Use the information below to answer the question:

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

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

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

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

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

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

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

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

Acceleration due to gravity = 10 m/s^2.

Atmospheric pressure = 10^5 Pa.

The speed of sound in the air at 0 ℃ = 331 m/s.

The Coulomb constant (k) in the air or vacuum = 9×10^9 $N \cdot m^2/C^2$.

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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.

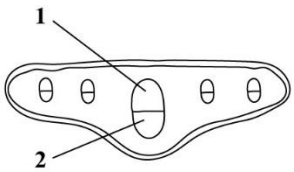
1. What is the main advantage of using the tissue culture technique compared to natural methods of asexual reproduction? (1.25 marks)

1. Meristem tissue can be made disease-free.
2. Meristem tissue is the most abundant tissue found in plants.
3. This technique produces clones with specific traits and is relatively inexpensive.
4. Other culture techniques are not as widely accepted as this technique.

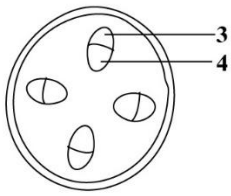
2. Plants reproduce through an alternation of generations, in which the_____ cells produce gametes that combine to form a new _____. (1.25 marks)

1. sporophyte; gametophyte
2. gametophyte; sporophyte
3. gametophyte; flowers
4. flower; gametophyte

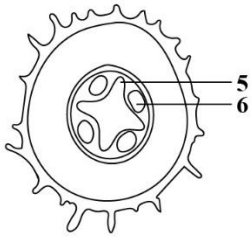
3. The roots of a plant were placed in a coloured dye. The diagrams below show the transverse sections of its leaf, stem, and root after one day.



leaf



stem



root

Which of the numbered tissues of the leaf, stem, and root would be most heavily stained by the dye? (1.25 marks)

1. 1, 3, 5
2. 1, 3, 6
3. 1, 4, 5
4. 2, 3, 6

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4. The light-dependent reactions of photosynthesis are said to be similar to a battery because they generate an electron flow. In which direction do the electrons move in this light-dependent reaction? (1.25 marks)

1. H_2O → PSII → electron transport chain → PSI → electron transport chain → NADPH
2. H_2O → PSII → chlorophyll b → PSI → chlorophyll a → NADPH
3. NADPH → PSII → electron transport chain → PSI → electron transport chain → $NADP^+$
4. $NADP^+$ → PSII → electron transport chain → PSI → electron transport chain → NADPH

5. A 3.60-m-long string, fixed at both ends, has a mass of 4.00 g. If you want to set up a standing wave on this string with a frequency of 300Hz Hz and four nodes, what tension should be applied to the string? (1.25 marks)

1. 324 N
2. 576 N
3. 1,296 N
4. 5,184 N

6. How does ATP synthase obtain energy to produce ATP in the process of photosynthesis? (1.25 marks)

1. Hydrogen ions flow down the concentration gradient from the thylakoid space to the stroma through ATP synthase, releasing energy that can be used to produce ATP from ADP + Pi.
2. Water splits, releasing electrons that flow from the stroma to the thylakoid space and bind to the active site of ATP synthase.
3. Electrons from the reaction center of photosystem II are funneled to ATP synthase, which uses the energy to produce ATP from ADP + Pi.
4. Hydrogen ions in the thylakoid space combine with electrons from the stroma at ATP synthase, releasing energy that can be used to produce ATP from ADP + Pi.

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7. A population of bacteria is in Hardy-Weinberg equilibrium. However, through repeated exposure to an antibiotic, the frequency of the recessive allele is rapidly increasing. What is the most likely explanation for this response? (1.25 marks)

1. The recessive allele is responsible for the susceptibility of the bacteria to the antibiotic.
2. The dominant allele is responsible for the susceptibility of the bacteria to the antibiotic.
3. The recessive allele is responsible for the bacterial resistance to the antibiotic.
4. The dominant allele is responsible for the bacterial resistance to the antibiotic.

8. Which of the following statements is incorrect? (1.25 marks)

A. $_{24}Cr$ has the electron configuration: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^4$

B. The spectral lines of the Lyman series emit photons in the ultraviolet region.

C. Transition elements have similar first ionization energies because they have the same principal energy level.

D. Atoms of $^{40}_{18}\mathrm{Q}$ and $^{40}_{20}\mathrm{W}^{2+}$ have the same number of electrons and are therefore isobars.

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

9. Ruby, Blue Sapphire, Yellow Sapphire, and Green Sapphire are varieties of corundum, which is a hard, crystalline form of aluminum oxide (Al_2O_3) commonly used as gemstones. Corundum has a hardness of 9 on the Mohs scale, a specific gravity of 3.9 – 4.0, and its diaphaneity ranges from transparent to translucent. It has an adamantine to vitreous luster, and a trigonal crystal system. Due to its hardness, its streak cannot be tested using a streak plate. Which physical properties make the 4 gemstones different and why? (1.25 marks)

1. Color varies due to different impurities.
2. Streak varies because each type of gemstone has a different streak.
3. Streak varies because each type of gemstone has a different major element.
4. Color varies due to different refractions of light within the crystal.

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10. A ball is thrown vertically upward. At which point does the ball have the highest energy, assuming there is no air resistance? (1.25 marks)

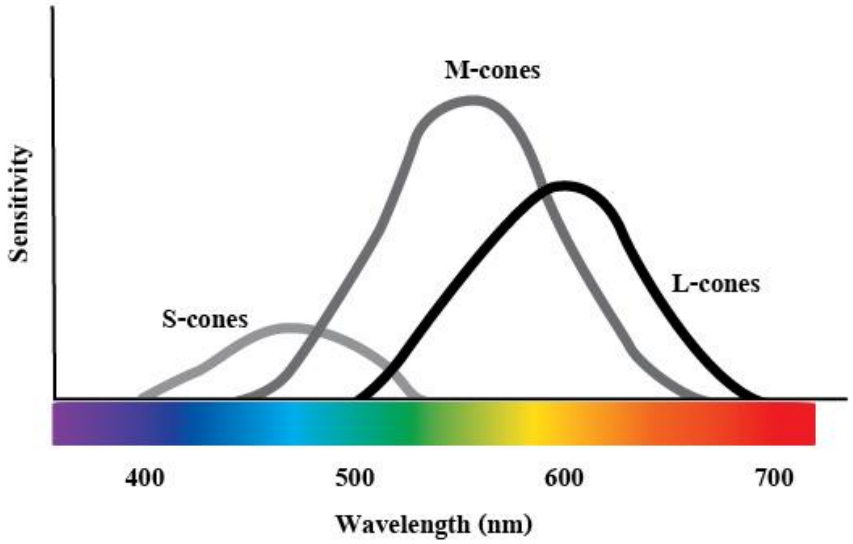
1. At the highest point of the throw.
2. At the point where the ball leaves the hand.
3. When the ball is halfway to the highest point of its path.
4. Everywhere - the energy of the ball is the same at all of these points.

11. A bat at rest emits ultrasonic sound waves at 36.0 kHz and receives the echoes reflected from an object moving directly away at 20 m/s. If the air temperature is 15°C, what is the frequency of the received sound? (1.25 marks)

1. 32.0 kHz
2. 33.9 kHz
3. 36.0 kHz
4. 38.3 kHz

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12. Considering the response patterns of each type of cone cell to different wavelengths of light



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

A. A malfunction of the L-cone cells would cause that person to perceive red objects as black.

B. If light with a wavelength of 600 nm strikes the retina, all three types of cone cells will respond equally

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

13. A car traveling at a velocity v can stop in a minimum distance d. What would the car's minimum stopping distance be if it were traveling at a velocity of 2v? (1.25 marks)

1. d
2. $\sqrt{2}$d
3. 2d
4. 4d

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14. Consider the following statements about the behavior and properties of gases:

A. Under the same conditions, 1 mol of H_2 gas and 1 mol of O_2 gas contain the same number of molecules.

B. If the temperature of a gas in a closed container increases while volume remains constant, the pressure increases according to Gay-Lussac's law.

C. At constant pressure, if the temperature of a gas doubles, its volume also doubles according to Charles's law.

D. An ideal gas sample of 0.50 mol at 273 K and 1 atm occupies approximately 11.2 dm^3.

Which of the statements are correct? (1.25 marks)

1. Statements A and B
2. Statements A, B, and C
3. All statements are correct
4. None of the statements are correct

15. There is an antibiotic called streptomycin that doctors often prescribe to treat infections. This antibiotic combines with the bacterial ribosomes, causing them to lose their normal function. Consequently, the bacterial cell dies, and the patient's condition improves. In other words, the antibiotic destroys bacteria by _____ (2.5 marks)

1. Inhibits all chemical synthesis in the bacteria.
2. Prevents bacteria from synthesizing new cell envelope materials.
3. Inhibits the production of ATP in the bacteria.
4. Prevents the bacteria from synthesizing proteins.

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16. A rare genetic disorder, "Cytosis X," has been identified in a small population. Research indicates that individuals with Cytosis X have a specific mutation in a gene encoding for a critical transmembrane protein, let's call it "Receptor Y." This Receptor Y is normally synthesized on the rough endoplasmic reticulum (RER) and subsequently transported through the Golgi apparatus to the plasma membrane, where it plays a vital role in cell-to-cell communication and nutrient uptake. The mutation in Cytosis X causes Receptor Y to be severely misfolded immediately after its synthesis in the RER.

Considering the intricate and interconnected functions of eukaryotic cell organelles and their quality control mechanisms, which of the following statements best describes the most probable and direct sequence of events or cellular responses occurring within a cell affected by this mutation? (2.5 marks)

1. The misfolded Receptor Y will be immediately packaged into transport vesicles from the RER and sent to the Golgi apparatus, where it will be further modified but ultimately fail to reach the plasma membrane due to its abnormal structure.

2. The accumulation of misfolded Receptor Y within the RER will trigger the Unfolded Protein Response (UPR), leading to an initial increase in chaperone protein production and a reduction in overall protein synthesis to alleviate ER stress.

3. Due to the inability of the cell to properly synthesize Receptor Y, the lysosomes will significantly increase their production of digestive enzymes to compensate for the reduced nutrient uptake, thereby maintaining cellular energy levels.

4. The severely misfolded Receptor Y will bypass the RER quality control system and be directly transported to the cytoplasm for degradation by cytoplasmic proteasomes, without entering the endomembrane pathway.

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The following information is provided for answering questions 17-18.

ASMOPSS Engineering Co., Ltd. is a materials engineering company currently developing a "special lightweight alloy" for the body structure of a new electric vehicle model. The aim is to reduce overall weight and enhance vehicle efficiency. The alloy is composed primarily of three metals: Aluminum (Al), Magnesium (Mg), and Zinc (Zn).

During the material design process, engineers must consider the atomic structure and chemical bonding of these metals, along with their atomic radii and first ionization energies, as these factors influence the strength and weight of the alloy.

Properties	Aluminum (Al)	Magnesium (Mg)	Zinc (Zn)
Atomic Number	13	12	30
Atomic Radius	??? pm	??? pm	??? pm
First Ionization Energy, IE_1	??? kJ/mol	??? kJ/mol	??? kJ/mol
Density	2.70 g/cm³	1.74 g/cm³	7.13 g/cm³
Melting Point	660 °C	650 °C	420 °C
Boiling Point	2,470 °C	1,090 °C	907 °C
Color	Silvery-white)	Silvery-white	Bluish-white
Electricity	Good	Semi	Good

This alloy will be processed by cold rolling, during which the atomic arrangement and the characteristics of metallic bonding influence its ductility and strength.

17. Consider the following statements regarding bonding in light metal alloys:

A. The metallic bond in special lightweight alloy is formed by the sharing of outermost electrons, which are free to move among the positive ions within the alloy's crystal structure.

B. Covalent bonds form between aluminum and zinc in the alloy.

C. The alloy is expected to conduct electricity well due to the presence of freely moving electrons.

D. The presence of hydrogen bonds in the alloy increases its flexibility during the cold rolling process.

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Which statement is correct? (2.5 marks)

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

18. Consider the following statements about the atomic properties of metal in an alloy

A. Zinc has the smallest atomic radius among the three metals.

B. Magnesium has the highest first ionization energy among the three metals.

C. Aluminum has the highest first ionization energy than that of zinc but smaller than that of magnesium.

D. The order of first ionization energy is: Zn > Mg > Al

Which statement is correct? (2.5 marks)

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

19. A door that is 1.00 m wide and 2.00 m high weighs 180 N and is supported by two hinges – one located 0.25 m from the top and the other 0.25 m from the bottom. Each hinge supports half of the door's total weight. Assuming that the door's center of gravity is at its center, find the horizontal components of forces exerted on the door by each hinge. (2.5 marks)

1. Upper hinge 40 N and lower hinge 50 N
2. Upper hinge 40 N and lower hinge 80 N
3. Upper hinge 45 N and lower hinge 45 N
4. Upper hinge 60 N and lower hinge 60 N

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20. A student conducts a reaction by mixing 75.0 cm^3 of sulfuric acid (H_2SO_4) solution with a concentration 0.80 mol/dm^3 and 5.04 g of sodium hydrogen carbonate ($NaHCO_3$) powder in a sealed flask. The reaction proceeds as follows:

$$2NaHCO_3\ (s) + H_2SO_4\ (aq) \longrightarrow Na_2SO_4\ (aq) + 2CO_2\ (g) + 2H_2O\ (l)$$

Assume the reaction goes to completion, and all CO_2 gas is collected at room temperature (25 °C) and 1 atm pressure.

Given : Molecular mass of $NaHCO_3$ = 84.0 g/mol

Universal gas constant (R) = 0.0821 L·atm/mol·K

What is the volume of CO_2 gas produced (in cm^3) and which substance is the limiting reactant? (2.5 marks)

1. 1400 cm^3, $NaHCO_3$ is limiting reactant
2. 2800 cm^3, $NaHCO_3$ is limiting reactant
3. 1400 cm^3, H_2SO_4 is limiting reactant
4. 2800 cm^3, H_2SO_4 is limiting reactant

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21. Environmental researchers conducted a study to assess the concentration of arsenic (As) in the Citarum River located in West Java province, which may affect the health of local residents. In this experiment, water samples were collected three times from the same location along the Citarum River three times. Each sample consisted of 1,000 milliliters of water and was brought back to the laboratory for analysis.

The analysis results showed the levels of arsenic detected in each water sample as shown in the table below:

Sampling (Day)	Amount of Arsenic (g)
1	1.25×10^{-5}
4	1.53×10^{-5}
7	1.18×10^{-5}

Calculate the concentration of arsenic in the Citarum River water samples in ppm. According to WHO standards, the concentration of arsenic in water should not exceed 0.013 ppm. Based on the results, does the arsenic level in these samples exceed the standard?

(2.5 marks)

1. 0.0120 – below the WHO standard
2. 0.0126 – below the WHO standard
3. 0.0132 – over the WHO standard
4. 0.0138 – over the WHO standard

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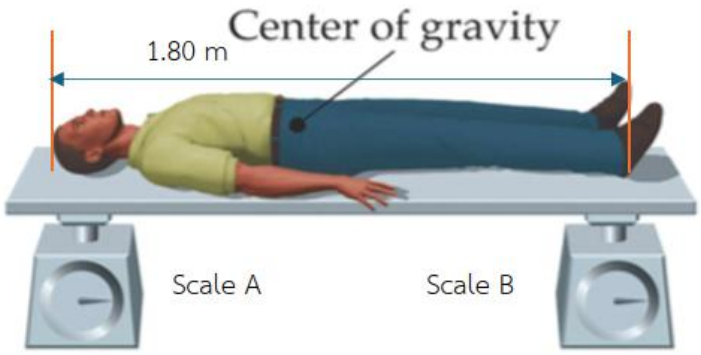
22. A ball is tossed from an upper-story window of a building, 9 m above the ground. It is given an initial velocity of 15 m/s at an angle of 37° above the horizontal.
How long does it take for the ball to strike the ground? (2.5 marks)

1. 1.0 s
2. 1.6 s
3. 2.8 s
4. 3.0 s

23. A bat strikes a 0.125-kg ball. Just before impact, the ball is traveling horizontally to the right at 15 m/s. It leaves the bat traveling to the left at an angle of 60°above horizontal with a speed of 25 m/s. If the ball and bat are in contact for 1.75 ms, find the magnitude of the average force on the ball. (2.5 marks)

1. 2,500 N
2. $1{,}500\sqrt{3}$ N
3. 2,750 N
4. $1{,}850\sqrt{3}$ N

24. A person's center of mass can be determined by having a person lying on a very light board that is placed on two scales, A distance of 1.80 m separates the scales. as shown in the figure below.



When scale A reads 420 N and scale B reads 380 N, how far is the center of mass of this man from his feet? (2.5 marks)

1. 82.5 cm
2. 85.5 cm
3. 94.5 cm
4. 97.5 cm

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25. An object is undergoing simple harmonic motion (SHM) with a period of 1.0 s and amplitude of 0.320 m. At t=0, the object is at x = 0.320 m and is instantaneously at rest. Calculate the time it takes the object to move from x= 0.320 m to x = 0.160 m.
(2.5 marks)

1. 0.150 s
2. 0.167 s
3. 0.200 s
4. 0.333 s

26. As part of the “Southern Monsoon Bay Exploration” project, students joined a research mission aboard the research vessel from the Institute of Marine Science. Their mission was to transmit sound waves (sonar) into the deep sea to measure the distance between the underwater mountains and the water surface, as well as to observe changes in the wave behavior as it passes through layers of water with different densities.

In an experiment, students transmitted a sound wave with a frequency of 5.0 kHz into the sea, knowing that:

The speed of sound waves in the surface water layer (Layer 1) is 1500 m/s.

The speed of sound waves in the deep water layer (Layer 2) is 1200 m/s.

The sound wave took 0.80 seconds to travel from the ship to the seabed and back.

When the sound wave travels from Layer 1 to Layer 2, refraction occurs and the wavelength changes.

Which of the following statements is correct? (2.5 marks)

1. The distance from the water surface to the underwater mountain is 600 m.
2. The wavelength in the deep water layer (Layer 2) is greater than that in the surface water layer (Layer 1).
3. The wavelength in Layer 2 is 0.24 m.
4. The sound wave slows down when entering the deep water, causing the wave to refract away from the normal.

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27. A bowling ball traveling with constant speed hits the pins at the end of a 17 m-long bowling lane. The bowler hears the sound of the ball hitting the pins 2.55 s after releasing the ball. What is the speed of the ball if the air temperature is 15°C? (5 marks)

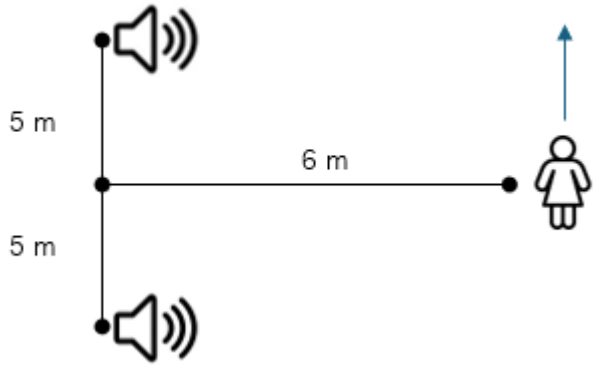
1. 6.8 m/s
2. 7.0 m/s
3. 7.2 m/s
4. 7.4 m/s

28. A jet aircraft is accelerating at 5 m/s^2 while climbing at an angle of 37° above the horizontal. What is the total force exerted by the cockpit seat on the 80-kg pilot? (5 marks)

1. $58\sqrt{155}$ N
2. $60\sqrt{182}$ N
3. $72\sqrt{165}$ N
4. $80\sqrt{178}$ N

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29. Two speakers, placed 10 m apart, emit identical sound waves with a wavelength of 2 m and are in phase with each other. The sound travels in a room where the speed of sound is 350 m/s. The girl starts at the midpoint between the two speakers. The room's walls and ceiling are covered with absorbers to eliminate reflections. How far from the center must she walk before she hears the sound reaching its third minimum intensity? (5 marks)



1. 0.500 m
2. 1.000 m
3. 1.414 m
4. 1.732 m

30. The projection lens in a certain slide projector is a single thin lens. A slide 28 mm high is to be projected so that its image fills a screen 2.1 m high. The distance from the slide to the screen is 3.8 m. How far from the slide should the projector's lens be placed to form the image on the screen? (5 marks)

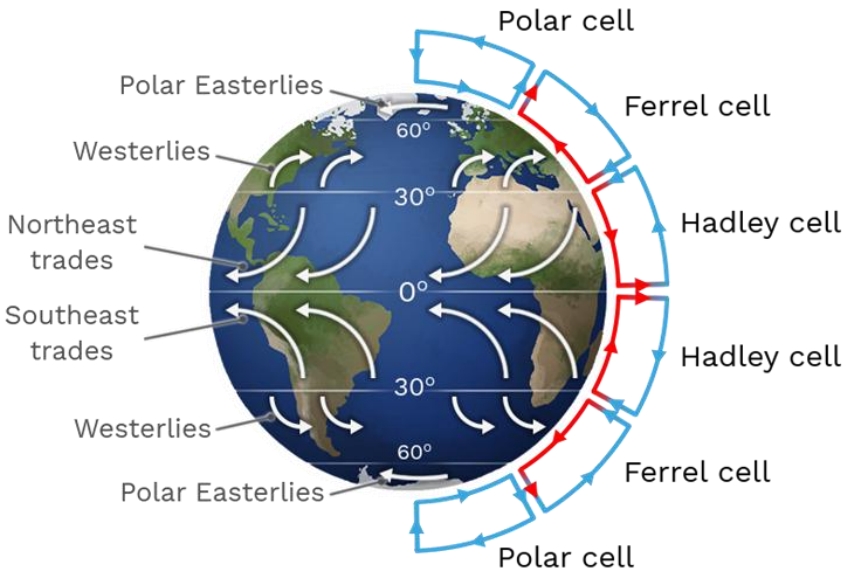
1. 0.05 m
2. 0.25 m
3. 3.55 m
4. 3.75 m

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31. An old clock is "losing" time because its pendulum moves too slowly. Assuming that the pendulum consists of a massive bob at the end of a string, the motion of this pendulum can be sped up by: (1.25 marks)

1. shortening the string.
2. lengthening the string.
3. increasing the mass of the bob.
4. decreasing the mass of the bob.

32. The three-cell model illustrates how the Earth's atmosphere is organized into large-scale circulation patterns that distribute heat and moisture, ultimately influencing weather and climate patterns across the globe. It describes three main convection cells in each hemisphere – the Hadley, Ferrel, and Polar cells as shown in the figure.



If you live at 15 degrees latitude, what will the weather be like as a result of air circulation? (1.25 marks)

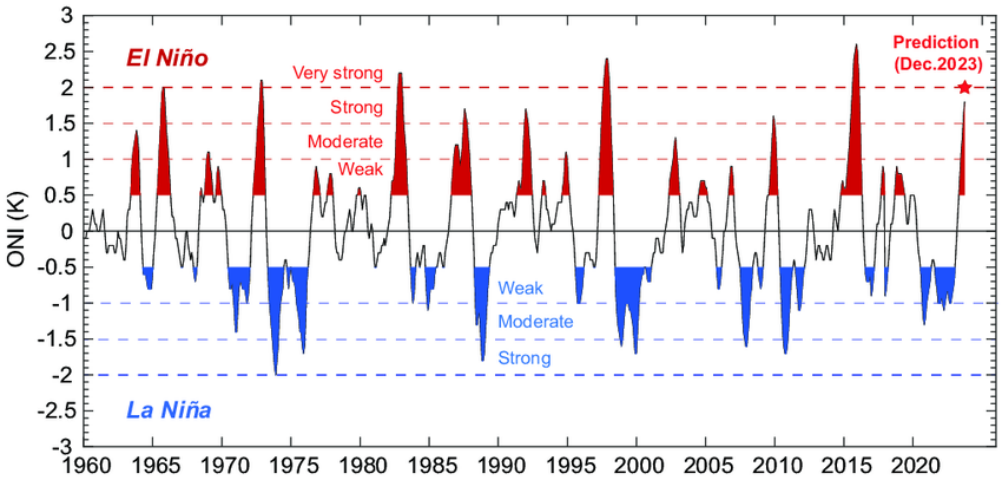
1. This cell contributes to the hot, moist air, and rainy conditions.
2. This cell is driven by the cold, dense air sinking at the low latitude.
3. This cell creates the temperate zones and unstable weather patterns.
4. This cell contributes to the formation of easterlies and the jet stream.

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33. An elevator cab is pulled directly upward by a single cable. The elevator cab and its single occupant have a mass of 2000 kg. When that occupant drops a coin, its acceleration relative to the cab is 8.00 m/s^2 downward. What is the tension in the cable? (2.5 marks)

1. 16 kN
2. 20 kN
3. 24 kN
4. 28 kN

34. Oceanic Niño Index (ONI) is a standardized measure used to monitor and track the El Niño-Southern Oscillation (ENSO) climate pattern, particularly the ocean component of El Niño and La Niña. It calculates the three-month running average of sea surface temperature anomalies in the east-central tropical Pacific Ocean as shown in the figure.



From this information, which statement is correctly summarized? (2.5 marks)

1. The ONI index is lower than zero because the central Pacific Ocean has a warmer current circulating.
2. The ONI index is greater than zero because the central Pacific Ocean has a cooler current circulating.
3. In 2015, the El Niño phenomenon resulted in a decrease in annual rainfall in southern Thailand.
4. In 2020, the La Niña phenomenon resulted in a decrease in annual rainfall in southern Thailand.

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35. Mr. Peter studied the growth of lateral buds in four plants of the same species, each of which was of the same age and had the same characteristics in every aspect. Each plant was treated as follows:

- **Plant A** : Apical bud left intact
- **Plant B** : Apical bud removed
- **Plant C** : Apical bud removed and the cut area coated with wax
- **Plant D** : Apical bud removed and the cut area coated with wax mixed with a substance similar to auxin

Then, all plants were placed under the same conditions suitable for growth for two weeks, and the growth of the lateral buds in each plant was observed. Based on the information provided, what should the result of the experiment be for Plant A, and which plant should show similar results to plant A? (2.5 marks)

1. The result of Plant A shows no inhibition of lateral bud growth, and the only plant with the same result is Plant D only.
2. The result of Plant A shows no inhibition of lateral bud growth, and the only plants with the same results as plant A are Plants B and C.
3. The experimental result of Plant A showed inhibition of lateral bud growth, and the only plant with the same results as plant A is Plant C only.
4. The experimental result of Plant A shows inhibition of lateral bud growth, and the plant with the same result as plant A is Plant D only.

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36. The following reaction takes place during the synthesis of compound AXY_2 (g)

$$A_2\,(g) + X_2\,(g) + Y_2\,(g) \longrightarrow 2AXY_2\,(g)$$

In a sealed container with a fixed volume of 10.0 L, an engineer introduces the following amounts of gases: 4.00 mol of A_2, 4.00 mol of X_2, and 6.00 mol of Y_2.

The reaction proceeds to 100% completion at a temperature of 400 K and an initial pressure of 10.0 atm. After the reaction is complete, the system is cooled to 300 K, while the volume of the container remains constant. Assume that all gases behave as ideal gases. What is the final pressure of the gas mixture in the container after the temperature change? (2.5 marks)

1. 3.45 atm
2. 4.48 atm
3. 5.36 atm
4. 6.70 atm

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Use the following information to answer Questions 37-38.

The dietary supplement company *HealthyBrain Co.* has launched a new product called "GinkgoMax" Plus, which claims to improve memory and concentration. It contains the following ingredients:

- Ginkgo biloba extract, featuring Ginkgolide B as the main active compound
- Vitamin B6
- Magnesium citrate ($Mg_3(C_6H_5O_7)_2$)

Ginkgolide B is a complex molecule that aids in binding to receptors in the brain. Magnesium citrate is an organic salt that supports neurotransmission and enhances the absorption of Vitamin B_6. Each "GinkgoMax Plus" capsule contains the following:

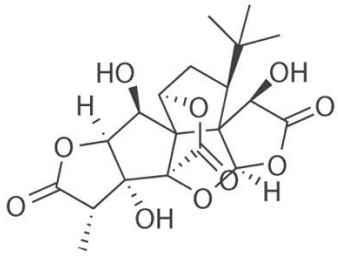
- 100 mg of Ginkgolide B
- 100 mg Vitamin B_6
- 250 mg of Magnesium citrate

37. The molar mass of magnesium citrate is 451.11 g/mol. If the body requires at least 120.00 mg of Magnesium (Mg) per day, how many "GinkgoMax Plus" capsules should a person take daily to meet this requirement? (Atomic mass of Mg = 24 g/mol) (5 marks)

1. 2 capsules
2. 3 capsules
3. 4 capsules
4. 5 capsules

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38. The types of chemical bonds present within and between Ginkgolide B molecules are shown in the figure.



Which of the following statements are incorrect? (5 marks)

A. Covalent bonds are present within the Ginkgolide B molecule, holding atoms together in its complex ring structure.

B. Hydrogen bonds are present within the Ginkgolide B molecule, helping maintain the covalent ring system.

C. Van der Waals forces occur between Ginkgolide B molecules in the solid state or in solution.

D. Ionic bonds form between different parts of a single Ginkgolide B molecule, stabilizing its overall structure.

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

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39. To reduce nitrogen oxide (NO_x) emissions from combustion engines, a team of chemical engineers developed a method using potassium nitrite (KNO_2) to break down harmful nitrogen oxides in exhaust gases. In a simulated exhaust gas scrubber, KNO_2 is known to undergo high temperature thermal decomposition to form potassium nitrate (KNO_3), nitrogen gas (N_2), and oxygen gas (O_2), as seen on the equation below:

$$2KNO_2\ (s) \longrightarrow 2KNO_3\ (s) + N_2\ (g) + O_2\ (g)$$

To investigate the rate of reaction, the engineers heated 4.00 g of solid KNO_2 in a sealed flask at 450°C and measured the total gas volume produced (N_2 + O_2) at constant pressure every 10 seconds using a gas syringe. The experimental results are shown below:

Time (s)	0	10	20	30	40	50	60	70	80	90
Volume of Gas (cm^3)	0	14	26	36	43	48	52	55	56	56

Specify : Molar mass of KNO_2 = 85 g/mol

Based on the experimental data and the chemical equation, which of the following statements are correct?

A. The rate of gas production was highest during the first 20 seconds.

B. The reaction is complete after 80 seconds.

C. The gas produced is a mixture of nitrogen and oxygen, in a 1:0.5 molar ratio.

D. The mass of KNO_2 used is the limiting factor, and the total volume of gas can be estimated using stoichiometry. (5 marks)

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

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40. A chemical engineering company is optimizing ammonia (NH_3) production via the Haber Process in a 2.00 L high-pressure reactor, using the reversible reaction:

$$N_2\,(g) + 3H_2\,(g) \rightleftharpoons 2NH_3\,(g)$$

Initially, 2.00 mol of nitrogen (N_2) and 6.00 mol of hydrogen (H_2) are introduced into the reactor at a constant temperature. At equilibrium, 1.60 mol of NH_3 is present.
Later, to increase ammonia production, the engineers decide to inject 1.00 mol of N_2 into the system, keeping the volume and temperature constant.
Consider the following statements:

A. The system will temporarily shift the equilibrium to the right, favoring the formation of more ammonia.

B. The concentration of hydrogen will temporarily decrease as it reacts to restore equilibrium.

C. The equilibrium constant (Kc) of the reaction will increase after nitrogen is added.

D. The new equilibrium concentration of NH_3 will be greater than 1.60 mol.

Which of the following statements are correct after the additional N_2 is injected? (5 marks)

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

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

Please check your answers before submitting the answer sheet.

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คำตอบวิชาวิทยาศาสตร์ ชั้นมัธยมศึกษาปีที่ 5

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

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