1. Hydrogen peroxide (H_2O_2) is a toxic compound that is produced by plant and animal cells. These cells also produce the enzyme catalase, which converts H_2O_2 into water and oxygen gas, preventing the buildup of H_2O_2. A student designed an experiment to test the effect of an acidic pH on the rate of the reaction of H_2O_2 with catalase. The data below summarize the outcome of the experiment.

pH Level	**7 (neutral)**	**6**	**5**	**3**
Reaction Rate (mL of oxygen/minute)	1.5	1.3	1.0	0.55

The best explanation for the change in catalase activity as the pH changed from 7 to 3 is that

1. strong acid digests the catalase, causing the reaction rate to increase
2. the student most likely cooled the H_2O_2 solution, causing the reaction rate to increase
3. in acidic solutions, the shape of catalase changes, causing the reaction rate to decrease
4. decreased oxygen production causes catalase to increase the rate of reaction

2. Colombia is a country in South America that grows and exports a large portion of the coffee that is used by Americans. A group of scientists in Colombia conducted an experiment on the effects of coffee on the development of Alzheimer's disease in elderly people. Their conclusion was that drinking coffee every day will decrease the occurrence of Alzheimer's disease, and they recommended that Americans drink coffee several times a day. In order to evaluate this conclusion and before they encourage Americans to drink more coffee, scientists in the United States should

1. construct a data table to test the hypothesis
2. go to Colombia and see how the coffee is grown
3. provide coffee to people with Alzheimer's and see if it cures their disease
4. conduct their own experiments to see if they arrive at the same conclusion

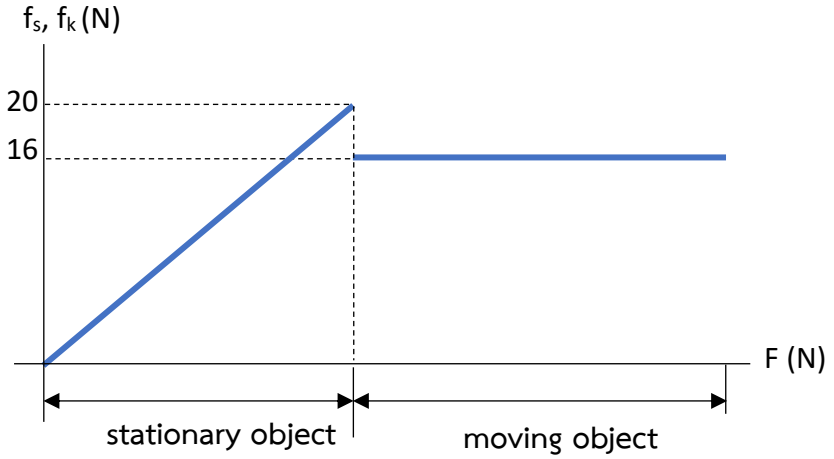
3. The table below shows the colour changes of bromophenol blue when used in acidic and alkaline solutions.

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

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

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

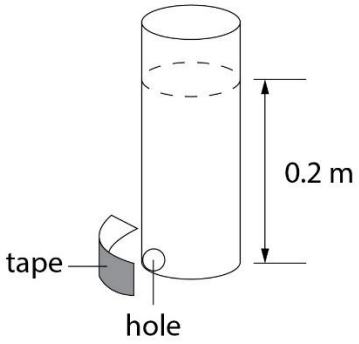
4. The graph below shows the relationships between static friction (f_s), kinetic friction (f_k), and tension (F) from an experiment on friction. The maximum static friction ($f_{s,max}$) is 20 N, and the kinetic friction (f_k) is 16 N.



According to the graph, if a student exerts a pulling force of 40 N, the object would accelerate at 4 m/s². How much of the pulling force should the student reduce to maintain a constant velocity of this object while moving?

1. 10 Newton
2. 16 Newton
3. 20 Newton
4. None of the above

5. A container is filled with water of density 1000 kg/m^3 to a height of 0.2 m. The base of the container is accidentally broken and water leaks out from a tiny hole of area 2.0×10^{-6} m^2. To prevent water from leaking out, a sticky tape is adhered over the tiny hole. [Take g = 10 N/kg]



What is the minimum force the tape must be able to withstand?

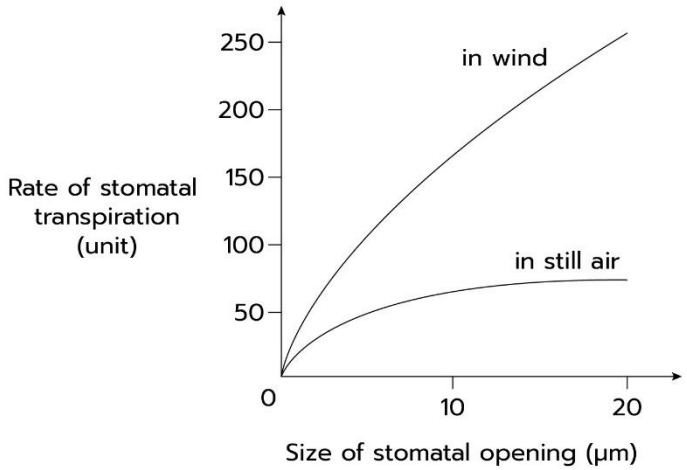
1. 0.002 N
2. 0.004 N
3. 2000 N
4. 4000 N

6. Iodine solution (brown) is commonly used to test for starch. It turns blue-black in the presence of starch.

When iodine is added to the leaf of plant A that has been cut open, a brown colour is seen. When it is added to the leaf of plant B that has been cut open, a blue-black colour is seen. Which of the following statements reflects the observation best?

1. Leaf A is not able to undergo photosynthesis.
2. Leaf B has just undergone respiration.
3. Leaf A has been left in the Sun for some time before it is cut open.
4. Leaf B has been left in the Sun for some time before it is cut open.

7. The graph below shows the relationship between the rate of stomatal transpiration and the size of stomatal opening of a plant.



Which of the following is the best conclusion from the graph?

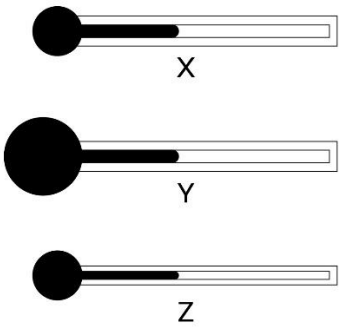
1. The humidity of the air affects transpiration rate.
2. The stomata open much wider under windy conditions.
3. The wider the stomata, the higher the rate of transpiration.
4. The rate of water absorption of the plant is always lower in still air.

8. If a student is a barista and needs to heat 1.5 kg of water that is stored at 24°C in a stainless steel container to 94°C, which is an optimal temperature for coffee extraction, using a programmable kettle that can customize the heating time and produce heat at a rate of 2,000 J/s, how long should the timer be set for to achieve the water temperature closest to the optimal temperature for coffee extraction?

Assume that the specific heat capacity of water is 4,200 J/kg·K, the heat capacity for a stainless steel container is 500 J/K, and no heat is lost to the surroundings.

1. 4 minutes
2. 4 minutes and 20 seconds
3. 4 minutes and 40 seconds
4. 5 minutes

9. The figures below shows three mercury thermometers, X, Y and Z, which are identical in every aspect except Y has a bigger bulb and Z has a smaller bore capillary tube.



Which of the following correctly describes sensitivity and range of the thermometer?

	Sensitivity	Range
1.	Z > X	Y > Z
2.	Z > Y	X > Z
3.	Z > X	X > Y
4.	Y > Z	X > Z

10. A transition metal V can form two cations, V^{2+} and V^{3+}. The following are four formulae of the oxides.

(A) **V**O (B) **V**O_3

(C) $\mathbf{V}_2O_3$ (D) $\mathbf{V}_2O_2$

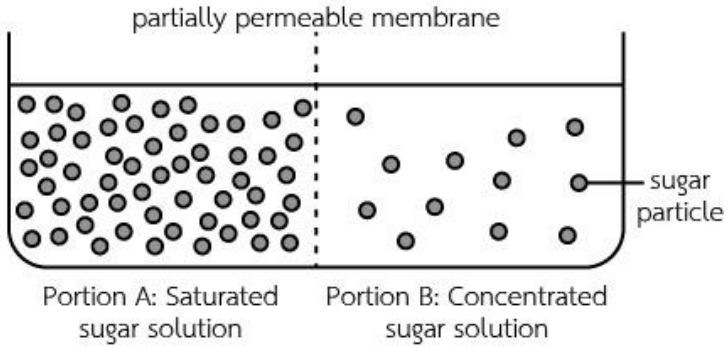
What would the formulae of the oxides of **V** be?

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

11. Which of the following statements best describes alloys?

1. Alloys are mixtures of compounds.
2. Alloys are man-made metals consisting of only 2 elements.
3. Alloys are substances that cannot be separated by any means.
4. Alloys are mixtures with special properties that the individual metal constituents do not possess.

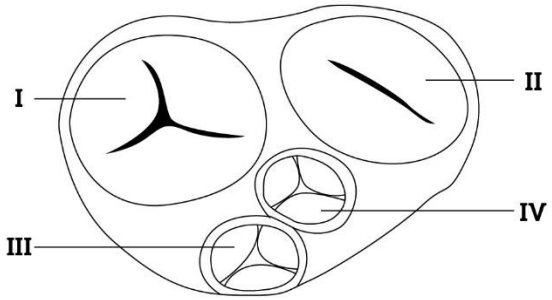
12. The diagram below shows a saturated sugar solution and a concentrated sugar solution separated by a partially permeable membrane. What will happen after both solutions are allowed to stand for an hour?



A. Portion B will become diluted.
B. Portion A will remain the same.
C. Portion A will become less concentrated.
D. The level of the solution in portion A will rise.

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

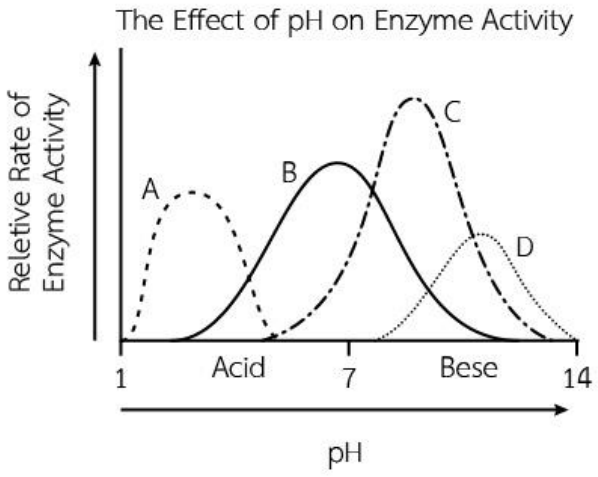
13. The diagram below shows the cross-section of a mammalian heart with the structures of various valves. (The parts are not drawn to scale.)



Which of the following valves close when the ventricles are contracting?

1. Valves I and II
2. Valves I and III
3. Valves II and IV
4. Valves III and IV

14. Students did an experiment comparing the activity of four different enzymes A, B, C, and D. The results are represented in the graph below.



A valid conclusion based on the information in the graph is that

1. the pH of some enzymes changes as the temperature changes
2. enzymes change color in proportion to the rate of activity
3. a difference in the pH of an environment changes enzyme activity
4. enzyme activity causes acids to change into bases over time

15. Students were studying the different species of organisms in two different pond ecosystems. Their findings are summarized in the chart below.

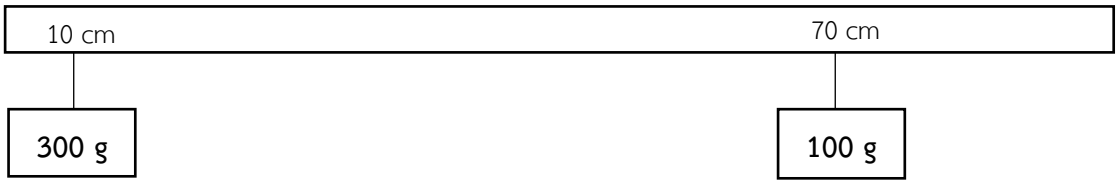
Species Present in Two Pond Ecosystems

	Plant Species	Microorganism Species
Pond A	10	20
Pond B	11	5

Based on the information in the chart, how does the biodiversity present in pond A compare to the biodiversity present in pond B?

1. Pond A has greater biodiversity than pond B because there are more species present.
2. Pond B has more biodiversity than pond A because there are more plants present.
3. Both ponds have the same levels of biodiversity because there is a variety of species present.
4. The biodiversity cannot be determined without also identifying the abiotic factors present.

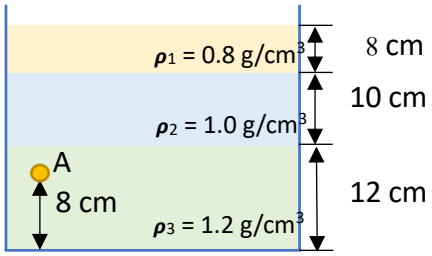
16. According to an experiment, the masses of 300 g and 100 g are placed at the positions of 10 cm and 70 cm, respectively, on a uniform meter rod weighing 200 g, as shown on the figure below.



Where should the student tie the string so that it can hang in equilibrium when being suspended? Assume that acceleration due to gravity is given as 10 m/s².

1. 22.22 cm
2. 25.00 cm
3. 30.15 cm
4. 33.33 cm

17. An opened container contains three types of liquid. The density of the liquid from top to bottom is 0.8 g/cm³, 1.0 g/cm³, and 1.2 g/cm³, respectively, as shown on the diagram.



Find the Gauge pressure at point A in Pascal (Pa), assuming that acceleration due to gravity is 10 m/s² and that atmospheric pressure is 101.3 kPa.

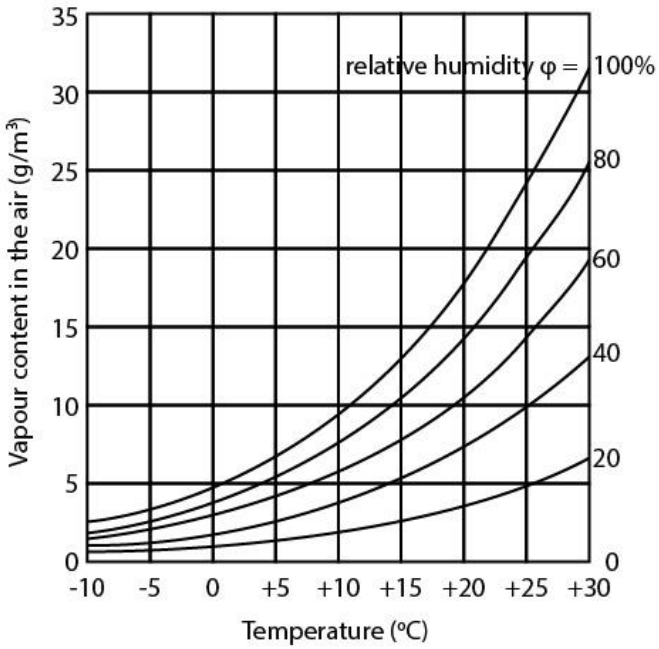
1. 212.0 Pa
2. 313.3 Pa
3. 2120.0 Pa
4. 3133.0 Pa

18. Which pairs of statements correctly describe the differences between the conduction of electricity during electrolysis and the conduction of electricity by metals?

	conduction during electrolysis	conduction by metals
1.	The current is due to the movement of both positive and negative ions.	The current is due to the movement of electrons.
2.	Charged particles move towards both electrodes.	Charged particles move in one direction only.
3.	It results in a chemical change.	It does not result in a chemical change.

1. 1, 2 and 3 are correct
2. 1 and 2 only are correct
3. 2 and 3 only are correct
4. 1 only is correct

19. A meteorologists collected the data of the air temperature and water vapor content, calculated the relative humidity, and presented the data in a graph as shown in the figure below:



From the data above Which of the statements is true?

1. As the amount of water vapor in the air increases, the temperature and the relative humidity decrease.

2. Rising air temperature leads to an increase in the amount of water vapor in the air, and, consequently, increases the relative humidity.

3. If the temperature is above 30 degrees Celsius and the amount of water vapor in the air increases, the relative humidity will decrease.

4. At 5 degrees Celsius, the air can have the same relative humidity even with different amounts of water vapor being present.

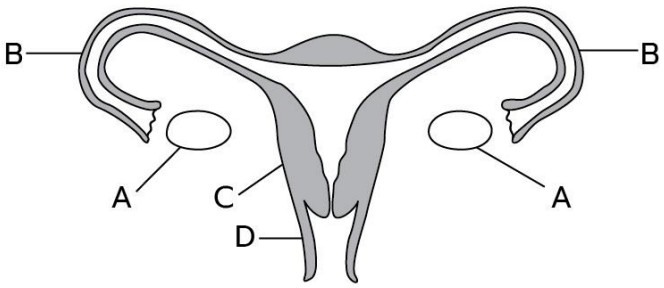
20. The United Nations Secretary-General António Guterres declared that the Earth is now entering what he referred to as "the era of global boiling." It is an intensified and urgent phase of climate change characterized by heightened heat waves, extreme weather events, and more frequent natural disasters. Simultaneously, human activities, especially since the time of the Industrial Revolution, contribute increasingly to a planet-wide temperature rise. According to the available data, scientists stress the importance of keeping the global temperature rise well below 1.5℃ to avoid severe impacts of climate change. From the following information,

A. Industrial activities
B. Crop rotation
C. Deforestation
D. Soil improvement for agricultural uses
E. Construction of large dams
F. Burning fossil fuels

which events contribute to global boiling?

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

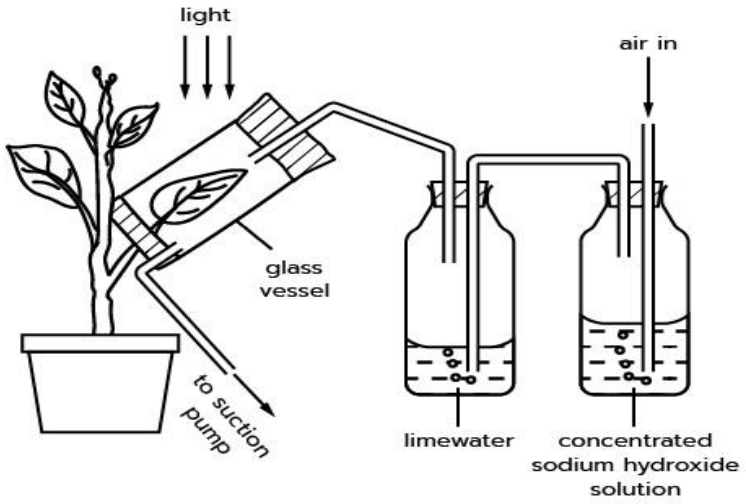
21. The letters in the diagram indicate structures present in a human female.



What would occur if both structures labeled B were damaged or blocked?

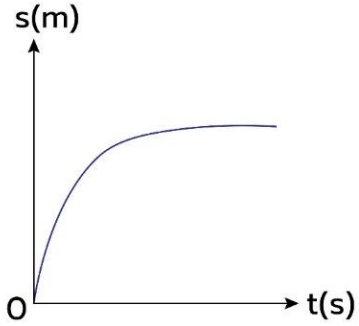
1. The egg would remain in the uterus and not travel to the ovary.
2. The egg would not be able to unite with the sperm.
3. The reproductive cycle in the female would stop.
4. The process of mitosis would stop in the ovary.

22. If the experiment is successful, which of the following can probably be observed when the leaf is tested?



1. The iodine solution will remain brown.
2. The iodine solution will turn bluish black.
3. A white emulsion will be obtained with ethanol emulsion test.
4. A brick-red precipitate will be obtained with Benedicts test.

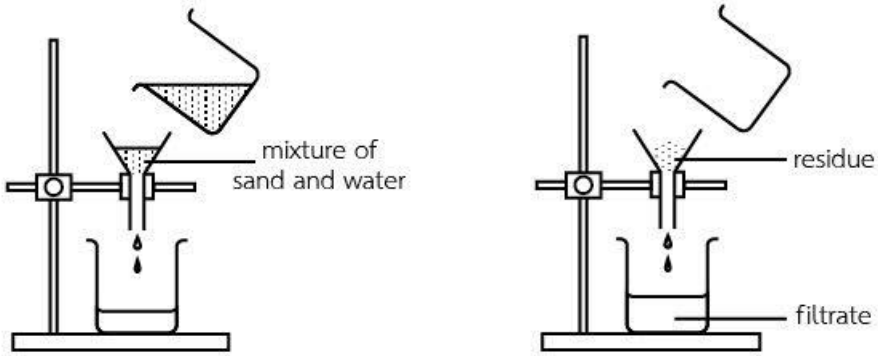
23. The graph below shows how the displacement of a runner changes with time.



Which of the following can be deduced from the graph?

1. The runner accelerates uniformly.
2. The runner accelerates until he reaches a steady velocity.
3. The runner decelerates until he comes to a rest.
4. The runner decelerates until he reaches a steady velocity.

24. The diagram below shows an experiment on filtration.

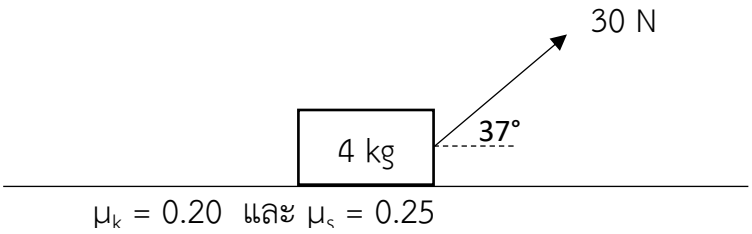


The mixture is separated based on _____.

A. the size of the particles of the filtrate
B. the size of the particles of the residue
C. the shape of the particles of the filtrate
D. the shape of the particles of the residue

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

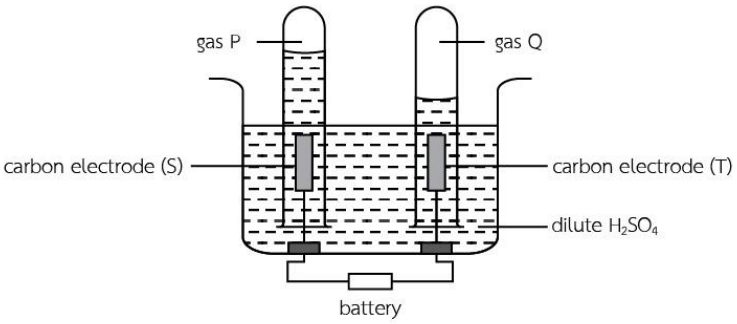
25. A mass of 4 kg is placed on a flat surface with coefficients of kinetic and static friction of 0.25 and 0.30, respectively. When a force of 30 N is applied to it at an angle of 37 degrees above the horizontal, as shown in the diagram, it causes the object to accelerate at 4.625 m/s².



Find the resultant force acting on this 4 kg object, given that cos 37° = 0.8, sin 37° = 0.6, and the acceleration due to gravity is 10 m/s².

1. 8.5 N
2. 12.25 N
3. 18.5 N
4. None of the above

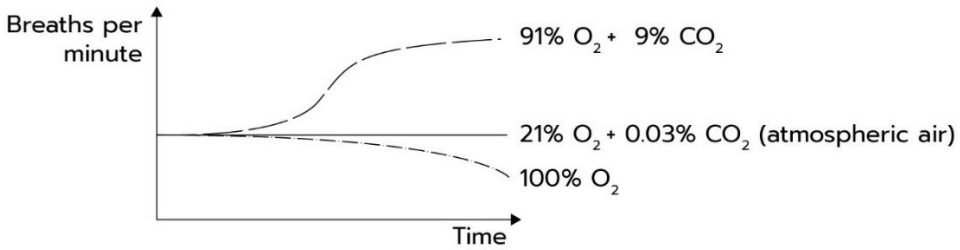
26. A current was passed through dilute sulfuric acid as shown in the diagram below.



Which of the following statements is correct?

1. Gas P is hydrogen.
2. Gas Q is oxygen.
3. Carbon electrode S is the anode.
4. SO_4^{2-} ions move towards carbon electrode T.

27. The graph below shows how the rate of breathing of a test subject changes under different conditions. At the beginning of each experiment, the subject is breathing in atmospheric air.



What conclusion may be derived from the graph?

1. Increase in carbon dioxide causes breathing rate to increase.
2. Increase in breathing rate causes carbon dioxide levels to increase.
3. Oxygen content in the air at 21% gives the greatest stability in breathing rate.
4. High levels of oxygen in the air cause breathing rate to drop, regardless of carbon dioxide levels.

28. Frostbite occurs when tissues freeze. This condition happens when you are exposed to temperatures below the freezing point of skin.

In conditions of prolonged cold exposure, your body sends signals to the blood vessels in your arms and legs telling them to constrict (narrow). By slowing blood flow to the skin, your body is able to send more blood to the vital organs, supplying them with critical nutrients, while also preventing a further decrease in internal body temperature by exposing less blood to the outside cold.

As this process continues and your extremities (the parts farthest from your heart) become colder and colder, a condition called the hunting response is initiated. Your blood vessels are dilated (widened) for a period of time and then constricted again. Periods of dilation are cycled with times of constriction in order to preserve as much function in your extremities as possible. However, when your brain senses that you are in danger of hypothermia (when your body temperature drops significantly below 98.6°F), it permanently constricts these blood vessels in order to prevent them from returning cold blood to the internal organs. When this happens, frostbite has begun

Source: http://webmd.com/a-to-z-guides/frostbite#1

Which is possible the long-term result of ?

1. Nerve damage may occur, leading to loss of sensation in the affected area.
2. Frostbite can cause chronic pain due to damaged nerves and tissues.
3. The body becomes more susceptible to infections due to compromised immune function.
4. Some cells/tissues may die when blood can no longer get to them when the vessels permanently constrict.

29. Which of the statements about the lymphatic system is true?

I : About 40% of the interstitial fluid enter the lymphatic system.

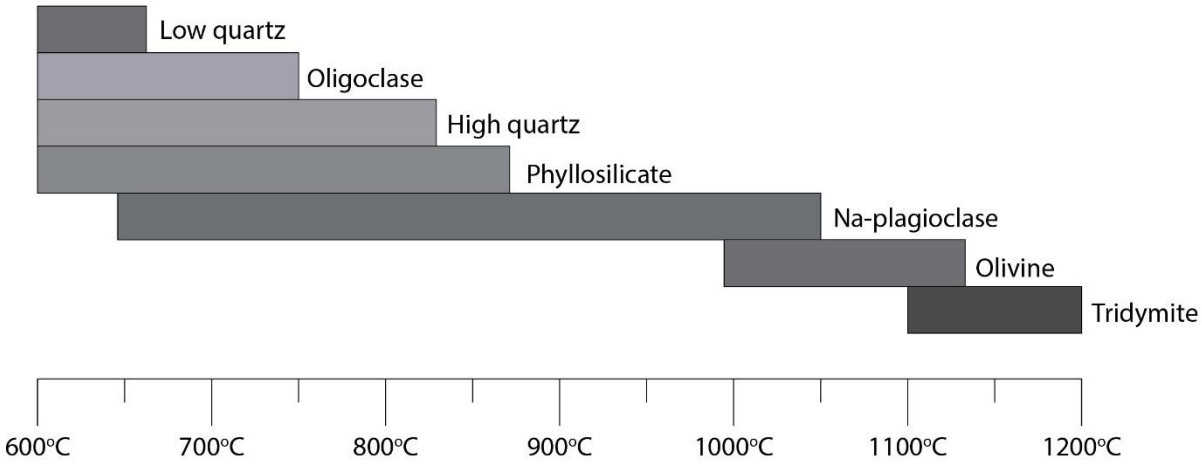
II : The lymphatic system is responsible for the transport of the products of lipid digestion.

III : The lymph nodes are places where useful substances from the lymph are absorbed back into the blood system.

IV : Lymph drains into the blood circulation via the thoracic duct that joins the left subclavian vein and the lymphatic duct that joins the right subclavian vein.

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

30. When molten magma from volcanoes cools down, The minerals in the magma crystallise (solidify). The graph below shows the different types of crystals formed at various temperatures as magma slowly cools.



At what temperature does Oligoclase begin to crystallise?

1. 600°C
2. 750°C
3. 850°C
4. None of the above

31. It is sometimes said that "one breathes faster when running because the muscles need more oxygen", Which of the following is the reason why the above statement is wrong?

1. The muscles do not use more oxygen when one is running.
2. It is not only when one is running that the muscles need more oxygen.
3. More oxygen is supplied to the muscles by more rapid circulation of the blood whether one breathes faster or not.
4. The stimulus for breathing is the concentration of carbon dioxide in the blood rather than a lack of oxygen.

32. Which of the following statements is true about the exchange of substances between a foetus and the mother?

I : The umbilical arteries carry deoxygenated blood to the placenta.

II : The umbilical vein carries oxygenated blood to the foetus.

III : Maternal blood crosses over the placenta into foetal blood.

IV : Alcohol and nicotine that have been consumed by the mother can enter foetal blood via the placenta.

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

33. The contraction of the cardiac muscles results in the pumping of the heart.

V - The impulses spread to both ventricles causing ventricular systole.

W - The sinoatrial node (SAN) generates electrical impulses.

X - The impulses reach the atrioventricular node (AVN).

Y - The impulses spread over the walls of the atria causing atrial systole.

Z - The Purkinje fibres conduct impulses to the apex of the heart.

Which of the following is the correct sequence of contraction of the cardiac muscles?

1. W, V, X, Y, Z
2. W, Y, X, Z, V
3. X, V, W, Y, Z
4. X, W, Y, Z, V

34. A barrel contains a 14-m layer of oil floating on water that is 30 m deep. The density of the oil is What is the gauge pressure at the bottom of the barrel? Given that density of the oil is 800 kg/m^3, density of the water is 1,000 kg/m^3, the atmospheric pressure is 100 kPa and the acceleration due to gravity is 10 m/s^2.

1. 312 kPa
2. 412 kPa
3. 512 kPa
4. 612 kPa

35. Some students tested two samples of a mixture of starch and water with two different indicators. The results of these tests are shown in Table 1 below.

Table 1 : Results of Testing a Starch-Water Solution with Indicators.

Indicator Used	Color of Indicator Alone	Sample Being Tested	Color of Sample After Indicator Was Added
starch indicator	amber	starch and water	black
glucose indicator + heat	blue	starch and water	blue

Next, a specific protein was added to two new samples of the starch and water mixture. After waiting 30 minutes, the students tested these samples with the same two indicator solutions. The results are shown in Table 2 below.

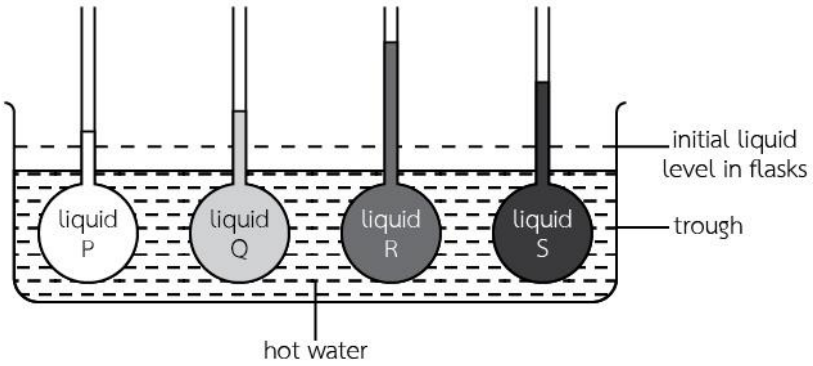
Table 2 : Results of Testing a Starch-Water Solution with Indicators 30 Minutes After Adding a Certain Protein

Indicator Used	Color of Indicator Alone	Sample Being Tested	Color of Sample After Indicator Was Added
starch indicator	amber	starch and water	amber
glucose indicator + heat	blue	starch and water	brick red

Based on these results, it can be concluded that the specific protein that was added to the samples was

1. a salt solution
2. a new indicator
3. a pancreatic hormone
4. a biological catalyst

36. Equal volume of different liquids at room temperature were placed in identical flasks and immersed in hot water. When the liquids reached the same temperature as the hot water in the trough, the liquid levels in the neck of the flasks were as shown in the diagram below.



What can we conclude?

1. Liquids increase their mass by different amounts for the same increase in temperature.

2. Liquids increase their volume by different amounts for the same increase in temperature.

3. Liquids increase their density by different amounts for the same increase in temperature.

4. Equal volumes of different liquids increase their temperature by different amounts.

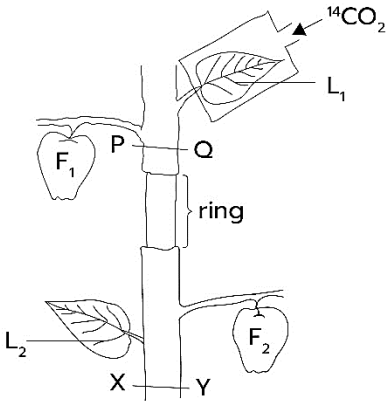
37. Munching on bacteria could be a good way to stimulate your immune system. Biologist Simon Cutting of the Royal Holloway University of London has transformed bacterial spores into an edible vaccine. He and his collaborators genetically altered the common bacterium *Bacillus subtilis* so that it produced harmless fragments of the toxin produced by tetanus. Then his team starved the bacterium so that it turned into a spore — a desiccated [dehydrated] packet tough enough to survive a trip through the digestive tract and into the bloodstream. Most of the mice that inhaled or ate the modified spores were then able to survive a lethal dose of tetanus.

"We selected tetanus because the immunology regarding this disease is well understood," Cutting says. But engineered bacteria could be similarly tailored to train the immune system to fight anthrax, traveler's diarrhea, and other illnesses. Edible vaccines would eliminate the need for needles and sterilizing equipment. Moreover, spores can withstand extreme heat and dryness, remaining viable [alive] for thousands of years. Cutting plans to start clinical trials in about two years. If the results measure up, spore vaccines could slash the cost of immunization programs, especially in poor countries where refrigeration is unreliable and transportation can be slow.

How could the immune system respond when exposed to the genetically altered *Bacillus subtilis*.

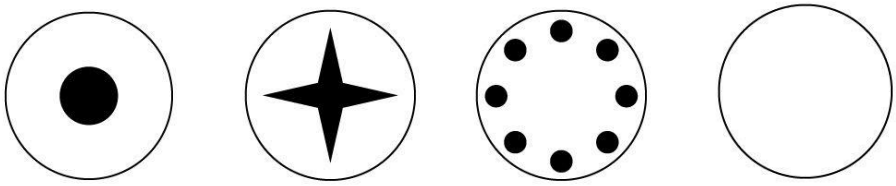
1. The immune system may produce enzymes to digest the bacteria.
2. The immune system may produce insulin to regulate blood sugar levels.
3. The immune system may produce antibodies to fight the tetanus bacteria.
4. The immune system may produce more red blood cells to fight the tetanus bacteria.

38. refer to the diagram below which shows an experimental set-up where a young plant with a ring of bark, containing the phloem, removed and leaf L_1 supplied with radioactive $^{14}CO_2$. The plant was exposed to light for 12 hours.



Thin sections were cut across the stem at PQ and XY. These sections were put on two photographic films. The dark area is the place where radioactivity is present. Which of the following combinations correctly represents the distribution of radioactivity at the two sections PQ and XY?

(1) (2) (3) (4)



	PQ	XY
1.	(1)	(2)
2.	(2)	(3)
3.	(3)	(2)
4.	(3)	(4)

39. Human activities have led to a temperature rise of approximately 1.0 degree Celsius compared to that of pre-industrial levels, and forecasts suggest a potential rise of up to 1.5 degrees Celsius by 2030-2052. If we want to help reduce global boiling, here are simple things that we can do:

A. Recycling household wastes.

B. Avoiding the use of products with a lot of packaging.

C. Providing alert systems for extreme weather events.

D. Relying more on walking, biking, or mass transit.

E. Introducing climate change education as a default pillar of education systems.

F. Turning off a television, stereo, and computer when they are not in use.

G. Outlawing greenhouse gas production to complete the switch to renewable energy.

Which of these things can we do ourselves?

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

40. Scientists have found a gene that makes a protein called PKG that controls certain behaviors in many types of ants. The soldier ant will help collect food when it has a low level of PKG. When it has a high level of PKG, the soldier ant will protect and defend its colony. Soldier ants that are given PKG are more likely to ignore food sources and attack intruders. Which conclusion can best be made from this information?

1. PKG protein is synthesized only by the soldier ants.
2. Genes control which type of amino acids a cell can make.
3. Eating too much protein makes some organisms very aggressive.
4. The behavior of soldier ants is controlled in part by the PKG protein.

คำตอบวิชาวิทยาศาสตร์ ชั้นมัธยมศึกษาปีที่ 2

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

* หมายเหตุ : ข้อ 25 เนื่องจากข้อความในคำถามและภาพไม่ตรงกัน กรรมการจึงพิจารณาคะแนนให้ทุกคน