ASMOPSS THAILAND 2026

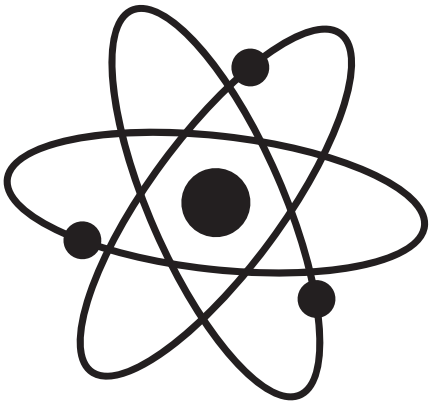
Asian Science & Mathematics Olympiad for Primary and Secondary Schools (Thailand)

Science Secondary G.9

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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Contact US

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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. Over a ten-year period, a park ranger in the Arctic circle takes photographs tracking environmental changes and notices that massive glaciers and ice sheets are melting away rapidly, causing local sea levels to rise and threatening polar bear habitats. This crisis is a direct consequence of global warming. Which of the following statements correctly explains the chain reaction driving this environmental crisis? (1.25 marks)

1. Air pollution makes the water toxic, and toxic water automatically expands its molecular volume tenfold when frozen.

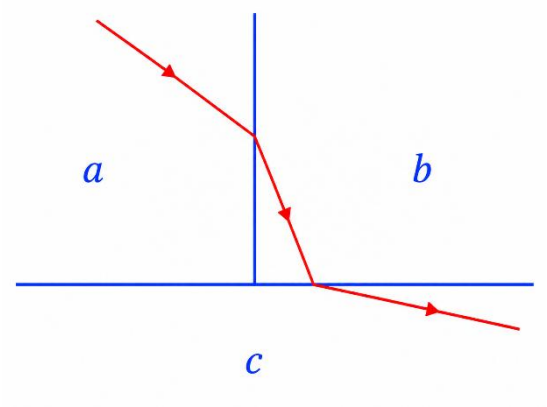
2. Increased greenhouse gases trap excess solar heat → global atmospheric temperatures rise →polar ice caps and glaciers melt → sea levels rise.

3. The Earth moves closer to the sun every year → the oceans boil away → gravity pulls the ice down into the center of the Earth.

4. As sea ice decreases, the exposed dark ocean surface reflects more incoming solar radiation back into space, cooling the Arctic and slowing the melting of land-based glaciers and ice sheets.

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2. A beam of light travels through three different materials a, b, and c.



Rank the materials based on their index of refraction (n), from the highest to the lowest (1.25 marks)

1. $n_b > n_a > n_c$
2. $n_a > n_b > n_c$
3. $n_c > n_b > n_a$
4. $n_b > n_c > n_a$

3. In a starch quality analysis laboratory, a researcher needs to use a Rapid Visco Analyzer (RVA) to study the gelatinization behavior of starch. It is necessary to precisely control the starch concentration on a dry basis to ensure that the experimental results are reliable and comparable. An assistant was assigned to prepare the starch sample for analysis with the following data information:

1. The total mixture to be prepared is 28.0 g.
2. The required starch concentration is 10.0% (w/w, dry basis)
3. The starch sample being used has a moisture content of 12.0% (w/w).

To prepare this starch sample, how many grams of the starch sample must the assistant weigh out for this study? (1.25 marks)

1. 2.80 g
2. 3.08 g
3. 3.18 g
4. 3.28 g

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4. During the process of inhalation, which of the following correctly describes the sequence of events occurring in the human respiratory system? (1.25 marks)

P : The volume of the thorax increases.

Q : Air flows from the environment into the lungs.

R : Air pressure inside the chest cavity decreases.

S : The external intercostal muscles contract.

T : The diaphragm moves downwards and the ribcage moves upwards and outward.

1. Q → P → S → R → T
2. S → T → P → R → Q
3. Q → P → S → T → R
4. S → Q → R → P → T

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5. The table compares sperm abnormality percentages across samples from one fertile individual and two individuals with low fertility.

	Person with normal fertility	Person A with low fertility	Person B with low fertility
Percentage of sperm with no acrosome	2	25	2
Percentage of sperm with deformed flagellum	11	11	35
Percentage of sperm with few mitochondria	4	4	30

What would be the causes of low fertility in person A and person B? (1.25 marks)

Choice	Person A	Person B
1.	Too many sperms cannot digest jelly coat of egg cell	Too many sperms cannot digest jelly coat of egg cell
2.	Too many sperms cannot digest jelly coat of egg cell	Too many sperms cannot move to the oviduct
3.	Too many sperms cannot move to the oviduct	Too many sperms cannot digest jelly coat of egg cell
4.	Too many sperm cannot move to the oviduct	Too many sperm cannot move to the oviduct

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6. According to a soil profile survey in a tropical rainforest with heavy rainfall throughout the year, it was found that one soil horizon is pale in color, has a texture of sand mixed with laterite, and is severely depleted of nutrients. Meanwhile, the horizon below has a deep reddish-brown color and contains a large amount of minerals. Which conclusion correctly describes the characteristics of this soil profile? (1.25 marks)

1. The soil in this area is still underdeveloped with an incomplete soil profile.
2. The pale soil horizon is the O horizon where organic matter decomposes rapidly due to high temperatures.
3. The reddish-brown soil horizon is the horizon C, consisting of weathered rock influenced by groundwater, causing iron rust.
4. The pale soil horizon is the E horizon, which is the result of the leaching process that carries minerals and clay particles down to the horizon B to be accumulated.

7. A parent cell contains 16 chromosomes. This cell is preparing to divide. Mitosis is used for growth and repairing damaged tissues, whereas meiosis is used to produce gametes such as sperms or eggs.

After a cell division is completed, how many chromosomes will be found in each new daughter cell for both processes? (1.25 marks)

1. Mitosis – 16; meiosis – 16
2. Mitosis – 16; meiosis – 8
3. Mitosis – 8; meiosis – 16
4. Mitosis – 8; meiosis – 8

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8. Hemophilia is an X-linked recessive disorder. Let:

X^H represent the allele for normal blood clotting

X^h represent the allele for hemophilia

John is a man with hemophilia (X^hY). He marries Jane, a woman who has normal blood clotting and is not a carrier (X^HX^H). They have a son named Mike, who does not have hemophilia.

Mike later marries a woman with the genotype X^HX^H, and they have a daughter. When Mike's daughter grows up, she marries a man with the genotype X^HY.

Assuming that no new mutation occurs, what is the probability that each child of this couple will have hemophilia? (1.25 marks)

1. 0%
2. 25%
3. 50%
4. 100%

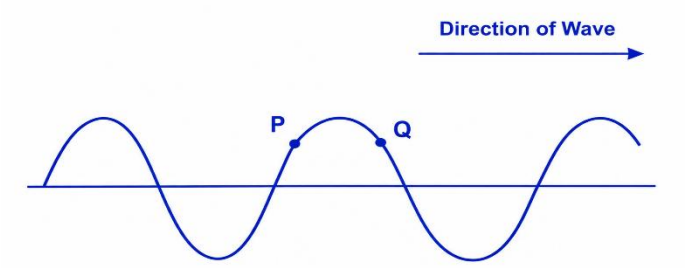
9. A group of students conducted a project to extract pectin from pomelo peels for use in gel products. They began by washing the peels, removing the green outer layer and finely grinding the white inner part of the pomelo peel. Then, they added a citric acid solution and heated it at approximately 80°C for 30 minutes. During the experiment, they observed that the solution became darker in color and its viscosity increased.

After that, the students filtered the solution to remove the residue and allowed the solution to cool until a gel-like substance was formed. When the extracted substance was analyzed for its various properties, it was found to consist of 92% pectin and 8% other substances. Which of the following is the most appropriate conclusion regarding the changes that occurred in this process? (1.25 marks)

1. It is entirely a chemical change because acid was used and heat was applied.
2. It is entirely a physical change, even though there were changes in color and viscosity.
3. It involves both physical and chemical changes because the properties of the substance changed.
4. It cannot be determined whether the changes are physical or chemical from the given information.

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10. A rope is shaken to create a wave traveling from left to right. The diagram below shows a "snapshot" of the rope at a single instant.



As the wave moves to the right, what is happening to points P and Q at this exact instant? (1.25 marks)

1. Point P is moving down, and Point Q is moving up.
2. Point P is moving up, and Point Q is moving down.
3. Both Point P and Point Q are moving to the right.
4. Both Point P and Point Q are stationary.

11. A geologists surveyed an area and discovered two types of rocks with similar chemical compositions, characterized as follows:

Rock Type 1: Has a texture consisting of large crystals visible to the naked eye. The mineral crystals are tightly interlocked.

Rock Type 2: Has a texture consisting of very small crystals that are invisible to the naked eye. Pores are scattered throughout the rock.

Based on the information, which conclusion correctly describes the formation environment of both types of rock? (1.25 marks)

1. Rock Type 1 formed from the deposition of sediment in the deep sea, while Rock Type 2 formed from the deposition of volcanic ash.
2. Rock Type 1 formed from the slow cooling of magma beneath the Earth's crust, while Rock Type 2 formed from the rapid cooling of lava on the Earth's surface.
3. Rock Type 1 is an extrusive igneous rock that took longer to crystallize, while Rock Type 2 is an intrusive igneous rock with a high amount of dissolved gas in the magma.
4. Rock Type 1 underwent metamorphism involving high heat, while Rock Type 2 formed from deposition of chemical precipitates.

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12. If we compare the apparent path of the Sun across the sky on March 21st and December 21st, for an observer located at the equator, which of the following correctly explains the difference between the two apparent paths? (1.25 marks)

1. On both days, the Sun will pass directly through the zenith, but the Sun sets between the horizon will differ.

2. On March 21st, the Sun will tilt towards the north, while on December 21st, it will tilt towards the south.

3. On March 21st, the Sun will rise later than on December 21st due to the difference in distance from the sun.

4. On March 21st, the Sun will pass through the zenith, while on December 21st, it will tilt towards the south.

13. On a certain day, an observer on Earth notices that the difference between the sea levels at high tide and low tide is very small. Which of the following options correctly identifies the position of the Moon corresponding to this phenomenon, and why?
(1.25 marks)

1. The Moon is in the Waning Gibbous/New moon (15th day of the waning moon) position, and the gravitational pulls from the Sun and the Moon reinforce each other.

2. The Moon is the Full Moon (15th day of the waxing moon) position, and the gravitational pulls from the Sun and the Moon counteract each other.

3. The Moon is at perigee (8th day of the waxing/waning moon) position, and the Moon's gravitational pull is so strong that it keeps the water level stable throughout the day.

4. The Moon is in the Third Quarter (8th night of the waning moon) position, and the gravitational pulls from the Sun and Moon are perpendicular to each other, resulting in the lowest net gravitational force acting on Earth.

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14. Consider the climate data of the following two areas:

Area A: Has a high average temperature (30 - 35°C) and receives heavy rainfall throughout the year.

Area B: Has a large temperature difference between day and night (0 - 40°C) and a very dry climate.

Based on the information, which of the following correctly explains the weathering characteristics of the rocks in each area? (1.25 marks)

1. Area A experiences high chemical weathering due to water and temperature, while Area B experiences high physical weathering from expansion and contraction of rocks.

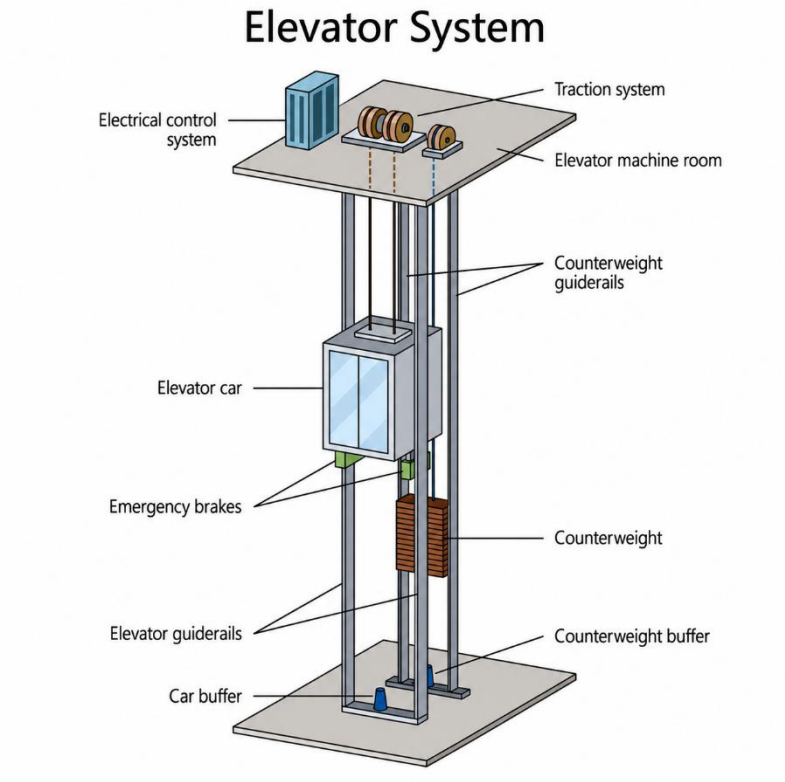
2. Rocks in Area A will be more durable than those in Area B due to the accumulated moisture from rainfall.

3. Area A experiences less erosion from water currents because the soil has high moisture, while Area B experiences chemical weathering from the oxidation of iron.

4. Both areas primarily experience physical weathering, but Area A is caused by plant roots, while Area B is caused by frost wedging.

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15. An elevator has a fully loaded cab with a total mass of 2000 kg. The elevator is programmed to carry its load upward a distance of 60 m in exactly 2.0 minutes, starting and ending at rest. To help lift the load, the elevator uses a 1500-kg counterweight.



What is the average power required by the motor to supply to the cable? (2.5 marks)

1. 250 W
2. 2500 W
3. 10000 W
4. 150000 W

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16. A technician uses an ideal pulley system with rope to lift a heavy weight, as shown in the figure. The weight is 100 N and needs to be lifted straight up a distance of 10.0 cm at a constant speed. Assuming there is no friction involved, what is the required input force, and how far must the technician pull the rope? (2.5 marks)



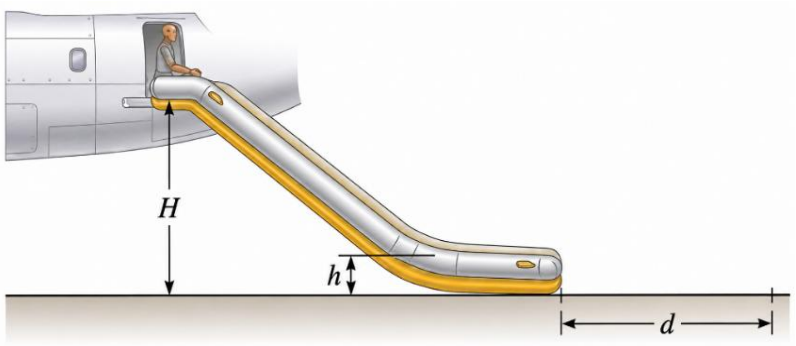
1. Force = 25.0 N, Distance = 2.50 cm
2. Force = 400 N, Distance = 2.50 cm
3. Force = 25.0 N, Distance = 40.0 cm
4. Force = 100 N, Distance = 10.0 cm

17. Consider the characteristics of a meandering river. If point X represents the outer bank and point Y represents the inner bank, which of the following correctly describes the geological processes occurring at both locations? (2.5 marks)

1. At point X, sediment deposition occurs because the water current slows down.
2. At point Y, severe erosion occurs due to the strong water current.
3. Both points undergo chemical weathering at the same rate because they are constantly in contact with water.
4. At point X, erosion occurs because the water current has high velocity and crashes against the riverbank, while at point Y, sediment deposition occurs because the water flows slowly.

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18. To ensure a quick escape during emergencies, airplane doors are equipped with inflatable evacuation slides that offer a fast and safe path to the ground. Aerospace engineers rigorously test these systems using a crash dummy.



A crash dummy is released from rest at the top of a frictionless airplane evacuation slide of height H. The bottom of the slide is perfectly horizontal and sits at h = 0.5 m above the ground. If the dummy lands on the ground at a horizontal distance of d = 3.0 m away from the edge of the slide, what is the initial height H of the airplane door? (2.5 marks)

1. 3.5 m
2. 4.5 m
3. 5.0 m
4. 9.5 m

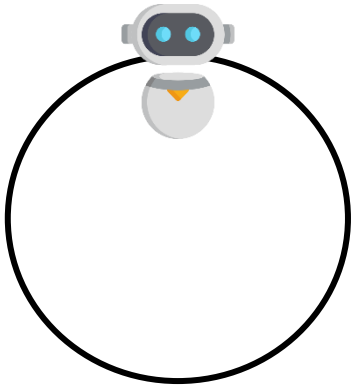
19. A helicopter is ascending vertically from the ground at a constant speed of 15 m/s. At the exact moment the helicopter reaches a height of 20 m above the ground, a crew member drops a supply bag out of the door. Assuming the helicopter continues upward at its constant speed and there is no air resistance, what is the height of the helicopter when the supply bag hits the ground? (2.5 marks)

1. 20 m
2. 35 m
3. 50 m
4. 80 m

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20. A small robot moves along a circular path with a radius of 4 m, traveling counterclockwise for 5 s and completing exactly 3.25 revolutions. At the end of the 5 s interval, the robot is located at the very "top" of the circle. What was the robot's average speed during this time, and what is the direction of its average velocity vector? (2.5 marks)

1. $\frac{26\pi}{5}\ m/s,\ \nwarrow$
2. $\frac{26\pi}{5}\ m/s,\ \nearrow$
3. $\frac{4\sqrt{2}}{5}\ m/s,\ \nwarrow$
4. $\frac{4\sqrt{2}}{5}\ m/s,\ \searrow$



21. A laser beam travels from air into a plastic block with a refractive index of 1.5. If the incident ray hits the surface at a 45° angle to the normal, what is the approximate angle of refraction? (2.5 marks)

1. 28°
2. 45°
3. 53°
4. 60°

22. A waterproof wooden crate measuring 50.0 cm × 50.0 cm and a height of 100.0 cm. The crate floats upright in the liquid without tilting. When 25% of its height is submerged, the buoyant force acting on the crate is 500 N. What is the density of the liquid? Use g =10 m/s². (2.5 marks)

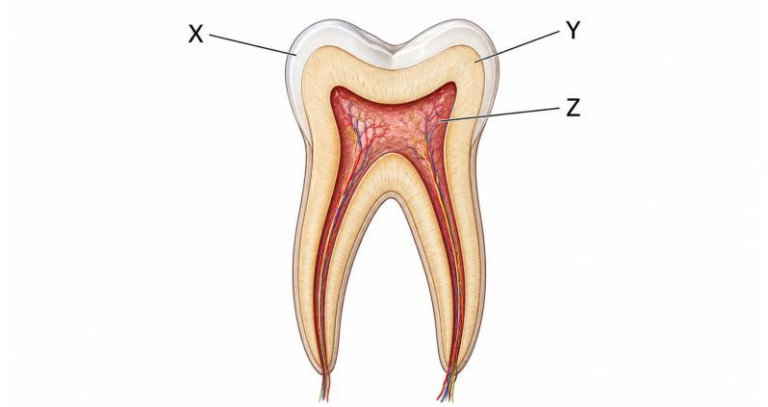
1. 750 kg/m³
2. 800 kg/m³
3. 850 kg/m³
4. 900 kg/m³

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23. A 5.0-cm-tall object is placed 18.0 cm in front of a convex lens that has a focal length of 12.0 cm. A concave lens is then placed 24.0 cm behind the convex lens. If the final image forms 66.0 cm from the object, what is the focal length of the concave lens? (2.5 marks)

1. 12.4 cm
2. 16.0 cm
3. 18.9 cm
4. 24.0 cm

24. The diagram below shows a cross-section of a human tooth.



Which of the following choices correctly identifies the labels in the diagram? (2.5 marks)

1. X - dentine; Y - enamel; Z - pulp cavity
2. X - dentine; Y - pulp cavity; Z - enamel
3. X - enamel; Y - pulp cavity; Z - dentine
4. X - enamel; Y - dentine; Z - pulp cavity

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25. Consider the changes of substance A in the following situations:

(1) Add solvent B to substance A and stir until completely dissolved, resulting in a clear, colorless solution.

(2) Heat the solution from (1) until solvent B completely evaporates, leaving substance A as a solid.

(3) Continue heating the substance A until it turns black and produces a burning smell.

Consider the following statements:

A. Situation 1 is a physical change.

B. Situation 2 is a chemical change.

C. Situation 3 is a chemical change.

D. Substance A in situations 1 and 2 remains the same substance.

Which of the following is correct? (2.5 marks)

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

26. Which row correctly shows where glucose will be found in the body of a healthy human after finishing a meal? (2.5 marks)

Choice	Renal artery	Renal vein	Glomerulus	Nephron	Ureter
1.	Yes	No	Yes	Yes	Yes
2.	Yes	Yes	No	No	No
3.	Yes	Yes	Yes	Yes	No
4.	No	Yes	No	No	Yes

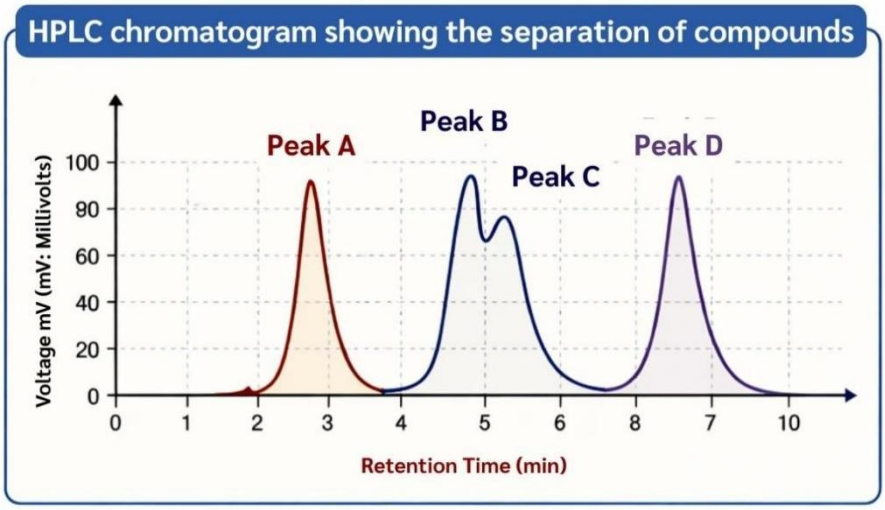
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27. In scientific analysis, researchers often need to separate a mixture into its individual components to accurately study the properties of each substance. One of the popular tools used is High-Performance Liquid Chromatography (HPLC), which was developed based on the principles of chromatography.

Inside the HPLC instrument, a solvent (mobile phase) acts as the carrier for the substances, and a column packed with an adsorbent (stationary phase) acts to retain them. When a mixture is injected into the system, each substance moves through the column at a different rate – some moves quickly, while others move slowly – depending on their retention and interaction with the stationary medium.

As the substances exit the column, they are detected and displayed as a graph called a 'chromatogram' where the horizontal axis represents time, and the vertical axis represents signal intensity. Each peak on the graph represents an individual substance, and the position of the peak indicates the retention time (the time the substance takes to exit the system). Generally, substances with lower affinity for the stationary medium will travel faster, while those with higher affinity will travel slower.

However, if certain substances have similar properties, their peaks may appear very close together or overlap, resulting in poor separation and analytical errors. When a particular sample is analyzed using the HPLC instrument, the resulting chromatogram is shown in the figure.



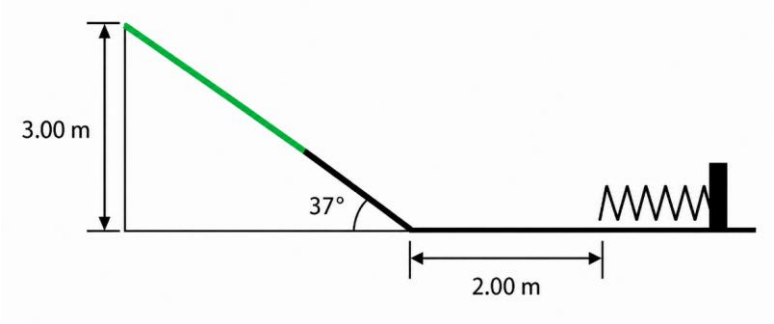
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Since Peak B and Peak C are not clearly separated, what problem do you think occurred during the separation process, and how will it affect the analysis?

Which of the following best describes the problem that occurred and its impact on the analysis? (5 marks)

1. It is caused by substances B and C having low solubility in the solvent, causing them to move slowly, resulting in the inability to detect clear signals.
2. It is caused by substances B and C having similar properties, causing them to elute from the column at similar times, resulting in overlapping peaks and unclear separation.
3. It is caused by the detector having low sensitivity, making the peaks of substances B and C small and inseparable.
4. It is caused by substances B and C having an excessive amount, making the peaks too high and difficult to separate.

28. A 2.0 kg box is released from rest at the top of an inclined plane that makes a 37° with the horizontal. The release point sits 3.00 m vertically above the horizontal floor. While the upper section of the incline is frictionless, the lower 1.25 m of the slope and the entire horizontal floor are rough, each sharing a kinetic friction coefficient of 0.5. A light spring with a spring constant of 600 N/m is fixed to a wall on the horizontal floor, positioned 2.00 m from the bottom of the incline, as shown in the figure.



Assume that g = 10 m/s², sin 37° = 0.6, and cos 37° = 0.8, what is the maximum compression of the spring? (5 marks)

1. 20.0 cm
2. 25.5 cm
3. 30.0 cm
4. 35.5 cm

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29. A group of students was assigned to study "Changes in Everyday Substances" by designing an experiment to observe the characteristics of the changes that occur.

They put baking powder into a test tube. Then, using a measuring cylinder, they slowly added vinegar while using the thermometer to measure the temperature of the substance throughout the experiment. What happened is shown in the figure. After the reaction ended, they touched the surface of the test tube and found that the temperature had decreased slightly.



Which of the following is the most accurate conclusion about the change that occurred in this experiment? (5 marks)

1. It is a physical change because the substances remain in the liquid and solid states.
2. It is a chemical change because a gas is produced and there is a change in energy.
3. It is a physical change because the substances can be separated later.
4. It cannot be concluded from the given information.

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30. A province with a large coastline experienced severe coastal erosion and decided to construct a sand groin – an engineering structure placed perpendicular to the shoreline to trap sand sediment. After the sand groin was installed, as shown in the diagram.



(figure sand groins)

What would be the effects on the coastline after 5 years have passed? (5 marks)

1. Sand is consistently trapped and deposited along the coastline, increasing the overall beach area.
2. The beach area up-drift of the current will expand, while the beach area down-drift will be eroded more severely.
3. Wave intensity is reduced in areas where sand groins are constructed, resulting in better mangrove forest growth compared to using the concrete pole method.
4. Sand groins help redirect coastal currents towards deeper water, minimizing the impact of currents on the beach.

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31. The students conducted hardness tests on three unknown minerals using equipment with known Mohs hardness scale ratings and obtained the following results:

Mineral A can scratch Mineral B.

A copper coin (hardness 3.5) can scratch Mineral B, but cannot scratch Mineral A.

Mineral C can scratch glass (hardness 5.5), and glass can scratch Mineral A.

Which of the following correctly ranks the hardness of the minerals on the Mohs scale from highest to lowest? (1.25 marks)

1. A > B > C
2. C > B > A
3. C > A > B
4. B > A > C

32. A student wants to treat highly acidic soil to make it suitable for planting crops. There are 4 types of solutions available to choose from: A, B, C, and D.

Since a pH meter is not available, the student used indicators to test the properties of each solution. The results are shown in the table below:

Solution	Phenolphthalein	Methyl orange	Bromothymol blue
A	Colorless	Red	Yellow
B	Pink	Yellow	Blue
C	Colorless	Orange	Green
D	Colorless	Yellow	Green

If the student must choose the most suitable solution to treat the soil so that its pH is close to 7, while avoiding making the soil too acidic or too basic:

Consider the following statements:

A. Solution B is not suitable because it may make the soil too alkaline.

B. Solution A can be used because it helps reduce the acidity of the soil.

C. Solution D is the most suitable for treating the soil.

D. Solution C is not suitable because its properties cannot be clearly determined.

Which of the following is correct? (1.25 marks)

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

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33. A student in Bangkok placed a wooden pole perpendicular to the ground and recorded the length of its shadow at noon throughout the year. He found that there are two days in a year when the shadow of the wooden pole disappears.

Which of the following correctly explains the position or apparent path of the sun corresponding to this phenomenon? (2.5 marks)

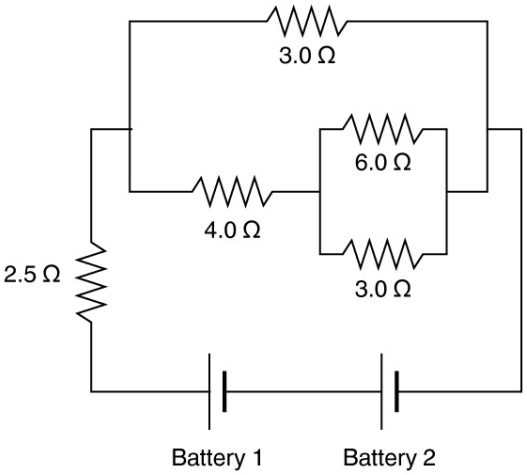
1. It is the day when the sun passes through the zenith.
2. It is the day when the sun is at the lowest point at noon.
3. It is the day when the sun is at the highest point at noon.
4. It is a day when the length of daytime is equal to the length of nighttime.

34. On a typical day, the highest tide at the coast of Samut Prakan province occurs at 10:00 AM. On the following day (24 hours later), at approximately what time should the highest tide occur at the same location, and for what reason? (2.5 marks)

1. 10:00 AM, because the Earth completes one rotation on its axis in 24 hours.
2. 11:30 AM, because due to the gravitational pull of the Sun, the Earth's rotation slows down by 90 minutes each day.
3. 10:25 AM, because the Moon orbits the Earth in the same direction as the Earth's rotation, so the high tide occurs after a slight lag due to the Earth's rotation.
4. 10:50 AM, because when the Earth completes one full rotation, the Moon has moved forward in its orbit, causing the Earth to rotate about 12 degrees more to align with the Moon again.

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35. Consider the circuit shown in the diagram below:



Battery 1 has an emf of ε_1 = 9.0 V and an internal resistance of r_1 = 0.2 Ω. Battery 2 has an emf of ε_2 = 9.0 V and an internal resistance of r_2 = 0.3 Ω. The two batteries are connected in series. What is the current that is flowing through the 4.0 Ω resistor? (2.5 marks)

1. 0.6 A
2. 1.2 A
3. 1.8 A
4. 2.4 A

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36. A student wants to produce a certain type of gas to use in a laboratory experiment. Four substances are available: A, B, C, and D. The student conducted a preliminary test by mixing each substance with substance X under the same conditions and records the results as follows:

Substance	Observation
A	Dissolves in substance X, resulting in a clear solution with no gas bubbles observed.
B	A large amount of gas bubbles is produced, and the temperature of the substance increases.
C	The substance turns into a liquid but can be returned to its original solid state when cooled.
D	A white precipitate is formed, but no gas is observed.

The student must select the substance that is most suitable for producing a gas.

Consider the following statements:

A. Substance B is the most suitable because gas is produced and there is a change in energy.

B. Substance A is not suitable because it is merely a physical change.

C. Substance C undergoes a chemical change.

D. Substance D undergoes a chemical change but is not suitable for gas production.

Which of the following is correct? (2.5 marks)

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

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37. Students conducted an experiment to study the effect of light intensity on the photosynthetic rate of the Canadian pondweed (*Elodea canadensis*). They cut 3 shoots of the plant to approximately the same size, placed them into beakers containing equal volumes of water, and positioned them at different distances from a 60 W light bulb. Throughout the experiment, the temperature was kept constant at 25 °C. They then counted the bubbles produced per 1 minute, yielding the following results:

Table 1 Bubble count without $NaHCO_3$

Distance from bulb (cm)	Bubbles per min
40	15
20	35
10	60
5	61

The student noticed that the number of air bubbles at a distance of 5 cm and 10 cm were almost identical, despite the 5 cm distance receiving the most light. Therefore, they conducted a second set of experiments by adding a small amount of sodium hydrogen carbonate ($NaHCO_3$) into the water before starting each round of the experiment.
The $NaHCO_3$ dissolves in water and releases CO_2. They then repeated the experiment at all the original distances and obtained the following results:

Table 2 Bubble count with $NaHCO_3$

Distance from bulb (cm)	Bubbles per min
40	16
20	36
10	85
5	87

From the results of both sets of experiments, which of the following is the most accurate conclusion? If the scientist wants to further increase the rate of photosynthesis at a distance of 5 cm, what adjustments should be made? (5 marks)

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1. Adding $NaHCO_3$ increases the rate of photosynthesis at all distances, even if the increase varies across each distance. However, it can be concluded that CO_2 is the primary limiting factor under all experimental conditions. Therefore, to further increase the rate of photosynthesis at a distance of 5 cm, more $NaHCO_3$ should be added because when there is sufficient light, CO_2 becomes the main variable controlling the rate of the reaction.

2. The fact that the results at 5 cm do not differ from those at 10 cm, even after adding $NaHCO_3$ indicates that the algae have reached saturation for both light and CO_2 simultaneously at this distance. The remaining factor that could still be limiting is the amount of chlorophyll present in the algae, which cannot absorb any more regardless of how much light or CO_2 is increased. Therefore, to increase the rate of photosynthesis, the number of algae sprigs in the beaker should be increased instead.

3. At distances of 40 cm and 20 cm, the addition of $NaHCO_3$ causes a slight increase in results, indicating that CO_2 affects photosynthesis equally across all distances. As for the 5 cm distance, where the results did not shift much, it is likely because the heat from the lamp accelerated the reaction just as the CO_2 ran out. Therefore, to improve results at 5 cm, both the water temperature and the amount of $NaHCO_3$ should be increased, as these two factors work cooperatively.

4. At distances of 40 and 20 cm, adding $NaHCO_3$ has almost no effect, indicating that at further distances, light is still the limiting factor. However, at 10 and 5 cm, adding $NaHCO_3$ shows a clear benefit, indicating that CO_2 has now become the limiting factor instead. Nevertheless, the results at 5 cm remain close to those at 10 cm even after adding $NaHCO_3$, suggesting that another factor has come into play as a limitation – potentially enzymes starting to denature due to heat from the lamp at a close distance. Therefore, the water temperature in the beaker should be lowered while simultaneously adding more $NaHCO_3$.

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38. In a science class on separation techniques, students learned about High-Performance Liquid Chromatography (HPLC), a method used to separate substances based on differences in their interactions with a stationary phase and their movement in a solvent.

The teacher explained that this technique is highly effective for separating complex mixtures. However, since the school laboratory does not have access to such equipment, the students were required to design an experiment using basic methods to separate a sample mixture instead.

One group of students chose to use filter paper as the stationary phase. They poured a solvent into a beaker and placed a piece of filter paper with a small spot of the sample at the starting point. The paper was then allowed to stand so that the solvent could move upward along it.

After some time, the mixture separated into several colored bands at different positions. Some bands traveled farther, while others moved only a short distance.

The students observed that substances that traveled farther tended to be more soluble in the solvent and had weaker attraction to the paper.

Consider the following statements:

A. This experiment is based on the same principle as HPLC.

B. Substances that travel farther have stronger attraction to the paper.

C. This method depends on differences in solubility and absorption of substances.

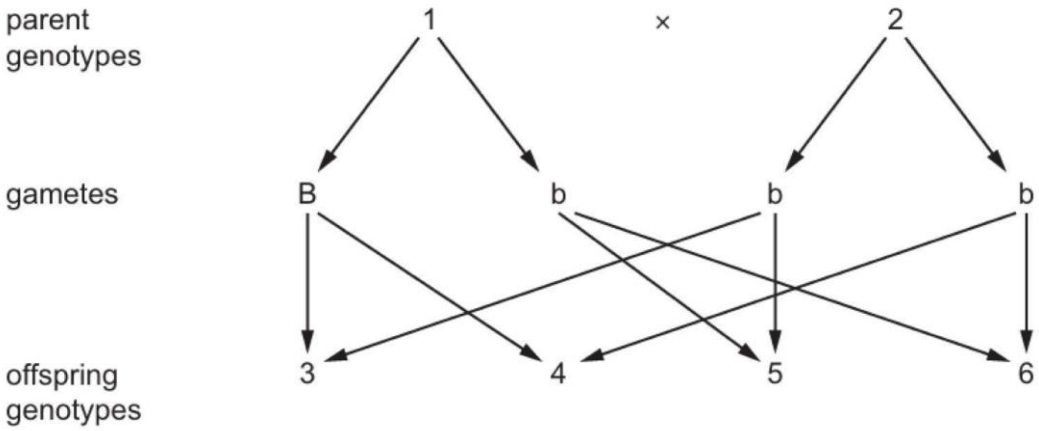
D. This method is a type of chromatography.

Which of the following is correct? (5 marks)

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

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39. The diagram illustrates a cross between two parents to study a single trait. B is the dominant allele, whereas b represents the recessive allele.



Based on the diagram, which individuals have a “heterozygous” phenotype? (5 marks)

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

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40. A group of students conducted an experiment using two pieces of limestone of equal mass as follows:

Block 1: Remained as a single, large cube.

Block 2: Was broken into many small pieces.

A 10% hydrochloric acid solution was poured over both sets of limestones.

The experimental results showed that Block 2 dissolved and produced gas bubbles significantly faster than Block 1.

Which of the following natural processes correctly explains the student's experiment results? (5 marks)

1. Natural acids are more effective at breaking down large rocks than small rocks.
2. Physical weathering increases the surface area, resulting in faster chemical weathering.
3. Surface area has no effect on the rate of weathering; it depends on the type of minerals that compose the rock.
4. Chemical weathering occurs most effectively when the rock has not previously undergone physical weathering.

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

Please check your answers before submitting the answer sheet.

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Answers Keys : Science Secondary - Grade 9

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

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