ASMOPSS THAILAND 2026

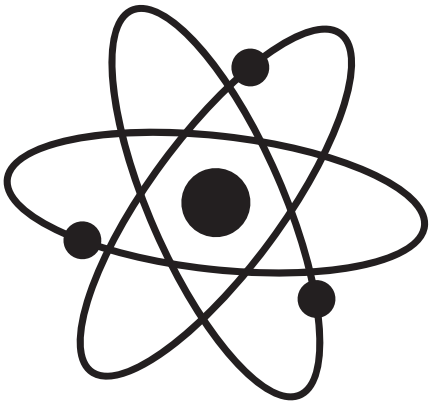
Asian Science & Mathematics Olympiad for Primary and Secondary Schools (Thailand)

Science Secondary G.10

Sunday, August 9, 2026

10:30 a.m. – 12:00 p.m. (90 minutes)

B



Instructions

1. This exam includes 40 questions, with 4 choices given (100 marks).
2. Use a 2B black pencil or darker one to fill in the circle.
3. Fill out your name, grade, school, test center, room, seat number, and identification number either in pen or in pencil.
4. If you want to change an answer that you have already marked, use a clean eraser to erase the incorrect answer and mark the new one.
5. It should be noted that figures in the exam are not drawn to scale.
6. Dictionaries, calculators, and electronic devices are not permitted in the test room.
7. Note taking can be done on the test paper only, with no extra sheet provided.
8. Do not write anything or make any symbols in the black barcode area along the edge of the paper except the answers on the answer sheet. Make sure the answersheet is not crumpled.
9. Submit the answer sheet to the proctor when the time is up.
10. Cheating in the exam may cause serious consequences including disqualification from receiving any award or joining the second round of the test held by ASMOPSS THAILAND.

Should any disagreement arise, the judgment of the panel is deemed final.

Announcement of the results via https://asmopssthailand.com on September 18, 2026

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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. A student examined cross-sections of leaves from two plant species.

▶ **Leaf P** has stomata mainly on its lower surface, several layers of palisade mesophyll, small intercellular spaces, and a thick cuticle on both surfaces.

▶ **Leaf Q** has stomata only on its upper surface, large air chambers within the spongy mesophyll, a waxy upper surface, and reduced supporting tissue.

One of these plants has leaves that float on the surface of a freshwater pond.

Which leaf is better adapted to this habitat? (1.25 marks)

1. Leaf P, because its thick cuticle prevents excessive water absorption, while its lower stomata absorb carbon dioxide dissolved in the pond water.

2. Leaf P, because its multiple palisade layers capture more sunlight, while its compact tissues prevent the leaf from being damaged by water pressure.

3. Leaf Q, because its upper stomata remain exposed to air, while its large air chambers support buoyancy and internal gas diffusion.

4. Leaf Q, because its reduced supporting tissue increases water transport, while its waxy surface allows oxygen to diffuse directly through the epidermis.

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2. About 200 years ago, a volcano in a tropical rainforest region erupted violently. Lava covered thousands of square kilometers, destroying the soil, plants, animals, and nearly all other organisms in the affected area. Over time, ecologists observed organisms gradually colonizing the site in a series of stages. The area eventually developed into the highly diverse forest seen today.

During the past 30 years, the species composition of the ecosystem has remained relatively stable. Which ecological process occurred, and which concept best describes the forest's current state? (1.25 marks)

1. Primary succession occurred because the ecosystem began developing on a surface with little or no soil. The present forest can be described as a climax community because its species composition has remained relatively stable.

2. Primary succession occurred because the lava destroyed most organisms. However, the present forest cannot be a climax community because primary succession always requires several thousand years to reach a stable state.

3. Secondary succession occurred because the eruption was a natural disturbance in an area that had previously supported life. The present forest is not a climax community because its biodiversity must still be increasing.

4. Secondary succession occurred because some soil and seeds normally remain beneath a lava flow. The present forest is a climax community because no further ecological changes can occur.

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3. Bread mold is commonly found growing on bread and other foods made from wheat. To study factors that influence the growth of bread mold, Jennifer performs an experiment.

Type of toast	First week	Second week	Third week
Open toast	No mold is observed.	Several spots of mold are observed.	Mold covers most of the toast.
Enclosed toast	No mold is observed.	No mold is observed.	Two spots of mold are observed on the toast.

Jennifer wants to find out whether bread mold spores can travel through the air. To test this, she toasts a piece of bread until it is crisp. Then, she quickly places it in a jar and immediately seals the jar with a tightly fitting lid. She also places another piece of crisply toasted bread in a second jar but leaves it open. Jennifer places the two jars side by side on a table and observes them for three weeks. The results are shown in the table above. Which of the following hypotheses is not supported by the evidence presented in the table? (1.25 marks)

1. Even brief exposure to air can cause bread to become contaminated with airborne bread mold spores.
2. Bread mold spores grow better on untoasted bread because heat destroys certain nutrients in the bread.
3. More bread mold grows on open toast than on enclosed toast because open toast is more exposed to airborne mold spores.
4. Bread mold spores can be made inactive or possibly destroyed by the high temperature used during toasting.

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4. Collagen is the most abundant protein in mammals and provides structural support in connective tissues, tendons, and skin. Each collagen polypeptide has a repeating Gly–X–Y sequence, in which glycine occurs at every third position. Each chain forms a left-handed helix, and three chains wind around one another to form a right-handed triple helix. This structure gives collagen its high tensile strength.

Which option correctly identifies the structural levels of collagen? (1.25 marks)

1. The amino acid sequence is the primary structure because the amino acids are linked by peptide bonds. The helix formed by one chain is the tertiary structure because it is a three-dimensional shape. The triple helix is the quaternary structure because it contains three polypeptide chains.

2. The repeating amino acid sequence is the secondary structure because it forms a regular pattern. The helix of one chain is the tertiary structure because it folds in three dimensions. The triple helix is the quaternary structure because several polypeptide chains assemble together.

3. The amino acid sequence is the primary structure because the amino acids are linked by peptide bonds. The helix of one chain is the secondary structure. The triple helix is the tertiary structure because it forms the complete three-dimensional shape of collagen.

4. The amino acid sequence is the primary structure because the amino acids are linked by peptide bonds. The helix formed by each chain is a secondary structure. The triple helix is the quaternary structure because it consists of three associated polypeptide chains.

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5. Identify the correct statement(s) regarding the process of mitosis in eukaryotic cells:
(1.25 marks)

I. Separation of sister chromatids occurs specifically during metaphase.

II. The nuclear envelope begins to reform around the two sets of daughter chromosomes during telophase.

III. DNA condensation occurs as chromosomes supercoil and become visible under a light microscope during prophase.

1. I and II only
2. II only
3. II and III only
4. I, II, and III

6. Different types of microscopes operate in different ways and have different limitations. A light microscope (LM), transmission electron microscope (TEM), and scanning electron microscope (SEM) are suited to different purposes. The choice depends on the required resolution, specimen preparation, and whether internal structures or surface details are being examined.
Which option correctly matches the specimen with the most appropriate microscope?
(1.25 marks)

1. Examining the three-dimensional surface features of pollen grains with a TEM because it provides highly detailed, naturally colored images of the pollen surface.
2. Examining mitotic stages in stained mouse bone marrow cells with an LM because stained chromosomes can be clearly distinguished, and specimen preparation is simpler than for electron microscopy.
3. Observing the movement of living bacteria in a liquid medium with an SEM because the bacteria can be viewed at high magnification without special preparation.
4. Examining the three-dimensional surface of a virus and the positions of its spike proteins with a TEM because it produces detailed images of external surface topography.

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7. The table below shows observations of four newly discovered entities: Q, R, S, and T.

Entity	Observation
Q	Contains a cell wall, cytoplasm, and genetic material, but has no membrane-bound internal compartments.
R	Consists of a protein coat surrounding RNA.
S	Contains membrane-bound internal compartments, including a compartment that contains DNA.
T	Exists only as free-floating DNA molecules in a liquid medium.

Based on cell theory, which row correctly identifies whether each entity is likely to be classified as a living organism? (1.25 marks)

Choice	Entity Q	Entity R	Entity S	Entity T
1.	Yes	No	Yes	No
2.	No	Yes	No	Yes
3.	Yes	No	No	Yes
4.	No	Yes	Yes	No

8. What type of transport is considered pinocytosis? (1.25 marks)
    1. Endocytosis, which is a form of transport requiring energy
    2. Endocytosis, which is a form of passive transport
    3. Exocytosis, which is a form of transport requiring energy
    4. Exocytosis, which is a form of passive transport.

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9. In a quality control process for small aerospace electronic components, a group of Grade 10 students used two types of high-precision measuring instruments to measure the dimensions of a cylindrical component. They used a Vernier Caliper to measure the outer diameter, obtaining an average value of 12.40 mm, and a Micrometer Screw Gauge to measure the thickness of a base plate, obtaining an average value of 3.125 mm.

When recording these results according to the principles of scientific notation and measurement uncertainty, which of the following correctly identifies the number of significant figures for both measured values and provides the most appropriate mechanical reasoning for choosing the thickness measurement instrument? (1.25 marks)

1. The Vernier Caliper has 3 significant figures, and the Micrometer has 4.

The Micrometer is chosen because it better reduces systematic errors.

2. The Vernier Caliper has 4 significant figures, and the Micrometer has 4.

The Micrometer is chosen because it has a higher resolution and is suitable for small objects.

3. The Vernier Caliper has 4 significant figures, and the Micrometer has 4.

The Micrometer is chosen because it improves measurement accuracy due to the ratchet stop (constant force mechanism).

4. The Vernier Caliper has 3 significant figures, and the Micrometer has 3.

Both instruments provide the same level of significance in the international measurement system.

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10. A prototype electric vehicle is being tested for its automatic braking system on a parallel straight test track at a research institute. The vehicle is moving at a constant velocity, and the test driver suddenly applies the emergency brakes. The central computer at the test facility records the resultant velocity relative to time, starting from the moment the brakes are applied until the vehicle comes to a complete stop, as shown in the table below:

Time after braking (seconds)	Vehicle velocity (m/s)
0 (Braking starts)	30.0
1.0	24.0
2.0	18.0
3.0	12.0
4.0	6.0
5.0	0.0 (Stopped)

Based on the analysis of the vehicle's motion behavior from the table, which of the following statements most accurately and completely describes the state of acceleration and the total braking distance of the vehicle according to kinematics principles?
(1.25 marks)

1. The vehicle moves with a constant acceleration of +6.0 m/s^2 and has a total braking distance of 150 meters.

2. The vehicle moves with a constant deceleration of 6.0 m/s^2 and has a total braking distance of 75 meters.

3. The vehicle moves with a deceleration directly proportional to time and has a total braking distance of 75 meters.

4. The vehicle moves at a constant average velocity of 15.0 m/s and has a total braking distance of 30 meters.

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11. An astronaut performing an extravehicular activity (EVA) is floating stationary relative to the International Space Station (ISS) in a microgravity environment. While performing maintenance on an electrical circuit panel, the astronaut pushes a 50.0 kg equipment box, causing it to move away toward the east with a constant force of 100.0 N for a short duration.

According to Newton's Laws of Motion, what physical phenomenon will occur to the astronaut (with a total mass of 100.0 kg, including the spacesuit) during the moment the push occurs? (1.25 marks)

1. The astronaut will remain stationary at the same coordinates because there is no Earth's gravitational pull in space to hold the structure.
2. The astronaut will move toward the east with an acceleration of 2.0 m/s^2, in the same direction as the equipment box.
3. The astronaut will be pushed by a reaction force to move toward the west with an initial acceleration of 1.0 m/s^2.
4. The astronaut will move backward toward the west with a constant velocity of 2.0 m/s without experiencing any acceleration.

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12. Phytic acid is one of the key value-added biomolecules in defatted rice bran (DFRB) extracts. It is a phytate compound abundantly found in rice bran and has the ability to bind with minerals, such as iron and zinc, as well as acting as an antioxidant. However, phytic acid can also reduce mineral absorption in the body, making it significant in nutrition, food applications, and biochemistry.

The phytic acid content was analyzed using a slightly modified standard method. A 5 ml volume of the supernatant was passed through an anion-exchange column. The column was then eluted with 0.1 M NaCl solution, followed by 0.7 M NaCl solution to obtain the phytate fraction. Subsequently, 3 ml of the eluted sample was mixed with 1 ml of Wade reagent and incubated at room temperature for 10 minutes. The absorbance was measured at 500 nm using a microplate spectrophotometer. A control (blank) solution was prepared, and the phytic acid concentration was determined using a standard curve constructed from standard solutions.

Consider the following statements:

A. Using a blank solution helps improve the accuracy of the absorbance measurements.

B. The standard curve is used to determine the concentration of phytic acid in the sample.

C. The 3 ml sample volume is the dependent variable in this experiment.

D. The microplate spectrophotometer is used to measure the absorbance at a specified wavelength.

E. Wearing personal protective equipment (PPE) is unnecessary because the procedure does not involve heating.

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

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

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13. Consider the following statements.

A. The atomic number refers to the number of electrons moving around an outer part of the atom, and the number of protons is equal to the number of electrons in a neutral atom.

B. Isotopes are atoms of the same element that have the same number of protons but different numbers of neutrons, resulting in different mass numbers.

C. Atomic radius increases from left to right across a period in the periodic table because the number of energy levels increases.

D. For elements in the same group, as the atomic number increases from top to bottom, the atomic radius increases due to the increase in nuclear attraction.

Which one is incorrect? (1.25 marks)

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

14. Consider the following substances:

CO_2 H_2O NH_3 CCl_4

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

A. All molecules contain covalent bonds.

B. Only two molecules have lone pairs of electrons on the central atom.

C. In the CO_2 molecule, the carbon atom has no lone pair electrons.

D. In the NH_3 molecule, the nitrogen atom has no lone pair electrons.

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

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15. A researcher adds DCMU to a suspension of isolated chloroplasts. DCMU blocks electron transfer from photosystem II to the plastoquinone pool, preventing electrons from leaving PSII and entering the intersystem electron transport chain. Assume that no external electron donor is present and that cyclic electron flow around photosystem I does not occur.
What is most likely to happen while the chloroplasts remain exposed to light? (2.5 marks)

1. Oxygen, ATP, and NADPH continue to be produced normally because water splitting continuously replaces electrons lost from PSII.

2. Oxygen and ATP continue to be produced normally, but NADPH production stops because electrons cannot reach photosystem I.

3. Oxygen continues to be released, and limited ATP is produced from water-derived protons, but no NADPH is formed.

4. After a brief initial period, oxygen evolution and linear electron flow stop; no ATP or NADPH is produced sustainably, so the Calvin cycle eventually stops.

16. In a population in Hardy-Weinberg equilibrium, red-green color blindness is inherited as an X-linked recessive trait, where allele h is located on the X chromosome. Because males only have one X chromosome, if they inherit a single h allele, red-green color blindness is automatically expressed. This means the proportion of color-blind males in the population directly reflects the frequency of allele h (q), rather than being calculated as q^2 like an autosomal recessive trait. A survey of this population found that 8% of males are color-blind. What percentage of females in this same population are carriers? (2.5 marks)

1. 7.4%
2. 14.7%
3. 16.0%
4. 64.0%

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17. In coral reef ecosystems, corals live in a mutualistic relationship with microscopic algae called zooxanthellae, which reside within coral tissues. Under normal conditions, the algae photosynthesize and transfer a large proportion of the sugars they produce to the coral. These sugars provide energy for coral growth and the formation of its calcium carbonate skeleton. In return, the coral provides the algae with shelter, carbon dioxide, and nitrogen-containing compounds.

However, when seawater temperatures remain about 1–2 °C above normal for several weeks, the photosynthetic system of the algae becomes stressed and produces excessive reactive oxygen species. These substances can damage coral cells. In response, the coral expels the algae or loses their photosynthetic pigments, causing the coral to appear white. This process is called coral bleaching. If stressful conditions continue, the coral loses much of its energy supply, becomes weakened, and may eventually die.

Which statement best explains this phenomenon from an ecological perspective?
(2.5 marks)

1. Rising temperature changes the relationship from mutualism to parasitism because the algae become a burden on the coral. By expelling them, the coral benefits, while the algae lose their habitat.

2. Bleaching occurs because the algae actively leave the coral in search of a more suitable environment. It is therefore caused by algal migration rather than by a stress response of the coral.

3. The ability of the coral and algae to separate shows that their relationship is commensalism rather than mutualism. Only the algae benefit, while the coral is largely unaffected by their absence.

4. Bleaching shows that mutualism can break down when environmental stress exceeds a critical threshold. Expelling the algae is a stress response that may reduce immediate cellular damage, but prolonged separation harms both organisms and the reef ecosystem.

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18. A research team collected soil samples from three biomes and analyzed their physical and chemical properties.

Soil A: A thick layer of organic matter has accumulated because decomposition is extremely slow at the low average annual temperature. The soil is slightly acidic, and a permanently frozen layer beneath the seasonally thawed surface restricts drainage and root growth.

Soil B: The surface organic layer is thin despite abundant plant litter. Warm, wet conditions promote rapid decomposition, and the released nutrients are quickly absorbed by plant roots. Heavy rainfall also leaches nutrients from the mineral soil.

Soil C: The soil has a deep, dark, humus-rich surface layer formed largely from the long-term decay of dense fibrous roots. Soil moisture varies seasonally, and its granular structure provides good water infiltration and retention.

Which option correctly identifies the biomes of Soils A, B, and C and best explains the characteristics of Soil A? (2.5 marks)

1. Soil A is from tundra, Soil B from tropical rainforest, and Soil C from temperate grassland. Low temperatures suppress microbial decomposition, while permafrost restricts drainage and root growth, allowing organic matter to accumulate.

2. Soil A is from taiga, Soil B from tropical rainforest, and Soil C from savanna. Long winters shorten the period of decomposition, while acidic compounds in fallen conifer needles cause organic matter to accumulate.

3. Soil A is from tundra, Soil B from tropical rainforest, and Soil C from savanna. Permanent waterlogging eliminates oxygen from the soil, completely preventing aerobic decomposition and inevitably producing a thick layer of peat.

4. Soil A is from taiga, Soil B from temperate grassland, and Soil C from desert. Conifer needles make the soil strongly acidic, causing most decomposers to become inactive and stopping the decomposition of organic matter.

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19. Arrange the atomic radius of elements X, Y, and Z from largest to smallest, given that:

Element X has an atomic number of 12 and a mass number of 24.

Element Y is an isotope of X.

Element Z has the same number of electrons as X when it forms a Z^{2+} ion.

(2.5 marks)

1. X > Y > Z
2. Z > Y > X
3. Z > X ≈ Y
4. X ≈ Y > Z

20. A student investigates how temperature affects amylase activity. Five test tubes are prepared, each containing 5 mL of 1% starch solution and 1 mL of 0.5% amylase solution. The tubes are incubated at 10, 20, 30, 40, and 50 °C for 10 minutes. The amount of maltose produced in each tube is then measured using the same method.
Another student suggests preparing a sixth tube containing 5 mL of 1% starch solution but no amylase. This tube is incubated at 37 °C for 10 minutes before its maltose level is measured.

Which statement best explains the role of tube 6 and correctly identifies the variables in the experiment? (2.5 marks)

1. Tube 6 is an additional experimental treatment used to investigate enzyme activity at 37 °C. The independent variable is temperature, the dependent variable is maltose production, and the controlled variables include pH, solution concentrations and volumes, incubation time, and measurement method.

2. Tube 6 is a positive control used to show that starch can be converted into maltose at body temperature. The independent variable is the amount of amylase, the dependent variable is temperature, and the controlled variables include pH, incubation time, and starch concentration.

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3. Tube 6 is a negative control used to determine whether maltose forms without amylase. However, matched control tubes should be prepared at each experimental temperature, and 1 mL of buffer should replace the amylase to keep the total volume constant. The independent variable is temperature, and the dependent variable is the amount of maltose produced.

4. Tube 6 is a control showing that 37 °C is the optimum temperature for amylase. The independent variable is maltose concentration, the dependent variable is enzyme activity, and the controlled variables include temperature, pH, incubation time, and solution volume.

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21. A membrane that is permeable to water but impermeable to glucose, fructose, and sucrose separates two solutions. In the first experiment, a 10% (w/v) glucose solution is placed on one side and distilled water on the other. Water moves from the distilled water side into the glucose solution.

The experiment is repeated with 10% (w/v) glucose and 10% (w/v) fructose solutions on opposite sides of the membrane. No significant net movement of water is observed.
A student then predicts that replacing the fructose solution with 10% (w/v) sucrose will cause water to move from the glucose solution toward the sucrose solution.
Which statement best explains the second result and correctly evaluates the student's prediction? (2.5 marks)

1. Glucose and fructose have the same molecular formula, $C_6H_{12}O_6$, and therefore the same molar mass. At the same mass-per-volume concentration, they contain approximately the same number of dissolved particles per unit volume and have similar osmotic pressures. Sucrose has a greater molar mass, so a 10% sucrose solution contains fewer particles per unit volume and has a lower osmotic pressure than 10% glucose.
Water should therefore move from the sucrose side toward the glucose side, contrary to the student's prediction.

2. Glucose and fructose have the same molar mass, so their osmotic pressures are equal. Although sucrose molecules are less numerous, each molecule has more hydroxyl groups and forms more hydrogen bonds with water. Sucrose therefore attracts water more strongly, causing water to move from the glucose side toward the sucrose side.

3. Glucose and fructose have the same molar mass, so no net osmosis occurs. Sucrose is made from glucose and fructose and dissociates into these two monosaccharides when dissolved. The sucrose solution therefore contains nearly twice as many particles and draws water from the glucose side.

4. Glucose and fructose have the same molar mass, so no net osmosis occurs. Because both glucose and sucrose solutions have a concentration of 10%, their osmotic pressures must also be equal regardless of molecular size, so no net movement of water should occur.

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22. Scientists examined liver cells from a mouse that had remained inactive for an extended period and had no unusual energy demand. The cells contained unusually high ATP levels, very low ADP and AMP levels, and a greatly increased NADH/NAD^+ ratio.

Which statement best explains the effect of these conditions on the Krebs cycle? (2.5 marks)

1. The Krebs cycle slows because low ADP prevents ATP synthase from functioning completely. This causes all protons to accumulate in the intermembrane space, permanently stops the electron transport chain, and eliminates all available NAD^+.

2. The Krebs cycle slows only because NADH inhibits several enzymes in the pathway. ATP has no regulatory effect on the cycle because it is produced exclusively by the electron transport chain.

3. The Krebs cycle accelerates because high ATP indicates that sufficient energy is available for biosynthesis. The cycle therefore increases its rate to provide more carbon skeletons for the production of cellular molecules.

4. The Krebs cycle slows because high ATP inhibits key regulatory enzymes, including isocitrate dehydrogenase. A high NADH/NAD^+ ratio also inhibits several dehydrogenases and reduces the availability of NAD^+ needed for oxidation reactions.

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23. To test an automated parcel sorting system at school, engineers released two small rescue robots, Alpha and Beta, to move toward each other on parallel straight tracks.
Robot Alpha starts from position X=0 and moves forward at an initial velocity of 4.0 m/s and a constant acceleration of 2.0 m/s^2. At the same time, Robot Beta, which is stationary at position X=120 m starts moving toward Robot Alpha with a constant acceleration of 6.0 m/s^2

Based on mechanics calculations and analysis, at what time (starting from the initial point) will the two robots meet (pass each other), and what is the total distance traveled by Robot Alpha? (2.5 marks)

1. Time = 5.0 seconds, Distance = 45.0 meters
2. Time = 5.0 seconds, Distance = 50.0 meters
3. Time = 6.0 seconds, Distance = 60.0 meters
4. Time = 6.0 seconds, Distance = 72.0 meters

24. A rectangular block of mass M_1 = 6.0 kg is placed on a smooth, horizontal, frictionless table. This block is connected to a steel box of mass M_2 = 4.0 kg by a light string passing over a frictionless fixed pulley at the edge of the table, allowing the box to hang vertically and move freely under Earth's gravity. If the system starts from rest, and the acceleration due to gravity is g = 10 m/s^2, calculate the magnitude of the system's acceleration (a) and the tension force (T) in the string while the objects are in motion. (2.5 marks)

1. Acceleration = 4.0 m/s^2 , Tension = 24 N
2. Acceleration = 4.0 m/s^2 , Tension = 40 N
3. Acceleration = 6.0 m/s^2 , Tension = 24 N
4. Acceleration = 6.0 m/s^2 , Tension = 36 N

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25. A group of students conducted an experiment to measure the antioxidant activity of pectin extracts using the DPPH (2,2-diphenyl-1-picrylhydrazyl) radical scavenging assay.
This method is based on the principle that the purple DPPH radicals are reduced by antioxidants, resulting in a decrease in color intensity, which can be measured using a spectrophotometer.

In this experiment, the students prepare aqueous solutions of pectin at various concentrations: 0.5, 1.5, 2.5, 3.5, and 4.5 mg/ml, using pipettes and graduated cylinders. Then, 2 ml of each pectin solution was mixed with 4 ml of DPPH solution (100 μM in ethanol) and shaken thoroughly.

Since DPPH is light-sensitive, the prepared solutions were kept in the dark for 30 minutes to prevent photodegradation and to allow the reaction to reach completion. Afterwards, the solutions were measured for absorbance at a wavelength of 517 nm using a spectrophotometer with pure ethanol used as a blank to calibrate the instrument to zero.

Throughout the experiment, the students wore gloves and safety goggles, and they worked in a well-ventilated area because ethanol is flammable and proximity to open flames must be avoided. Furthermore, preparing solutions of different concentrations requires the use of high-precision equipment, such as pipettes or burettes, to ensure reliable results.

Consider the following statements:

A. Storing the DPPH solution in the dark helps prevent its degradation due to light sensitivity.

B. Ethanol is flammable, so working near open flames should be avoided, and the experiment should be conducted in a well-ventilated area.

C. Measuring absorbance at 517 nm can be done using a colorimeter instead.

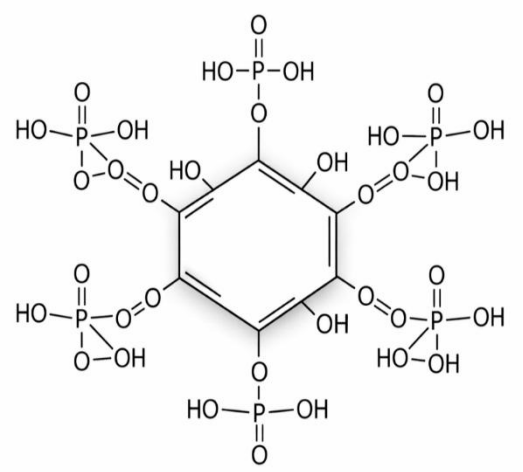
D. Preparing multiple concentrations should utilize precise equipment should utilize precise equipment, such as pipettes and burettes.

Based on the statements above, which are correct and which are incorrect? (2.5 marks)

1. A, B, and C are correct
2. B, C, and D are incorrect
3. A is correct; B and C are incorrect
4. C and D are incorrect

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26. Consider the structure of phytic acid, which consists of an inositol ring (C_6) with six phosphate groups ($-PO_4H_2$) attached. The molecule contains C–O, P–O, P=O bonds, and numerous –OH groups.



Consider the following statements:

A. The molecule contains both single and double covalent bonds.

B. The bonds between P–O and C–O atoms are covalent bonds.

C. This molecule is capable of forming intermolecular hydrogen bonds.

D. This molecule exhibits dipole–dipole intermolecular forces.

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

1. A, B, and C
2. A, C, and D
3. B, C, and D
4. All are correct

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27. Two friends of equal physical fitness went hiking in an extremely hot desert. Assuming they sweat at the exact same rate, Kenji – who normally eats a plant-based diet – supplemented with sodium tablets and drank plenty of water to prevent dehydration and offset sodium loss. John ate his usual diet consisting of meat and potatoes, supplemented with protein bars, and consumed nearly identical amounts of sodium and water as Kenji. After a long day of hiking during which they both ran short of water, they returned to camp and provided a urine sample. Which of the following statements is true? (5 marks)

1. Kenji's kidneys will produce highly concentrated urine, resulting in a negative free-water clearance.

2. John's kidneys will produce more highly concentrated urine, resulting in a more negative free-water clearance than Kenji's.

3. The urine of both Kenji and John will show similar free-water clearance because they consumed nearly identical amounts of water and both were supplemented with sodium.

4. Neither Kenji nor John will be able to produce urine with a negative free-water clearance, as they sweated at the same rate, drank similar amounts of water, and both were supplemented with sodium.

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28. In isolated mitochondria supplied with adequate NADH and ADP + Pi, researchers add cyanide, which blocks electron transfer to oxygen at the final step of the electron transport chain. Normally, protons are pumped into the intermembrane space as electrons move through the complexes, creating a gradient utilized by ATP synthase. However, following the addition of cyanide, electron transport halts and NADH can no longer be oxidized back to NAD^+. Which outcome is most likely to occur immediately in this study? (5 marks)

1. Oxygen consumption will increase because cyanide accelerates the rate at which oxygen accepts electrons at the final complex.
2. NADH levels will decrease because the blocked electron transport chain forces NADH to transfer electrons directly to ATP synthase.
3. ATP production will increase because the accumulation of electrons triggers an increase in substrate-level phosphorylation within mitochondria.
4. ATP production by ATP synthase will decrease because the proton gradient is no longer maintained by electron transport.

29. A Maglev train is approaching the main station platform at a constant speed of 40 m/s. When the front of the train is 200 meters away from the center of the platform, the station master signals the train to begin slowing down. The operator shuts off the propulsion system and applies the brakes, causing the train to experience a deceleration that varies with time according to the function a(t) = -0.4t where t is the time in seconds after the brakes are applied.

Given this non-constant acceleration scenario, use calculus (integration) to calculate the velocity of the train after 10 seconds and the total distance traveled from the point the brakes were applied until the train comes to a complete stop. (5 marks)

1. Velocity = 20 m/s, Stopping distance = 266.7 meters
2. Velocity = 20 m/s, Stopping distance = 377.1 meters
3. Velocity = 10 m/s, Stopping distance = 266.7 meters
4. Velocity = 10 m/s, Stopping distance = 350.0 meters

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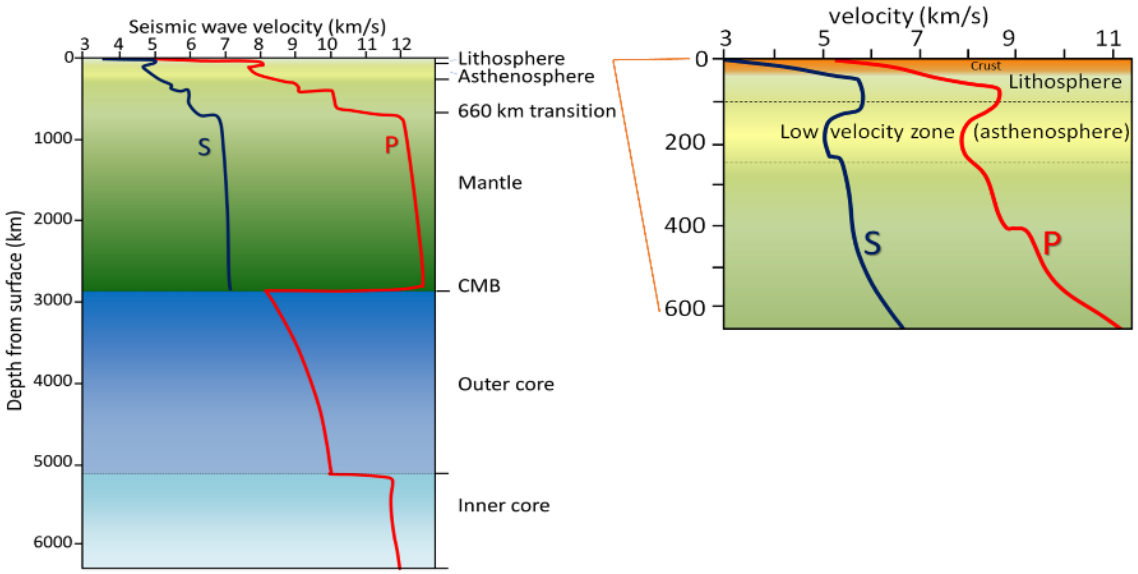
30. A 10 kg cargo box is pulled up an inclined plane at an angle of 37° to the horizontal by an external force (F) directed parallel to the incline. The coefficient of kinetic friction $(\boldsymbol{\mu_k})$ between the box and the inclined plane is not constant; it varies linearly with the distance traveled along the incline according to the function $\mu_k(x) = 0.05x$ (where $\mathbf{X}$ is the distance in meters from the starting point $\mathbf{X}$=0 and g = 10 m/s^2)

If engineers want the cargo box to slide up the incline at a constant velocity throughout the journey, calculate the function of the pulling force $F(x)$ that must be adjusted according to the distance, and specify the magnitude of the required pulling force at the coordinate $\mathbf{X}$ = 4.0 meters. (5 marks)

1. $F(x) = 60 + 4x$, Force at x = 4 m is 76 N
2. $F(x) = 60 + 4x$, Force at x = 4 m is 80 N
3. $F(x) = 80 + 3x$, Force at x = 4 m is 92 N
4. $F(x) = 80 + 4x$, Force at x = 4 m is 96 N

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31. When considering the graph showing the relationship between depth and seismic wave velocity, it can be observed that at a depth of approximately 100-250 kilometers, the velocities of both primary and secondary waves decrease slightly before increasing again at greater depths, as shown in the figure.



What does this data reveal about the physical characteristics of the Earth's internal structure at this depth? (1.25 marks)

1. This region has high temperatures that cause rocks to partially melt, reducing their rigidity.

2. It is a shadow zone caused by the refraction of waves that travel from a solid state to a liquid state.

3. This layer has a sudden decrease in density due to a high accumulation of radioactive elements.

4. It is the boundary between the Earth's crust and the mantle where there is a chemical change in composition, from granite to peridotite.

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32. Consider the following hypothetical periodic table and the statements, where the letters P, Q, R, X, Y, and Z represent elements at various positions.



A. Element Z exhibits a greater tendency to gain electrons than element Q.

B. Elements X and P exhibit similar chemical properties, with element P having a larger atomic radius than element X.

C. Element R is relatively inert.

D. Element Y exhibits a greater tendency to lose electrons than element X.

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

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

33. Studies of mid-ocean ridges show that basalt rocks further away from the ridge become progressively older. Furthermore, the basalt rocks exhibit the alignment of iron minerals according to the Earth's magnetic field, with symmetrical magnetic reversals on both the left and right sides of the mid-ocean ridge. How does this information explain the movement of tectonic plates and geological processes in the mid-ocean ridges? (2.5 marks)

1. Tectonic plates move away from each other, creating a new crust as magma rises from the mantle.
2. The denser oceanic plate subducts beneath the continental plate, forming a trench.
3. Two or more tectonic plates move toward each other and collide, leading to subduction.
4. Two oceanic plates converge, and the older, colder, denser plate subducts beneath the other, forming a volcanic island arc.

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34. During a biology lab, a teacher provided students with slides prepared from onion root tips for observation. The samples were prepared by soaking the root tips in an HCl solution to soften the cell walls, then stained with a DNA-binding dye. When viewed under a microscope, cells like the one observed below were observed.



Which molecular event is most likely taking place inside this cell? (2.5 marks)

1. The nuclear envelope is breaking down, while chromatin is condensing from long fibers into increasingly visible chromosomes. At the same time, spindle fibers are beginning to form, preparing to attach to the chromosomes in the next phase.

2. The proteins holding the two sister chromatids together are being cleaved. With the tension that holds sister chromatids gone, the individual sister chromatids separate and are pulled by spindle fibers toward opposite poles of the cell.

3. All the chromosomes are aligned along the metaphase plate, with spindle fibers from opposite poles pulling them with a perfect balanced tension, holding each chromosome in place at the center of the cell.

4. The nuclear envelope is reforming around each group of chromosomes at opposite poles of the cell, and The chromosomes are uncoiling into long, thin chromatin fibers as the cell prepares for the final stage of the cell division.

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35. A type of white blood cell can migrate to sites of infection. After reaching the site, it surrounds pathogens or foreign particles with its cell membrane and engulfs them by phagocytosis, forming a vesicle called a phagosome. The cell then destroys the pathogen inside this vesicle.

Which organelle is likely to be especially abundant in this type of cell, and why? (2.5 marks)

1. The Golgi apparatus, because it modifies and packages proteins into vesicles. It delivers digestive enzymes directly to the phagosome and is therefore mainly responsible for destroying engulfed pathogens.

2. Mitochondria, because cell migration and phagocytosis require ATP. A large number of mitochondria therefore enables the cell to digest pathogens directly inside the phagosome.

3. Rough endoplasmic reticulum, because its ribosomes produce proteins for secretion and for use in organelles. It is therefore the main site where engulfed pathogens are broken down.

4. Lysosomes, because they fuse with phagosomes to form phagolysosomes. These compartments are acidic and contain enzymes that digest proteins, lipids, nucleic acids, and other components of pathogens.

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36. Consider the following statements about the mechanisms of membrane transport:

M – When red blood cells are placed in an isotonic solution, they do not change in size because the solute concentrations inside and outside the cell are equal, causing water to move into and out of the cell at the same rate, resulting in a dynamic equilibrium.

N – Active transport is capable of moving substances from a region of lower concentration to a region of higher concentration, using energy derived from ATP. This process requires carrier proteins that are specific to the substance being transported, and it plays a role in the absorption of glucose and amino acids across the wall of the small intestine.

O – Facilitated diffusion and simple diffusion are similar in that neither requires ATP, and both transport substances down the concentration gradient. However, they differ in that facilitated diffusion can transport substances without limitation due to a large surface area of the cell membrane.

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

1. M and N only
2. M and O only
3. N and O only
4. M, N, and O

37. From the study of tsunamis, it was found that when a wave travels in an ocean at a depth of 4,000 meters, it has a speed of approximately 700 km/hr, a wavelength of 400 kilometers, and a height of about 30 centimeters. However, when the wave approaches the shore where the depth is 10 meters, its speed decreases to approximately 30 km/hr, its wavelength shortens to 10 kilometers, and its height can reach up to 30 meters. Based on this information, what equation can be written to calculate the speed of a tsunami?

(5 marks)

1. $v = s/t$
2. $v = u + gt$
3. $v = (gd)^{1/2}$
4. $v = at + 1/2gt^2$

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38. A high-speed experimental maglev train departs from station A from rest with a non-constant acceleration profile defined by the function $a(t) = 1.2t - 0.05t^2$ (where a is in m/s^2 and t is the elapsed time in seconds). The onboard safety system activates emergency deceleration regulators exactly at t = 30 seconds to safely bring the train to a halt at station B. Using kinematic integration calculus for variable acceleration systems, determine the maximum linear velocity (v_{max}) achieved by the train before the safety braking system takes over, and calculate the total distance (S) covered during this 30-second acceleration phase. (5 marks)

1. Maximum velocity = 90.0 m/s Total distance = 1,850.0 meters
2. Maximum velocity = 90.0 m/s Total distance = 2,025.0 meters
3. Maximum velocity = 120.0 m/s Total distance = 2,025.0 meters
4. Maximum velocity = 120.0 m/s Total distance = 2,400.0 meters

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39. When the water content of the blood falls below the normal level, receptors in the hypothalamus detect the resulting increase in blood osmolarity. The hypothalamus then causes antidiuretic hormone (ADH) to be released from the posterior pituitary gland.
ADH increases water reabsorption in the kidney tubules, gradually restoring the water balance of the blood. Once the water balance returns to normal, ADH secretion decreases.
Which statement best explains the mechanism regulating this process? (5 marks)

1. It is negative feedback because ADH restores the blood water balance. However, it is a special type of fixed-setpoint feedback that differs from ordinary negative feedback, which does not regulate conditions around a set point.

2. It is positive feedback because ADH increases water reabsorption, strengthening the response until the blood water balance reaches its normal level. The response stops only after the target level has been reached.

3. It is negative feedback because the body responds to a deviation from normal by releasing ADH, which restores the blood water balance. Once normal conditions return, the stimulus for ADH release decreases and the response is reduced.

4. It is positive feedback because ADH causes the kidneys to reabsorb more water, increasing the water content of the blood. Since the water level rises during the response, the mechanism reinforces the original change rather than opposing it.

40. The antibacterial activity of the defatted rice bran (DFRB) extract against pathogenic bacteria was determined using the agar well diffusion assay. The extract showed a significant inhibitory effect on Gram-positive bacteria, particularly *Staphylococcus aureus*. In contrast, its inhibitory effect on Gram-negative bacteria, *Pseudomonas aeruginosa, was* less pronounced or not detected. This difference may be attributed to structural differences in bacterial cell envelopes. Gram-negative bacteria possess an outer membrane that acts as a permeability barrier. Additionally, hydrophobic compounds such as phenols, esters, and tannins have limited ability to penetrate this membrane. The experimental results are summarized in the table below.

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Table: Antibacterial activity of DFRB extract (inhibition zone, mm)

Bacterium	Inhibition zone (mm)
Escherichia coli	ND
Salmonella Typhi	ND
Pseudomonas aeruginosa	8.00 ± 0.01
Staphylococcus aureus	30.00 ± 0.00

ND = not detected

Consider the following statements:

A. The DFRB extract is more effective against Gram-positive bacteria than Gram-negative bacteria.

B. "ND" indicates that the extract has absolutely no antibacterial activity against those bacteria.

C. The smaller variation (± value) reflects higher precision in the experimental results.

D. The outer membrane of Gram-negative bacteria is the independent variable in this experiment.

E. Hydrophobic compounds may have limited effectiveness against Gram-negative bacteria due to permeability barriers.

Which of the statements are correct? (5 marks)

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

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

Please check your answers before submitting the answer sheet.

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Answers Keys : Science Secondary - Grade 10

No.	Answers	No.	Answers
1.	3	21.	1
2.	1	22.	4
3.	2	23.	1
4.	4	24.	1
5.	3	25.	4
6.	2	26.	4
7.	1	27.	2
8.	1	28.	4
9.	2	29.	2
10.	2	30.	1
11.	3	31.	1
12.	1	32.	2
13.	4	33.	1
14.	3	34.	2
15.	4	35.	4
16.	2	36.	1
17.	4	37.	3
18.	1	38.	2
19.	3	39.	3
20.	3	40.	2

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