14th International Mathematics and Science Olympiad (IMSO)
Science Theory Test 1

Singapore
21 November 2017

Instructions:

1. Do not turn over this page until you are told to do so.

2. Write and shade your index number on the Optical Answer Sheet.

3. Answer all the questions. A correct answer for each question will be awarded 1 mark.

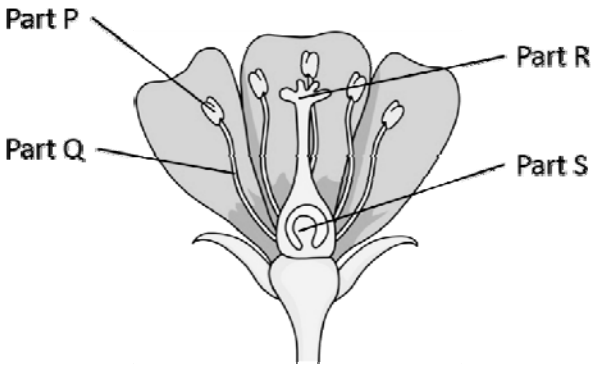
4. Use a 2B pencil to shade the bubble fully (●) for the alphabet (A, B, C, or D) that represents your answer for each question on the Optical Answer Sheet. An example is shown below:

Example **Question Paper**	**Answer Sheet**
1. Which of the following reasons explains why volcanoes erupt? A. It is supplied with magma. B. The clogged vent has been cleared. C. The magma is under pressure and is very buoyant. D. There is excessive pressure built up in the magma chamber.	**A B C D** **1** ○ ○ ○ ● **2** ○ ○ ○ ○ **3** ○ ○ ○ ○ **4** ○ ○ ○ ○ **5** ○ ○ ○ ○

5. There are 35 questions printed on a total of 16 pages, excluding the cover page.

6. You have 60 minutes to complete this test.

1 The figure below shows the longitudinal section of a flower.



Identify the parts that are the anther and stigma.

	Anther	**Stigma**
A.	Part Q	Part S
B.	Part R	Part S
C.	Part P	Part R
D.	Part R	Part P

2 Forensic scientists were tasked to collect samples from a crime scene to identify the culprit.

Which type of cells should the scientists extract from the samples in order to obtain all 23 pairs of chromosomes?

A. Egg cells
B. Sperm cells
C. Red blood cells
D. White blood cells

3 A population consists of all the organisms _____.

A. found in a particular area at the same time
B. found in a particular place in a food chain at the same time
C. of all the species that are found in a particular habitat at the same time
D. found in a given area at the same time that can interbreed with each other

4 Food chains usually contain no more than four trophic levels because _____.

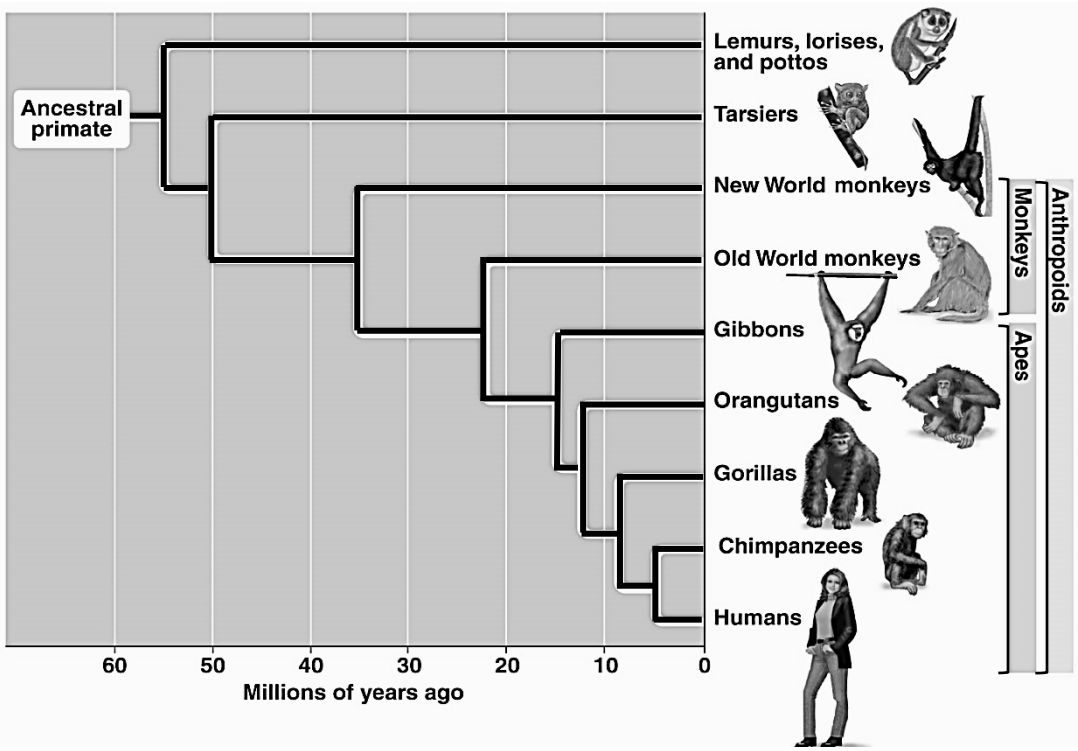
A. only a single species of herbivore feeds on each plant species.

B. predator species tend to be less diverse and fewer in numbers compared to prey species.

C. local extinction of a species causes the extinction of the other species higher up the food chain.

D. most of the energy is lost when organisms of the higher trophic level consumes the organism of a lower trophic level.

5 The figure below shows how primates can be classified.



Which of the following conclusions can be made from the figure?

A. Chimpanzees are a different type of monkey.

B. Gibbons belong to a subset of new world monkeys.

C. Humans are more similar to old world monkeys than they are to new world monkeys.

D. Lemurs are more different from tarsiers than they are different from new world monkeys.

6 Which of the statements below on respiration is false?

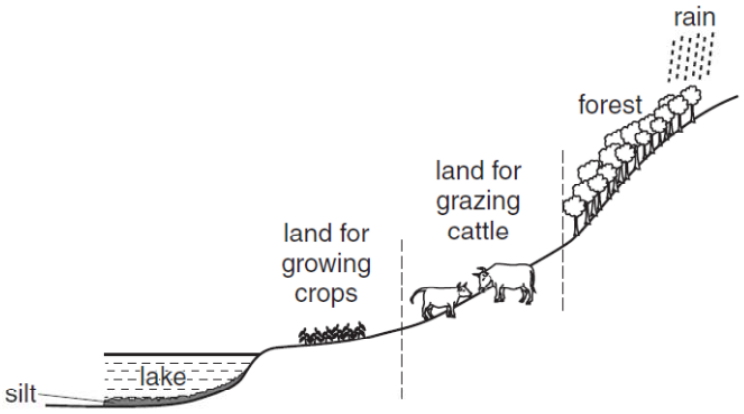
A. The amount of dust particles in exhaled air is more than inhaled air.

B. The concentration of nitrogen is the same in exhaled and inhaled air.

C. The concentration of water vapour in inhaled air is lower than in exhaled air.

D. In exhaled air, the concentration of oxygen is more than the concentration of carbon dioxide.

7 The figure below shows how some land near a lake is used.



Which of the following actions will most likely cause the lake to flood?

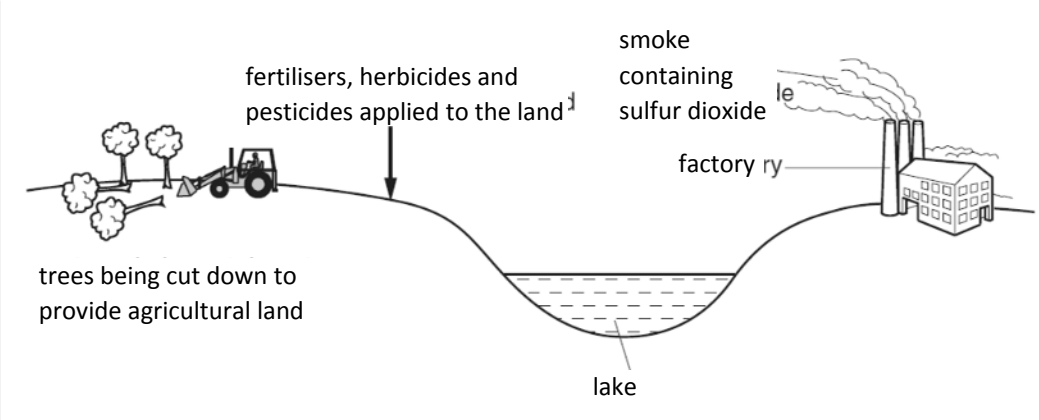
A. deforestation

B. removing the cattle

C. removing the silt from the lake

D. growing genetically modified organisms instead of the original crops

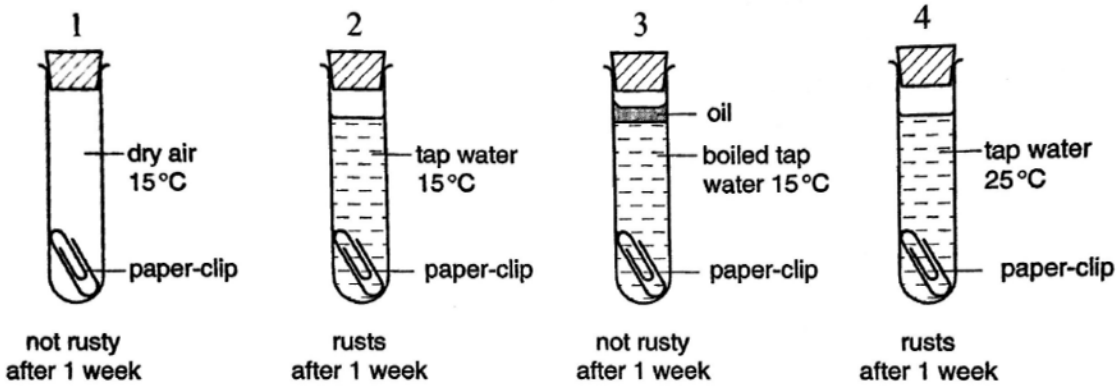
8 The figure below shows an area being developed for industry and agriculture.



Which of the following is most likely to cause an initial increase in plant life in the lake?

A. smoke
B. fertilisers
C. herbicides
D. pesticides

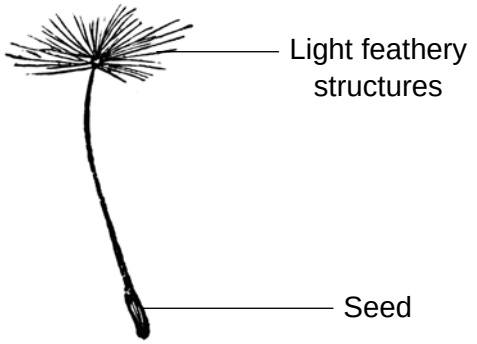
9 John wanted to find out the conditions needed for a metal paper clip to rust. His experimental set-ups and findings are shown below.



Which two set-ups can be used to show that water is needed for iron to rust?

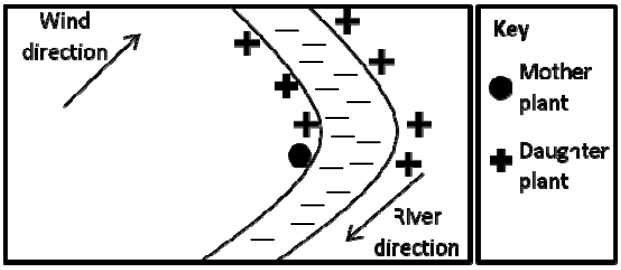
A. 1 and 2
B. 1 and 3
C. 2 and 3
D. 2 and 4

10 The fruit of Plant P is shown below.

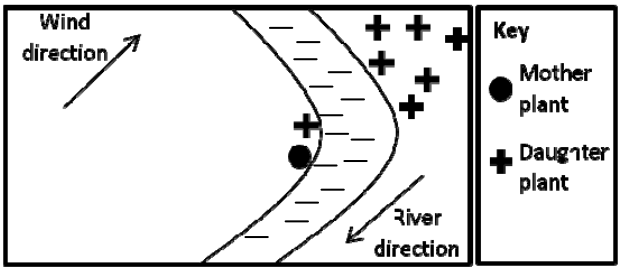


Which of the following maps correctly shows how Plant P is dispersed?

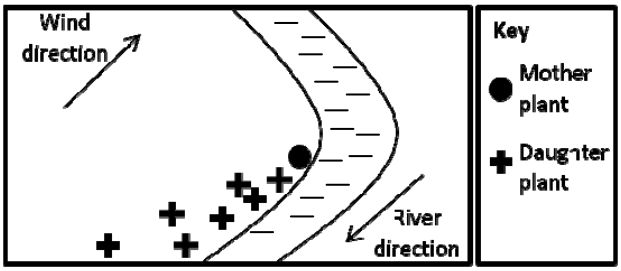
A.



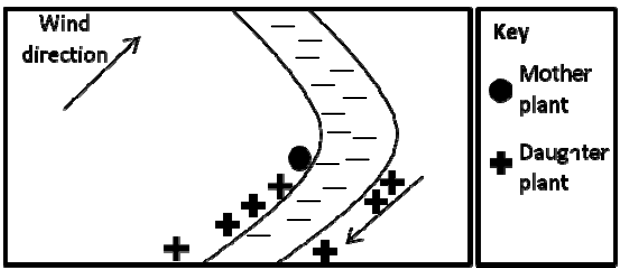
B.



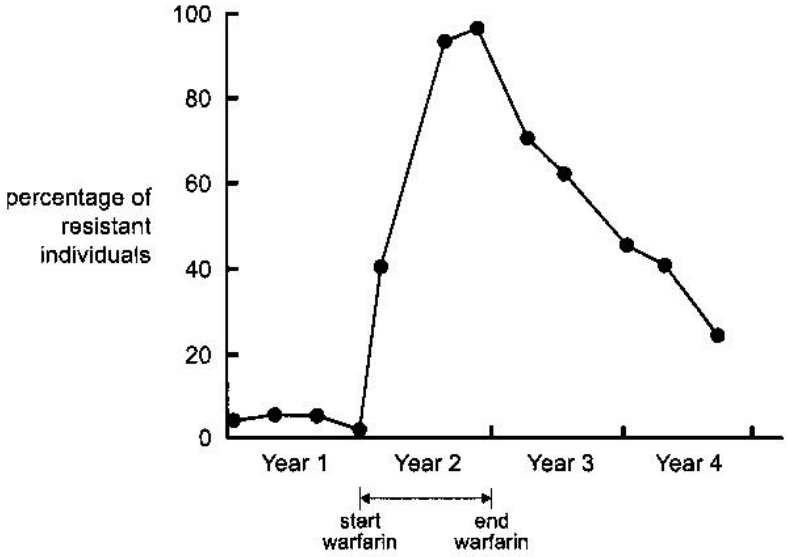
C.



D.



11 Warfarin is a poison used to control rat populations. It is an anticoagulant that prevents blood clotting. However, some rats are resistant to warfarin and are not affected by the poison. The figure below shows changes in the percentage of rats resistant to warfarin in a particular rat population over a period of about four years. High levels of warfarin were used on this population during Year 2.



Which of the following can be inferred from the graph?

A. The use of warfarin results in healthier rats in year 3 and 4.

B. Rats developed resistance to warfarin at the beginning of Year 2.

C. As with rats, the use of warfarin will result in high levels in human beings.

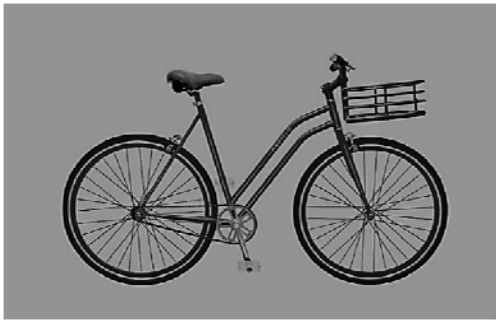
D. If even higher levels of warfarin were used at the beginning of Year 2, 100% of the rat population could become resistant to it at the beginning of Year 3.

12 The human body requires blood to supply enough oxygen to all parts of the body. A person involved in a car accident lost a large amount of blood and went into shock. How would his/her typical pulse rate and respiratory rate immediately change?

	Pulse rate	**Respiratory rate**
A.	Increase	Increase
B.	Increase	Decrease
C.	Decrease	Increase
D.	Decrease	Decrease

13 The pictures below show two cameras. One camera has a small hole for light to pass through and it produces photographs which are sharp, but dark.

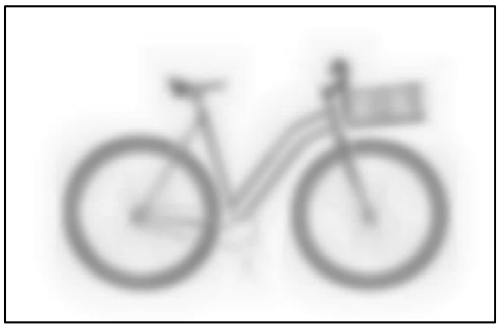
Camera with small hole



Sharp and dark picture

The other camera has a large hole for light to pass through, and produces photographs that are bright, but blur.

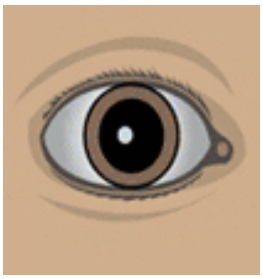
Camera with large hole



Blur and bright picture

How would pupils that are dilated (larger) affect vision?

Normal pupil



Dilated (larger) pupil

A. No change to vision.

B. Vision will be sharper and brighter.

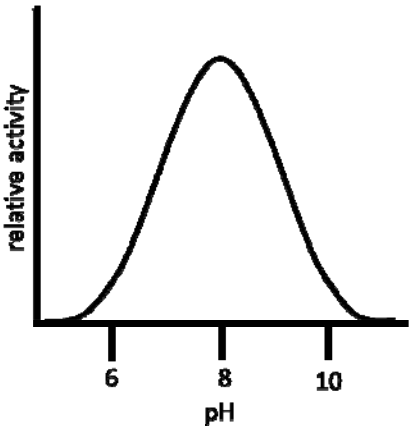
C. Vision will be blurred and brighter.

D. Vision will be sharper and dimmer.

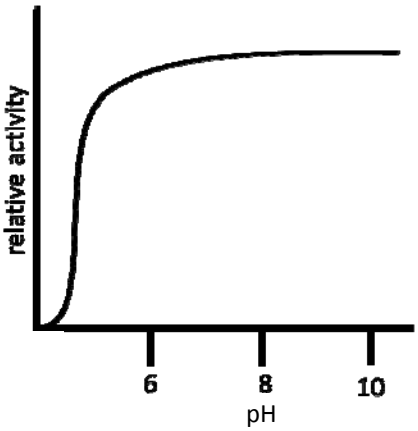
14 Protease is an enzyme which works in the stomach to digest protein.

Which of the following graphs best represents how protease activity varies with pH?

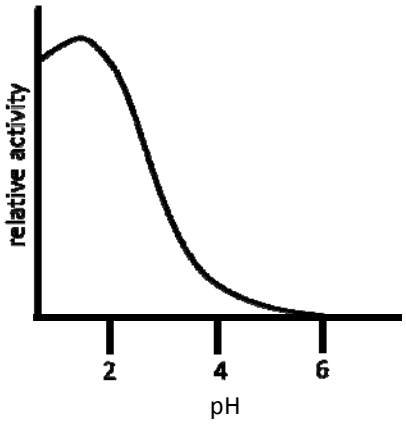
A.



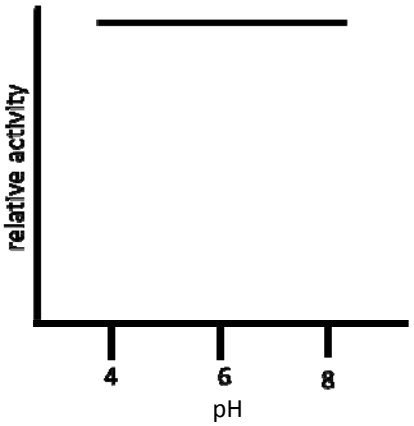
B.



C.



D.



15 Compared to all the other planets of the solar system, Earth has the _____.

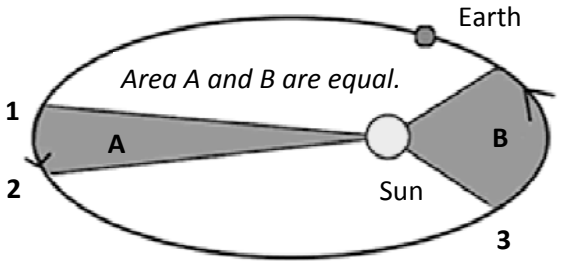
A. highest density
B. largest diameter
C. highest gravitational force
D. lowest average temperature

16 Although Venus is further from the Sun compared to Mercury, its average surface temperature is higher than Mercury.

Which of the following is a possible explanation for this?

A. Venus is more than twice the size of Mercury.
B. The carbon dioxide in Venus' atmosphere traps heat.
C. Ice is present on Mercury's surface but not found on Venus.
D. The length of a day on Mercury is 58 Earth days while a day on Venus is 243 Earth days.

17 As a planet orbits the sun, an imaginary line joining a planet and the sun sweeps out equal areas in the same amount of time. This is shown in the figure below where the Earth takes 40 days to move from position 1 to 2, and another 40 days to move from position 3 to 4. The area of A is equal to the area of B.



Which one of the following statements is false?

A. Planets will travel faster when they are nearer to the sun.

B. Planets which are closer to the sun will take less time to make a full orbit.

C. Planets will spin slower when they are further from the sun.

D. Planets will experience more gravitational force when they are nearer to the sun.

18 Which of the factors below are responsible for determining the weather?

1. Temperature
2. Movement of air
3. Amount of water vapour in the air
4. Types of plants and animals in the area

A. 1, 2 and 3 only

B. 1, 2 and 4 only

C. 2, 3 and 4 only

D. All of the above

19 Which one of the following is a cause of chemical weathering of rocks?

A. growth of plant roots

B. carbonic acid from acid rain

C. freezing of water in fractures in the rocks

D. changes in temperature between day and night

20 The figures below show a liquid-in-glass thermometer at different temperatures. At 0°C, the length of the liquid column is 3.0 cm. At 100°C, the length of the liquid column is 28.0 cm.

What is the length of the liquid column at 60°C?

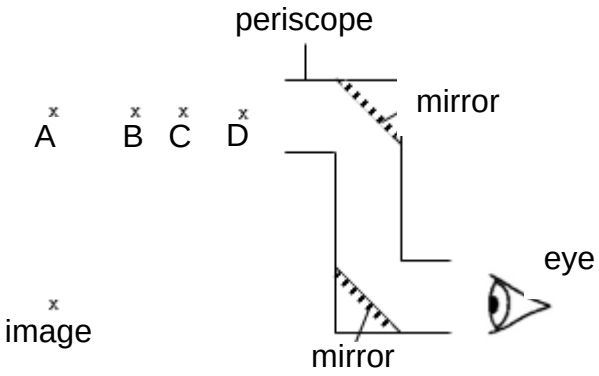
A. 15.0 cm

B. 16.8 cm

C. 18.0 cm

D. 19.8 cm

21 A man looks into a periscope which has two mirrors. He sees the image of an object at the position shown in the figure below. At which position is the object most likely to be placed?



22 Which of the following methods would <u>not</u> produce convection currents in a container filled with water at 30°C?

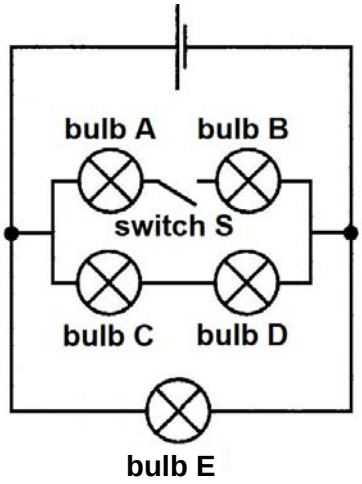
A. Float a piece of ice on the water.

B. Light a candle beneath the container.

C. Drop a piece of hot metal into the water.

D. Place a light bulb near the water surface.

23 Five identical light bulbs are connected with switch S opened as shown below.



When switch S is closed, which light bulb(s) will be brighter compared to the rest?

A. bulb E only

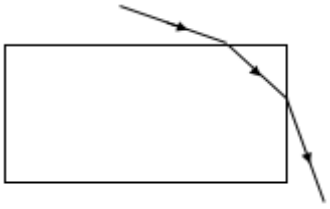
B. bulb A and bulb B only

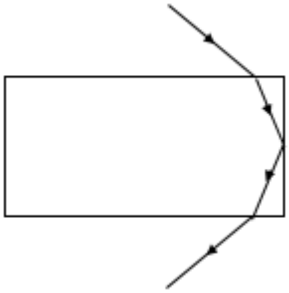
C. bulb C and bulb D only

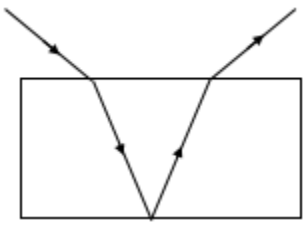
D. bulb A, bulb B, bulb C and bulb D only

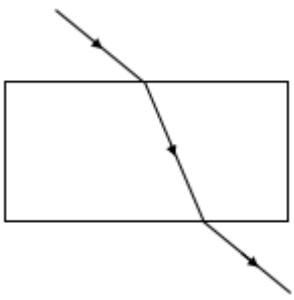
24 A ray of light is incident on one side of a rectangular block of glass. Its path is plotted through the block and out through another side.

Which of the following paths shown below is <u>not</u> possible?

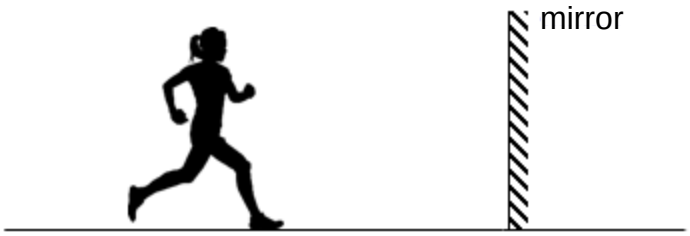
A. 

B. 

C. 

D. 

25 A girl runs towards a mirror at a speed of 4 m/s.

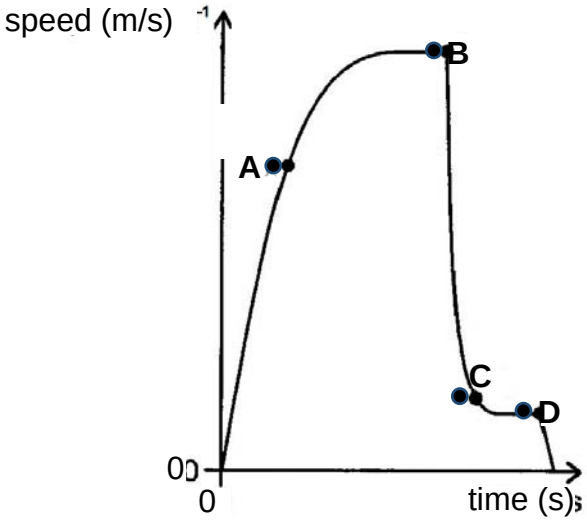


How fast does the girl's image appear to run towards her?

A. 0 m/s
B. 2 m/s
C. 4 m/s
D. 8 m/s

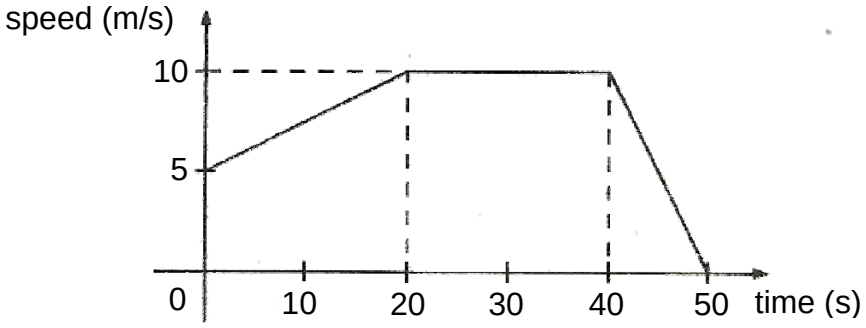
26 The graph below shows the speed-time graph of a sky diver from the moment he jumped off a helicopter to the moment he landed on the ground.

At which point in the graph did he open his parachute?



27 The graph below shows how the speed of a car changes with time.

What is the distance travelled by the car in the first 20 seconds?



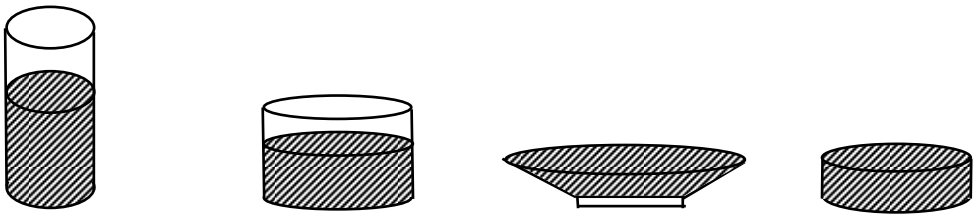
A. 100m

B. 150m

C. 200m

D. 400m

28 Four containers shown below are filled with the same amount of water and placed in a room. Which container will be left with the most amount of water after 1 day?



29 A roller-coaster train of mass 2000 kg is stationary at top of the track. The train has gravitational potential energy of 3000 kJ. When released, it rolls down the track. When it reaches the bottom of the track, it has a gravitational potential energy of 2000 kJ and a speed of 20 m/s at the bottom of the track. [Formula for kinetic energy = ½ x mass x $(\text{speed})^2$]

How much energy is lost in the form of heat and sound?

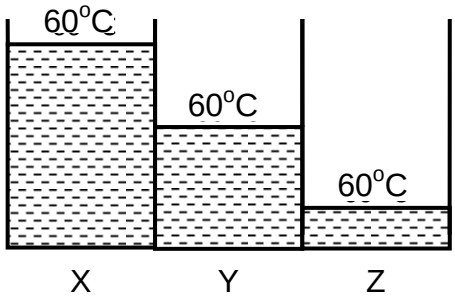
A. 400 kJ

B. 600 kJ

C. 1000 kJ

D. 2400 kJ

30 Three identical glasses of water at 60°C are placed side by side in contact with each other as shown below.



Given that glass X contains 0.5 kg of water, glass Y contains 0.3 kg of water and glass Z contains 0.1 kg of water, which of the following is true about the heat flow by conduction between the glasses?

A. There is net heat flow in all directions.

B. There is net heat flow from glass X to glass Y.

C. There is no net heat flow among these three glasses.

D. There is net heat flow from glass Y to glass X and from glass Y to glass Z.

31 "Exercise alone cannot help a person to lose weight. A person must also reduce the amount of energy they take in, such as by eating less."

Based on the above, which of the following statements is true?

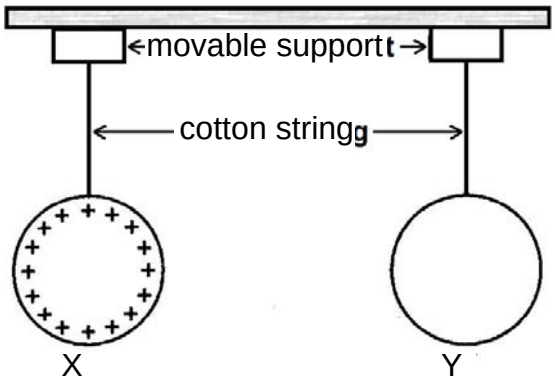
A. A person gains more weight by eating and exercising.

B. Exercising reduces the amount of energy a person uses.

C. To lose weight, a person must use up more energy than they gain from food.

D. Exercising uses up so much energy that a person must eat more food to survive.

32 Metal sphere X has a positive charge and metal sphere Y is uncharged.



X is moved close to Y but the spheres do not touch. Y is then earthed by touching it with a wire connected to the ground. The wire is then removed and X is moved far away from Y.

What is the final charge distribution on X and Y?

	Final charge distribution on X	**Final charge distribution on Y**
A.	neutral	neutral
B.	positive all over the surface	negative all over the surface
C.	negative all over the surface	negative all over the surface
D.	neutral on the left and positive on the right	negative on the left and neutral on the right

33 Antacid is a medicine that is used to relieve heartburn and indigestion. It reacts with the acids in our stomach.

Which one of the following statements best describes the properties of antacid?

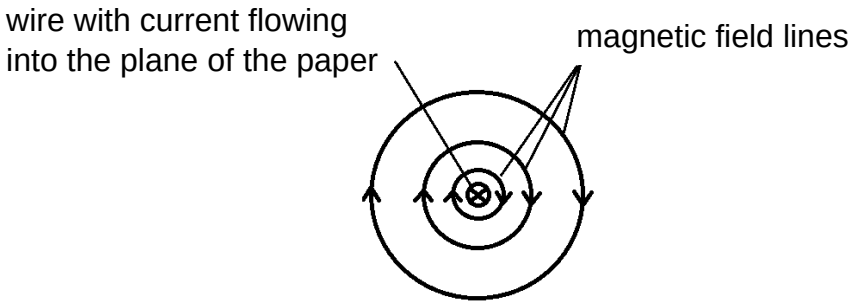
A. It is acidic in nature.

B. It is highly reactive.

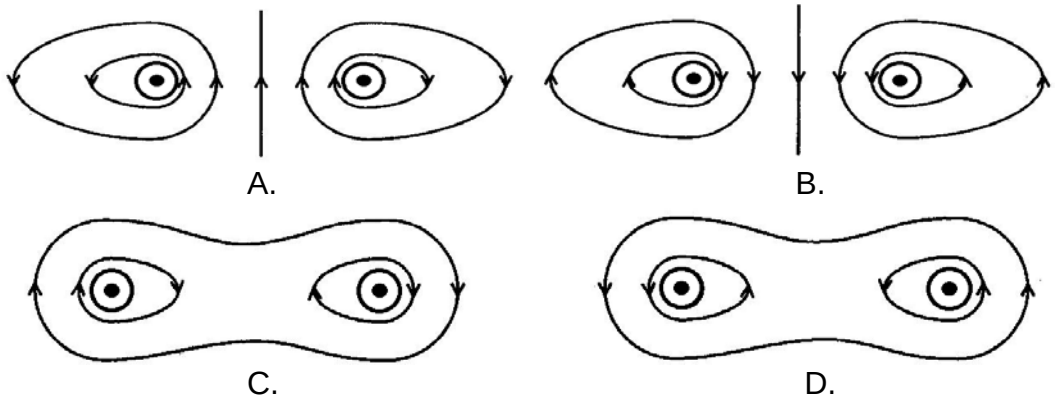
C. It helps break down food.

D. It has a pH value higher than 7.

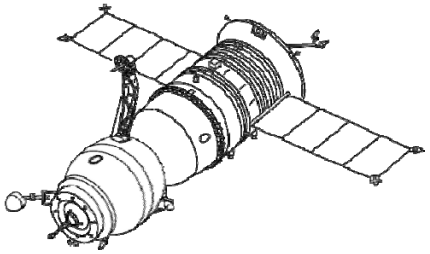
34 A current in a wire flowing <u>into</u> the plane of the paper produces a magnetic field pattern as shown below.



Which figure correctly shows the magnetic field pattern due to the currents in two parallel wires flowing <u>out</u> of the plane of the paper?



35 Satellites operate in space where the conditions are very different from on Earth.



Which one of the following properties is the most important criteria for materials used to make the body of the satellite?

A. waterproof

B. highly transparent

C. flexible when stretched

D. does not change state at very high and very low temperatures

End of Paper