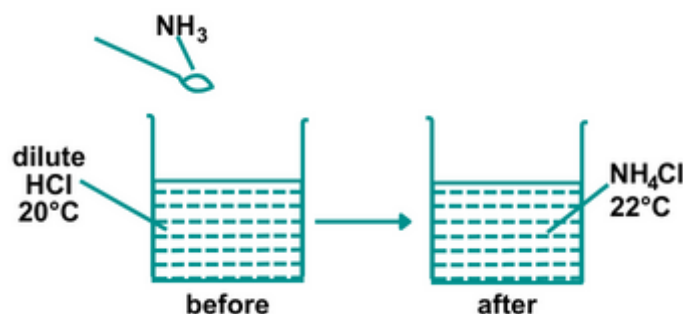
- a. 8.7 g  
b. 26.3 g  
c. 13.1 g  
d. 52.4 g

## Cognitive Domain: Applying

## Content Domain: Chemistry

13. The diagram depicts an experiment where a student mixes two chemicals which results in a chemical reaction. The final solution contains ammonium chloride ( $NH_4Cl$ ). Identify the type of reaction that occurred during the experiment.

- A. Endothermic  
B. Neutralisation  
C. Exothermic

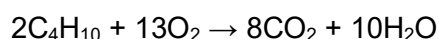


- a. B only  
b. A and B only  
c. B and C only  
d. C only

## Cognitive Domain: Reasoning

## Content Domain: Chemistry

14. You are designing a portable camping stove that uses butane fuel canisters. When butane ( $CH_4H_{10}$ ) from the fuel canister reacts with oxygen ( $O_2$ ) in the air, a significant amount of heat is produced. This heat transfer is classified as an exothermic process.



Which of the following statements best explains why burning methane is an exothermic reaction?

- A. The energy escapes the reaction and can potentially be measured as a temperature rise in the surroundings.

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- B. The reaction only occurs at high temperatures.
- C. The reactants have weaker bonds than the products.

- a. A only
- b. A and B only
- c. A and C only
- d. A, B and C

**Cognitive Domain: Knowing**

**Content Domain: Chemistry**

15. Esters are a class of organic compounds. Which of the following combinations of functional groups is most likely to result in the formation of an ester?

- a. Aldehyde - Ketone
- b. Carboxylic acid - Alkene
- c. Cycloalkane - Alcohol
- d. Carboxylic acid - Hydroxyl

**Cognitive Domain: Reasoning**

**Content Domain: Chemistry**

16. The table below provides information on the amount of energy released when one mole of various alkanes is burned.

Given the data, analyse the relationship between the number of carbon atoms in the alkane molecule and the amount of energy released when one mole of the alkane is burned. Which of the following statements is true?

- A. The energy released reflects the higher number of C-H bonds available for combustion.
- B. As molecular complexity increases, so does the potential energy released from combustion reactions.
- C. The linear relationship suggests that all CH<sub>2</sub> groups contribute equally to the total energy released.

Name of Alkane	Energy Released (kJ)
Methane	890
Ethane	1560
Propane	2220
Butane	2877
Pentane	3500

- a. A only
- b. A and B only
- c. B and C only
- d. A, B and C

**Cognitive Domain: Knowing**

**Content Domain: Chemistry**

17. Different metals require different extraction methods due to their reactivity. Match the following metals with the most extraction process for each.

	Column I		Column II
1.	Mg	A.	Heating the ore
2.	Fe	B.	Electrolysis
3.	Hg	C.	Reacting with Carbon



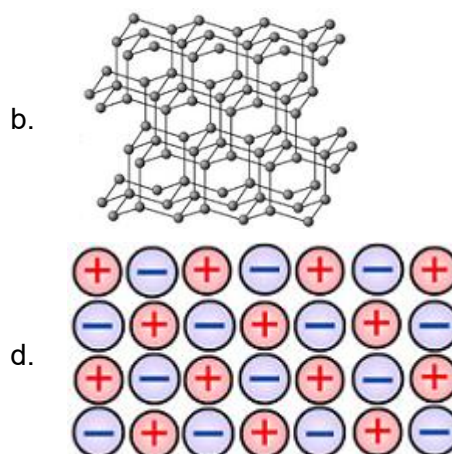
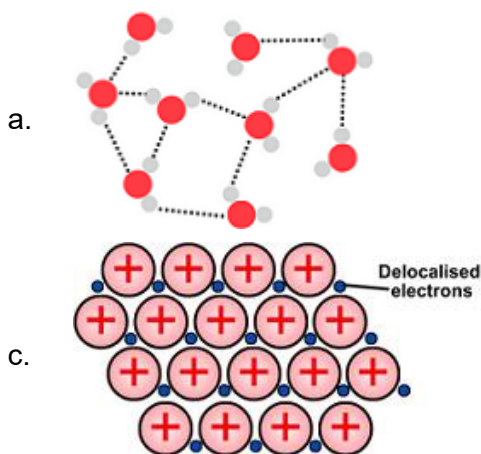
- a. 1:B, 2:A, 3:C  
c. 1:C, 2:A, 3:B

- b. 1:B, 2:C, 3:A  
d. 1:A, 2:B, 3:C

**Cognitive Domain: Applying**

**Content Domain: Chemistry**

18. Metals are known for their unique properties like conductivity and ductility. These properties are related to their specific bonding structure. Which of the following diagrams represents the structure of a metal at the atomic level?



**Cognitive Domain: Applying**

**Content Domain: Biology**

19. Scientists are studying a population of yeast cells used for bread production. They discover a mutation in a protein essential for repairing DNA damage during cell division. How might this mutation affect the offspring of these yeast cells?

- a. The offspring will have more chromosomes than usual.  
b. The offspring will be more likely to reproduce asexually.  
c. The offspring will grow at a slower rate.  
d. The offspring may have genetic abnormalities.

**Cognitive Domain: Applying**

**Content Domain: Biology**

20. A pea plant can have either smooth or wrinkled seeds. This trait is controlled by a single gene that has two different alleles. You are examining the pea plant's DNA for this gene. Which of the following statement(s) is correct about these two alleles?

- A. They control the same trait.  
B. They control different traits  
C. They occupy same position on the chromosome.  
D. They occupy different positions on the chromosome.
- a. A and D only  
b. A and C only  
c. B and C only  
d. B and D only

**Cognitive Domain: Knowing**

**Content Domain: Biology**

21. Birds, unlike mammals, lack sweat glands. However, they can still regulate their body temperature. Given the role of the excretory system in osmoregulation, how might birds be able to expel excess heat and water without sweating?
- They excrete a large amount of watery urine to cool their bodies.
  - They excrete excess salts through specialised glands near their beak.
  - They produce highly concentrated uric acid waste, minimising water loss.
  - They eliminate excess water and heat through rapid panting and respiration.

**Cognitive Domain: Applying**

**Content Domain: Biology**

22. Xylem is a plant tissue responsible for transporting water and dissolved minerals from the roots to the leaves. Certain features of xylem vessels make them particularly well-suited for this function, such as:

- No end walls in individual xylem elements
- Lignified walls

Select the option that explains how these features adapt xylem vessels for their function of transporting water from roots to leaves.

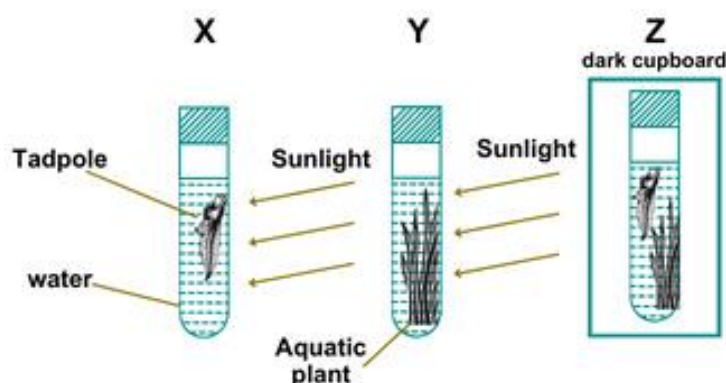
- A: allow continuous water flow, B: prevents vessels from collapsing inwards
- A: allow continuous water flow, B: prevent water loss from the xylem
- A: allow water storage, B: allow water to move into and out of them
- A: allow water storage, B: make vessels waterproof, preventing water loss

**Cognitive Domain: Reasoning**

**Content Domain: Biology**

23. An experiment is set up with tadpoles and aquatic plants as shown in the illustration below. Each tube starts with the same amount of water and the same concentration of dissolved carbon dioxide and oxygen. Tubes X and Y are placed in sunlight for one hour, while tube Z is placed in darkness for one hour. After one hour, the concentration of dissolved carbon dioxide is measured in each test tube. After one hour, the concentration of dissolved carbon dioxide and oxygen is measured in each test tube.

Based on your understanding, which of the following most accurately predicts the concentration of gases in each test tube after one hour?



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- a. **Test tube X** - CO<sub>2</sub>: decreases O<sub>2</sub>: decreases, **Test tube Y** - CO<sub>2</sub>: decreases O<sub>2</sub>: increases, **Test tube Z** - CO<sub>2</sub>: remains same O<sub>2</sub>: decreases
- b. **Test tube X** - CO<sub>2</sub>: increases O<sub>2</sub>: decreases, **Test tube Y** - CO<sub>2</sub>: decreases O<sub>2</sub>: increases, **Test tube Z** - CO<sub>2</sub>: increases O<sub>2</sub>: decreases
- c. **Test tube X** - CO<sub>2</sub>: increases O<sub>2</sub>: decreases, **Test tube Y** - CO<sub>2</sub>: decreases O<sub>2</sub>: decreases, **Test tube Z** - CO<sub>2</sub>: remains same O<sub>2</sub>: remains same
- d. **Test tube X** - CO<sub>2</sub>: increases O<sub>2</sub>: decreases, **Test tube Y** - CO<sub>2</sub>: increases O<sub>2</sub>: decreases, **Test tube Z** - CO<sub>2</sub>: decreases O<sub>2</sub>: increases

**Cognitive Domain: Knowing**

**Content Domain: Biology**

24. In an experiment, a potted plant is placed on its side. After several days, the roots exhibit positive gravitropism. Which hormone is primarily responsible for this response?
- a. Gibberellin  
b. Ethylene  
c. Auxin  
d. Abscisic acid

**Cognitive Domain: Applying**

**Content Domain: Biology**

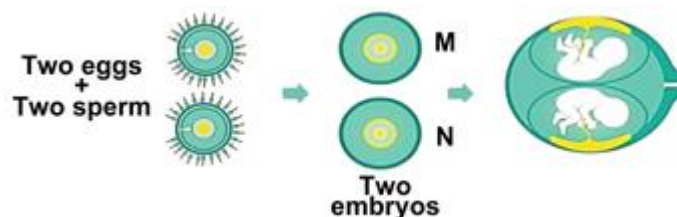
25. You're on a camping trip and get lost in the forest. As night falls, the temperature drops significantly. You start to shiver uncontrollably. This helps maintain your body temperature. Which of the following system(s) in your body is/are responsible for this shivering response?
- A. Endocrine system, releasing hormones to generate heat.  
B. Peripheral nervous system, detecting the cold and sending signals to muscles.  
C. Central nervous system, interpreting the temperature change and initiating shivering.
- a. A and B only  
b. C only  
c. B and C only  
d. A, B and C

**Cognitive Domain: Reasoning**

**Content Domain: Biology**

26. A woman gave birth to a pair of twins, M and N. The diagram below shows their formation. Considering their genetic and environmental background, which of the following characteristics of M and N are not likely to be the same?

- A. Genetic information  
B. Sex  
C. Blood type  
D. Height



- a. A and B only  
b. C and D only  
c. D only  
d. A, B, C and D

<b>Cognitive Domain: Knowing</b>	<b>Content Domain: Biology</b>
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27. Bacteria are constantly evolving. Some strains develop resistance to antibiotics, making them difficult to treat with those medications. Doctors are looking for ways to slow the emergence of antibiotic-resistant bacteria.

According to the principles of natural selection, how might regularly changing the type of antibiotic prescribed for a particular bacterial infection MOST LIKELY decrease the chances of an antibiotic-resistant strain developing?

- a. It allows doctors to target the specific weaknesses of a particular bacterial strain.
- b. It weakens all existing bacterial strains, making them less likely to mutate.
- c. It exposes bacteria to a wider range of antibiotics, making them less likely to develop resistance to any one type.
- d. It strengthens the immune system, making it better equipped to fight off any resistant bacteria.

<b>Cognitive Domain: Knowing</b>	<b>Content Domain: Environmental Science</b>
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28. A team of researchers discovers a unique deep-sea hydrothermal vent ecosystem teeming with life. Unlike most ecosystems where sunlight fuels the base, these vents rely on chemosynthetic bacteria. How might an ecological pyramid depicting the biomass at each level differ in this ecosystem compared to a sunlit one?

- a. The pyramid will lack photosynthetic biomass altogether.
- b. The pyramid will be inverted with the most biomass at the top.
- c. The pyramid will be wider at the base compared to a sunlit ecosystem.
- d. There will be no difference; pyramids always look the same.

<b>Cognitive Domain: Applying</b>	<b>Content Domain: Environmental Science</b>
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29. Weathering is the process by which rocks are broken down into smaller fragments or dissolved by various agents. Based on the following descriptions of weathering processes identify the type of weathering involved.

- 1. Minerals within a rock expand at different rates when heated, causing the rock to crumble.
- 2. Carbonic acid in rain reacts with limestone rock to produce calcium bicarbonate, which is highly soluble.
- 3. Tree roots grow into cracks and over time are capable of splitting rocks apart.

	1	2	3
A.	Physical	Physical	Biological
B.	Chemical	Physical	Biological
C.	Physical	Chemical	Biological
D.	Chemical	Chemical	Physical

- a. A
- b. B
- c. C
- d. D

**Cognitive Domain: Reasoning**

**Content Domain: Environmental Science**

30. In an effort to protect waterways, some farmers are using less chemical fertilisers. These fertilisers help crops grow more, but too much fertiliser can end up in rivers, harming the environment. Order the following statements to reveal the sequence of events leading to river pollution by excess fertiliser:

- A. Spreading algae prevents sunlight from reaching plants on the riverbed.
- B. Oxygen levels decrease, causing fish to die.
- C. Fertilisers cause an increase in algae.
- D. Plants then die and are decomposed by bacteria.
- E. Excess fertiliser gets into waterways.

- a. ECDAB
- c. ECADB

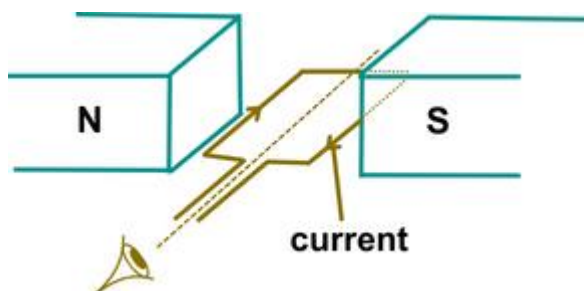
- b. ECDBA
- d. ECBAD

### Scholar Section (Each Question is 2 Marks)

**Cognitive Domain: Applying**

**Content Domain: Physics**

31. The diagram shows a pivoted coil held between the two poles of a magnet. The pivoted coil carries a steady current in the direction shown. When the coil is released, it rotates and then stops at an angle  $\theta$  to its initial position. When viewed as shown, in which direction does the coil rotate and what is the value of  $\theta$ ?



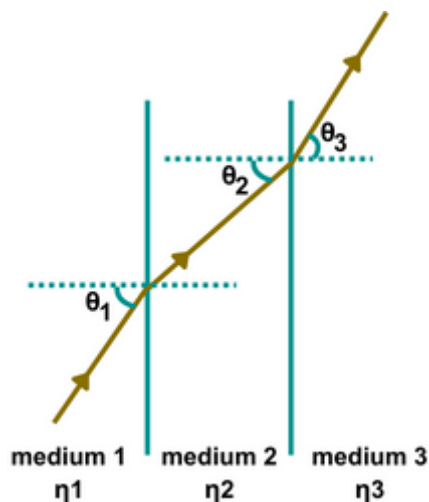
- a. Direction - Anticlockwise,  $\theta - 90^\circ$
- c. Direction - Clockwise,  $\theta - 90^\circ$

- b. Direction - Anticlockwise,  $\theta - 180^\circ$
- d. Direction - Clockwise,  $\theta - 180^\circ$

**Cognitive Domain: Reasoning**

**Content Domain: Physics**

32. A light ray passes through three media of refractive indices  $\eta_1$ ,  $\eta_2$  and  $\eta_3$  respectively. Given that  $\theta_1 > \theta_3 > \theta_2$ , which of the following is correct?



- a.  $\eta_1 > \eta_2 > \eta_3$   
 b.  $\eta_2 > \eta_1 > \eta_3$   
 c.  $\eta_1 > \eta_3 > \eta_2$   
 d.  $\eta_2 > \eta_3 > \eta_1$

**Cognitive Domain: Applying**

**Content Domain: Chemistry**

33. You have a beaker containing an alkaline solution. Which of the following would happen when you add pure water to it?

- A. Concentration of  $\text{OH}^-$  ions increases  
 B. Concentration of  $\text{OH}^-$  ions decreases  
 C. Number of  $\text{OH}^-$  remains the same  
 D. pH increases  
 E. pH decreases  
 F. pH remains the same
- a. A and D only  
 b. B and E only  
 c. B, C and E only  
 d. C and F only

**Cognitive Domain: Reasoning**

**Content Domain: Chemistry**

34. You are a chemist working in a laboratory. You take a small amount of solid sodium chloride ( $\text{NaCl}$ ) in a clean and dry test tube and carefully add some concentrated sulfuric acid ( $\text{H}_2\text{SO}_4$ ). The reaction produces a gas. You want to determine whether the gas produced is acidic or basic using different litmus paper. You hold each of them near the opening of the test tube where the gas is escaping as shown in the figure below. Which of the following observations would most likely indicate the nature of the gas?

- a. A  
 b. B  
 c. C  
 d. D

**Cognitive Domain: Knowing**

**Content Domain: Chemistry**

35. A chemist analyses a sample of a silicate mineral which consists of silicon, oxygen, and aluminium. The mass percentages are found to be 28.3% silicon, 46.6% oxygen, and 25.1%



<b>Cognitive Domain: Applying</b>	<b>Content Domain: Biology</b>
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38. The table below shows the number of chromosomes in different cell types of a plant species. Which of the following statements is most likely true?

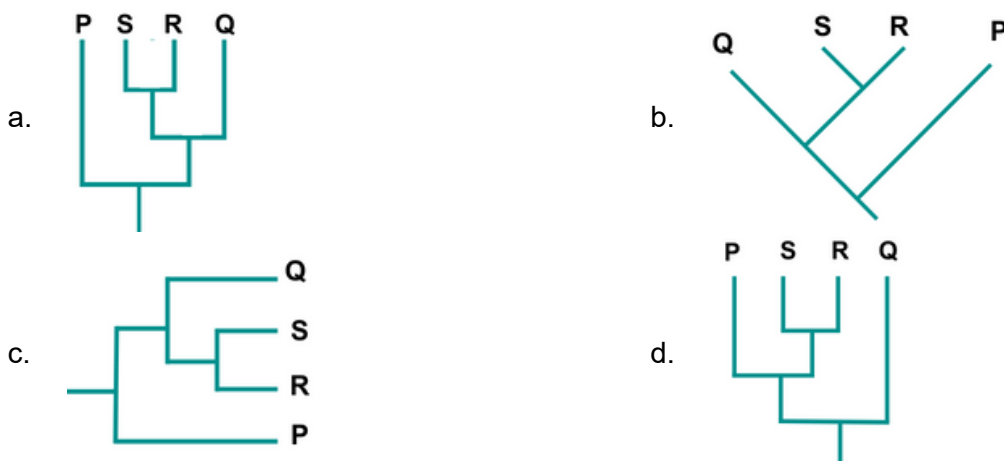
Cell Type	Root Cell	Pollen Grain	Ovule
<b>Number of Chromosomes</b>	10	5	5

- a. This plant species can produce a diploid zygote.
- b. This plant species reproduces asexually.
- c. This plant species has a haploid number of chromosomes equal to 5.
- d. Fertilisation in this plant results in offspring with 20 chromosomes.

<b>Cognitive Domain: Applying</b>	<b>Content Domain: Biology</b>
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39. A student is examining several evolutionary trees depicting the relationships between species P, Q, R, and S. They know that one of the trees is incorrect and doesn't accurately represent the evolutionary history of these species.

Based on your understanding, identify the odd one out from the following trees.



**Direction (for questions 40 to 42):** Carefully read through the passage and answer the following questions.

You are helping to move a 3000 N refrigerator into a house, and you decide to use a ramp to make the task easier. The ramp is 5.0 m long, and the entrance to the house is 1.0 m above the ground. To understand how much easier the ramp makes your task, you need to calculate the ideal mechanical advantage (IMA) of the ramp.

The mechanical advantage is a measure of how much a machine, like your ramp, multiplies the force you apply. It is a way to quantify the reduction in effort needed to lift or move an object

By using the ramp, you distribute the required lifting force over a longer distance, making it possible to move the heavy refrigerator with much less effort. This principle is why ramps, levers, pulleys, and other simple machines are so useful in everyday tasks. They allow us to perform tasks that would otherwise require much more force.





Pollutant	Emission Rate (kg per MWh)
CO <sub>2</sub>	900
SO <sub>2</sub>	4
NO <sub>x</sub>	2

**Cognitive Domain: Knowing**

**Content Domain: Environmental Science**

43. Which of the following best explains the environmental impact of sulphur dioxide and nitrogen oxides as outlined in the passage?
- They lead to acid rain and smog, which harm ecosystems and human health.
  - They contribute to the depletion of the ozone layer.
  - They are primarily responsible for the thermal inversion in urban areas.
  - They increase the albedo of the atmosphere, leading to global cooling.

**Cognitive Domain: Applying**

**Content Domain: Environmental Science**

44. Analyse how the introduction of hazardous chemicals into aquatic ecosystems during mining alters the food web and nutrient cycles. What are the potential cascading effects on terrestrial ecosystems?
- Disruption of aquatic food webs leads to reduced fish populations only, impacting animals reliant on these fish for food
  - Increased nutrients may lead to algal blooms, which can decrease oxygen levels and affect both aquatic and nearby terrestrial ecosystems
  - Chemical pollutants primarily affect only aquatic species, with minimal impact on terrestrial ecosystems
  - Enhanced growth of aquatic plants due to increased nutrients, improving the overall health of the ecosystem

**Cognitive Domain: Reasoning**

**Content Domain: Environmental Science**

45. If a coal-fired power plant operates at full capacity, generating 1000 MWh of energy, how much CO<sub>2</sub> would it emit? What does this data imply about the scale of pollution from a single plant in a day?
- 900 kg of CO<sub>2</sub>; indicates minimal environmental impact
  - 9,000 kg of CO<sub>2</sub>; suggests unmanageable pollution levels
  - 90,000 kg of CO<sub>2</sub>; implies significant contribution to air pollution
  - 900,000 kg of CO<sub>2</sub>; implies a critical level of pollution

## Answer Key

1.	c	2.	c	3.	a	4.	c	5.	d	6.	a	7.	a
8.	d	9.	b	10.	a	11.	b	12.	b	13.	c	14.	c
15.	d	16.	b	17.	b	18.	c	19.	d	20.	b	21.	d
22.	a	23.	b	24.	c	25.	c	26.	d	27.	c	28.	a
29.	c	30.	c	31.	a	32.	d	33.	c	34.	d	35.	a
36.	a	37.	c	38.	a	39.	d	40.	d	41.	c	42.	b
43.	a	44.	b	45.	c								