



VANDA

SCIENCE GLOBAL FINALS

Primary 6 / Grade 6

Full Name: _____ Country: _____

School: _____ Index Number: _____

Instructions to Students:

1. Only scientific calculators are allowed during the contest for secondary school/Grade 7 and above students.
2. The duration of this contest is **1 hour**. You may not leave the contest venue within the first half an hour of the paper.
3. This examination paper contains **20** questions and comprises of **18** printed pages, inclusive of the cover page.
4. Each question has only 4 possible answers: **A, B, C** and **D**. You must shade your correct option on the Answer Entry Sheet provided.
5. The total marks for this paper is 70 points:

Section A:

Question 1 to 5: +2 points for correct answer, 0 points for no answer and –1 point for wrong answer.

Section B:

Question 6 to 10: +3 points for correct answer, 0 points for no answer or wrong answer.

Section C:

Question 11 to 20: +4 points for correct answer, 0 points for no answer or wrong answer.

6. You are not allowed to bring the question paper and answer script out of the contest venue.

Note:

- 1) You may assume that there is no air resistance throughout the contest, unless otherwise stated.
- 2) All temperatures are in degree Celsius, unless otherwise stated.
- 3) Room temperature is 25°C at 1 atmospheric pressure.
- 4) Gravitational Acceleration is taken to be 9.8 m/s².

Rough Working



Vanda Science Global Finals, Primary 6 / Grade 6

Section A: (Question 1 to 5: +2 points for correct answer, 0 points for no answer and –1 point for wrong answer.)

Q1) The table below shows the melting and boiling points of 6 substances. Analyse the table and answer questions 1 and 2.

Substance	Melting point (°C)	Boiling point (°C)
S	-38.82	356.6
T	0	100
U	3414	5555
V	-259.2	-252.9
W	1084.6	2560
Z	10 to 15	120 to 130

Which pure substance is a liquid at room temperature (20°C)?

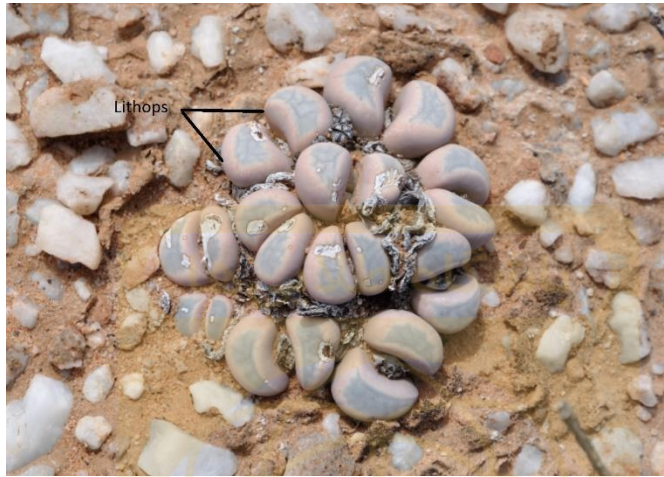
- 1) S
- 2) T
- 3) V
- 4) W

- A) Option 1 only
- B) Option 1 and 2
- C) Option 1, 2 and 3
- D) Option 2 and 3

Q2) Which of the substances is not a pure substance?

- A) Substance Z
- B) Substance S and V
- C) Substance S, T, U, V, W
- D) All of the above

- Q3) Succulents are plants which have parts of them, usually their leaves, that are thick and fleshy, for storage of water. A commonly known succulent is the cactus. Succulents usually grow in arid conditions. Lithops are a type of succulent, stemless and each plant has 2 leaves that are conical and connect directly to tap roots. They grow in clusters. Most of the plant is underground with only the top exposed at the surface of the soil. Because of the way they look, they camouflage and are known as 'living stones'. They originate from southern Africa. Below is a picture of Lithops.



Based on the information above and the picture shown, which of the following statements are true about Lithops?

- 1) They do not have leaves to minimise water loss through transpiration.
 - 2) The 'flat tops' on the plant are cells that act like windows, allowing sunlight to enter deep into the plant where there is more chlorophyll.
 - 3) They draw moisture from mist or fog.
 - 4) They are flowering plants.
-
- A) Option 1 and 3
 - B) Option 2, 3 and 4
 - C) Option 1, 2 and 3
 - D) All of the above

Q4) Wind-pollinated and insect pollinated flowers are examples of which scientific concept(s)?

- 1) Evolution and natural selection
- 2) Adaptations
- 3) Newton's Laws of Motion
- 4) The Scientific Method

- A) Option 4
- B) Option 2
- C) Option 1 and 2
- D) Option 1, 2 and 3

Q5) The following diagrams show different cells found in organisms.



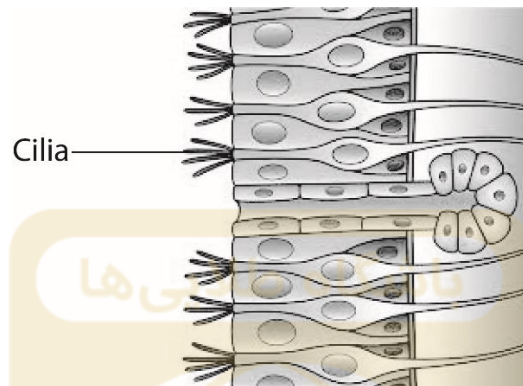
Which of the following statements are true about the above cells?

- 1) They have specific functions.
- 2) Different types of cells come together to form tissues.
- 3) They all have a nucleus, cell membrane and cytoplasm.
- 4) Some of the cells shown are plant cells.

- A) Option 1, 2 and 3
- B) Option 2 and 3
- C) All of the above
- D) Option 1 only

Section B: (Question 6 to 10: +3 points for correct answer, 0 points for no answer or the wrong answer.)

- Q6) Particles in the air, such as dust, soot, mould, fungi, bacteria and viruses deposit on the surface of our respiratory tracts, as well as alveolar surfaces. The respiratory system has defense mechanisms to clean and protect itself. Only extremely small particles which are less than 3 to 5 microns in diameter, are able to penetrate deep into the lung.

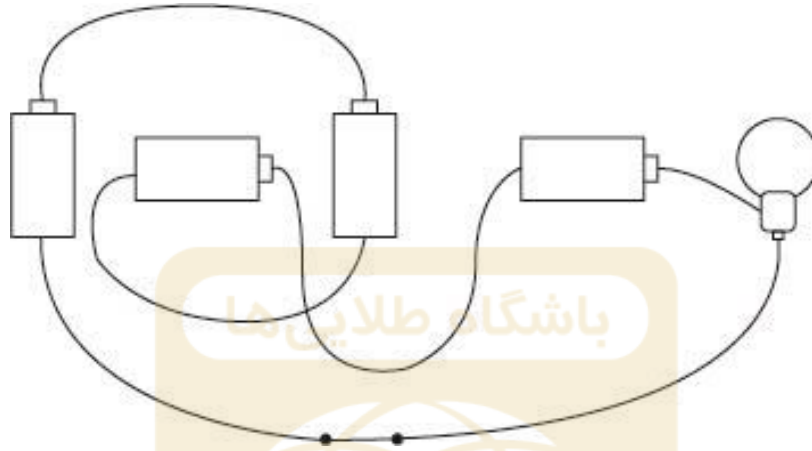


The diagram above shows tiny hair-like structures, called cilia, found on cells. What is the likely function of cilia?

- A) Cilia are sharp and they rupture any foreign particles so that they cannot further penetrate into the lungs.
- B) Cilia move in a rhythmic way to 'sweep' away dust and possibly harmful foreign particles, as well as propel mucus secreted to trap harmful bacteria, fungi or viruses.
- C) Cilia increases the surface area of the respiratory tract, so that more air can be taken in and more oxygen can be absorbed by the body.
- D) Cilia increases the surface area of the respiratory tract so that good bacteria in the air can pass through quickly into the body.

Refer to the following information for questions 7 and 8.

- Q7) Study the electrical circuit below, Jane says that the bulb was not lighted up when she turned on the switch.

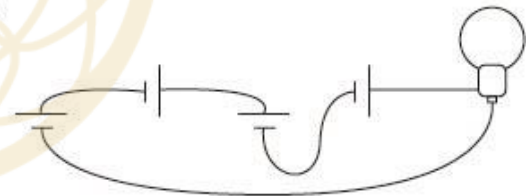


How should she connect the components such that the bulb would light up?

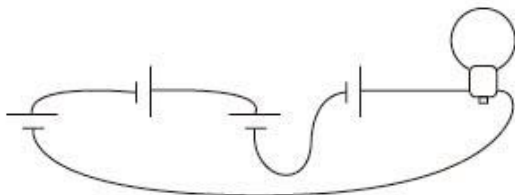
A)



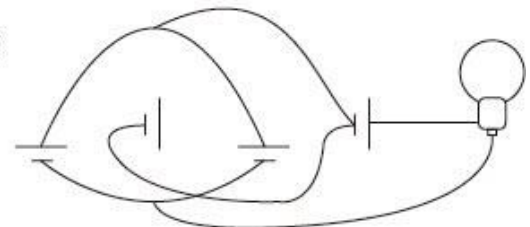
B)



C)



D)



- Q8) Jane succeeded in connecting the components correctly, such that the circuit lit up. However, this time she would like the light bulb to be able to stay lit for a longer time.

Which type of arrangement should she use for this to happen and what would be her observation?

- A) Parallel arrangement of batteries; the bulb would be able to stay lit for 4 times longer.
 - B) Parallel arrangement of batteries; the bulb would also be brighter.
 - C) Series arrangement of batteries; the bulb would also be brighter.
 - D) Series arrangement of batteries; the bulb would be able to stay lit for 4 times longer.
- Q9) Which of the following shows the correct sequence of blood flow within the double loop of our circulatory system?

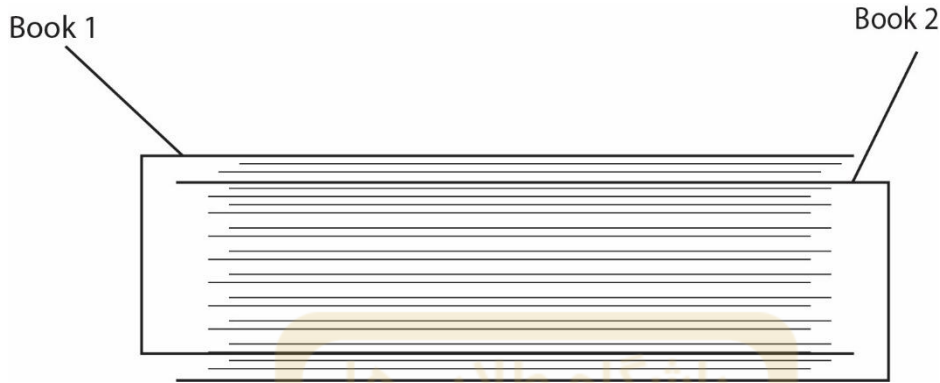
- A) Aorta (to all parts of the body) → right ventricle → right atrium → pulmonary vein → lungs → pulmonary artery → left atrium → left ventricle → Vena cava (from all parts of the body)
 - B) Vena cava (from all parts of the body) → left atrium → left ventricle → pulmonary vein → lungs → pulmonary artery → right atrium → right ventricle → aorta (to all parts of the body)
 - C) Vena cava (from all parts of the body) → right atrium → right ventricle → pulmonary artery → lungs → pulmonary vein → left atrium → left ventricle → aorta (to all parts of the body)
 - D) Aorta (to all parts of the body) → left atrium → left ventricle → pulmonary vein → lungs → pulmonary artery → right atrium → right ventricle → Vena cava (from all parts of the body)
- Q10) Many of the world's largest solar plants are located in China and India. They cover thousands of kilometres and can generate enough energy to power up to hundreds of thousands of households.
- Solar panels contain photovoltaic cells made from silicon and could be connected to rechargeable batteries for use of stored power in the night.

How is energy converted in solar plants?

- A) Electrical → Light → Electrical
- B) Kinetic → Electrical → Light → Chemical potential energy
- C) Chemical potential energy → Light → Electrical
- D) Light → Electrical → Chemical potential energy

Section C: (Question 11 to 20: +4 points for correct answer, 0 points for no answer or the wrong answer.)

Q11) 2 books were assembled, page by page, interlaced with each other, as shown in the cross-sectional diagram below.

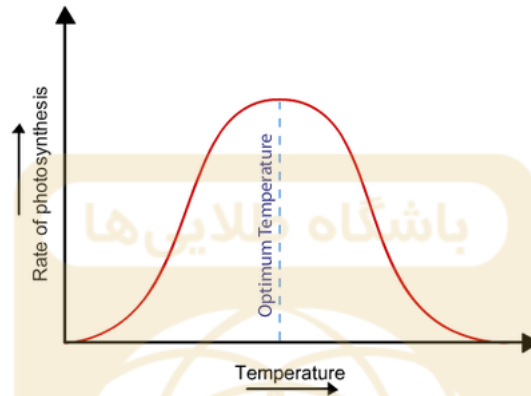


Tommy tried to pull the 2 books apart with the maximum strength he has but failed several times. Why is this so?

- A) Friction between his hands and the books prevents him from separating the 2 books from each other.
- B) Book 2 is being pressed down by the weight of Book 1.
- C) Each of the books' pages have been placed on top of one another, and between each of these pages is friction acting between them, preventing them from sliding past one another. Hence, he was unable to pull the books apart.
- D) Gravity was holding the books' pages down onto each other. As the pages are pressing on one another, it was impossible to pull them apart.

Refer to the following diagram for questions 12 and 13.

- Q12) Photosynthesis has 2 sets of reactions, the light reactions, and the dark reactions. Light reactions are where light energy is used to create ATP and NADPH in the chloroplasts. ATP and NADPH is then used to synthesise glucose in the absence of light, this process called the dark reactions. During photosynthesis, oxygen is also produced and released. A scientist discovered that the rate of photosynthesis decreases past a certain temperature. He plotted the rate of photosynthesis against temperature.



He also noted that enzymes* are involved in the dark reactions.

*Enzymes are biological substances which speed up a chemical reaction without reacting in the reaction itself. They are sensitive to changes in temperature and pH past their tolerable range.

Based on the information given, what is the role of the enzyme involved in dark reaction of photosynthesis?

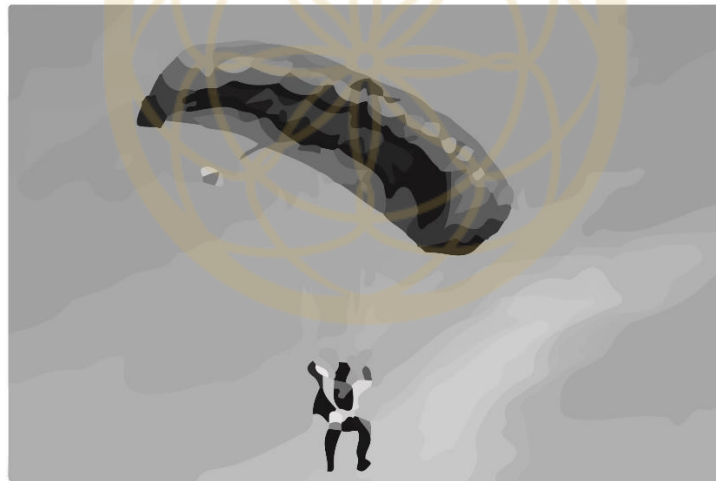
- A) The enzymes help to synthesise ATP and NADPH.
- B) The enzymes are broken down to release energy to produce glucose.
- C) The enzymes are essential in the production of glucose.
- D) The enzymes are not involved in the production of glucose.

- Q13) Enzymes have 'active sites' which dictate which substance they can work on. This is specific and fixed. Active sites are not changed after the enzyme has worked on a substance (known as a substrate). Hence enzymes are reusable. However, huge changes in temperature and pH can damage the active sites on the enzymes. This causes them to be 'denatured'.

Which of the following explains why a huge increase in temperature can affect the rate of photosynthesis?

- A) The enzymes slow down as they have gained too much heat and is no longer able to function. Hence, the rate of photosynthesis decreases.
- B) The enzymes move faster and speed up the glucose production process. Hence, the rate of photosynthesis decreases.
- C) Enzymes change into other chemical substances and no longer participate in the glucose production process. Hence, the rate of photosynthesis decreases.
- D) When temperature increases beyond the optimum working temperature of the enzyme, the enzyme becomes denatured and is no longer able to participate in the glucose production process. Hence, the rate of photosynthesis is affected.

- Q14) When a parachutist jumps from a plane, he triggers his parachute to open up and allow a safe and gentler landing.



What changes should be made to the parachute in order to support a heavier parachutist?

- A) Use a thicker parachute.
- B) Use a larger parachute.
- C) Increase the strength of the harness.
- D) Use thinner ropes.

- Q15) Chytridiomycosis is a fungal disease that eats away the skin of amphibians; frogs, toads and salamanders.

The number of amphibians globally is experiencing a sharp and sudden decline also due to chemical contamination of waters, the exploitation of habitats, UVB radiation and climate change.

Which of the following is a correct statement regarding the impact of declining amphibians, on the environment and its ecosystems?

- A) Salamanders are herbivores, with their decline in numbers it can lead to an overgrowth of water plants in the rivers and waters.
- B) Frogs and toads are part of the land ecosystems only and will cause the land ecosystems to be imbalanced and eventually collapse.
- C) There would be more flies and mosquitoes as there would be less frogs and toads to prey on them, which can be beneficial to us as these insects are pests.
- D) When there are lesser frogs and toads, there would also be less tadpoles. This can lead to a rapid growth of algae in the water which can be harmful to water plants and the living organisms in the water (e.g. fish).

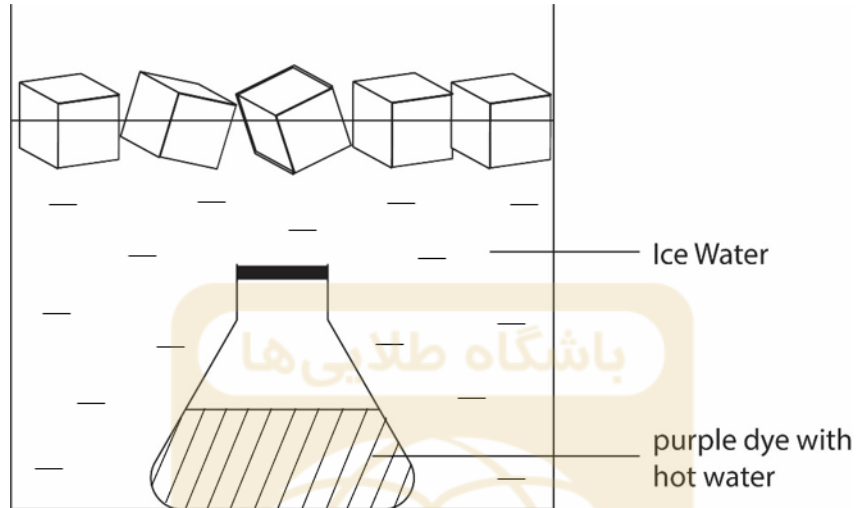
- Q16) In 2017, an 'insect apocalypse' concept was introduced to the world, where the insect kingdom was under great threat due to man's impact on Earth. This crisis is global and there is so far a 75% drop in flying insects in the world. An ecologist mentioned that this is a 'collapse of nature', and all other living organisms will be affected directly or indirectly. She highlights that the decline in insects will majorly affect our agricultural activities.

Which of the following statements describe the impact to the environment and ecosystems?

- 1) Insects are primary producers and are the fundamental parts of many food chains and webs. Without them the food chains and food webs would collapse.
- 2) Insects are aid to decomposers, which recycle nutrients through breaking down of dead organic matter so that they can return to the soil to be taken up by plants.
- 3) They provide food for birds and animals, which support the secondary and tertiary consumers.
- 4) They have an integral role as pollinators to plants. Without them, most of the flowers cannot be pollinated and plants cannot reproduce. This affects the production of crops by farmers.

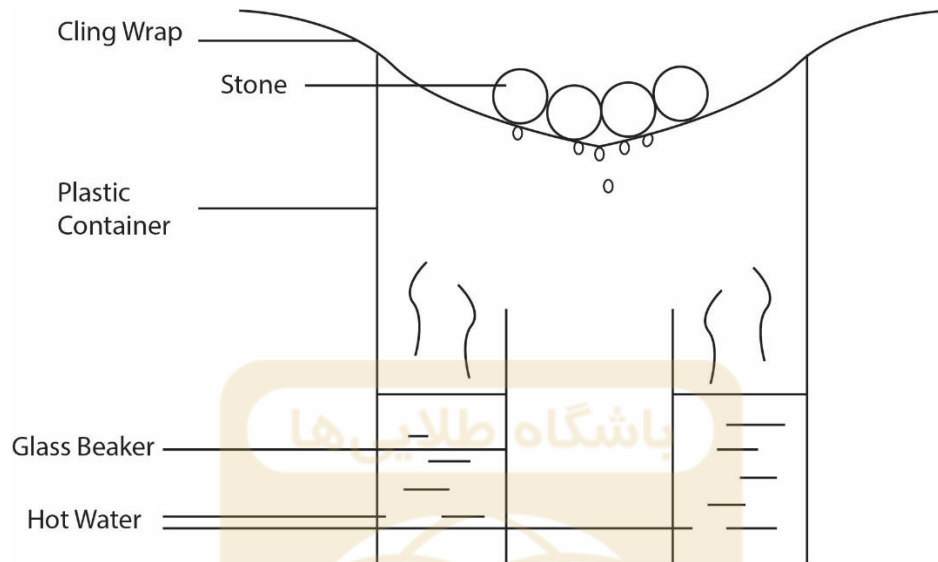
- A) Option 1 only
- B) Option 3 and 4
- C) Option 2, 3 and 4
- D) All of the above

- Q17) Anya filled a small conical flask with purple dye and filled half of it with hot water. She immersed this into a big cylindrical container filled with ice water. She removed the lid of the conical flask and after a few minutes, she observed that the entire water was dyed purple. What is the reason for her observation?



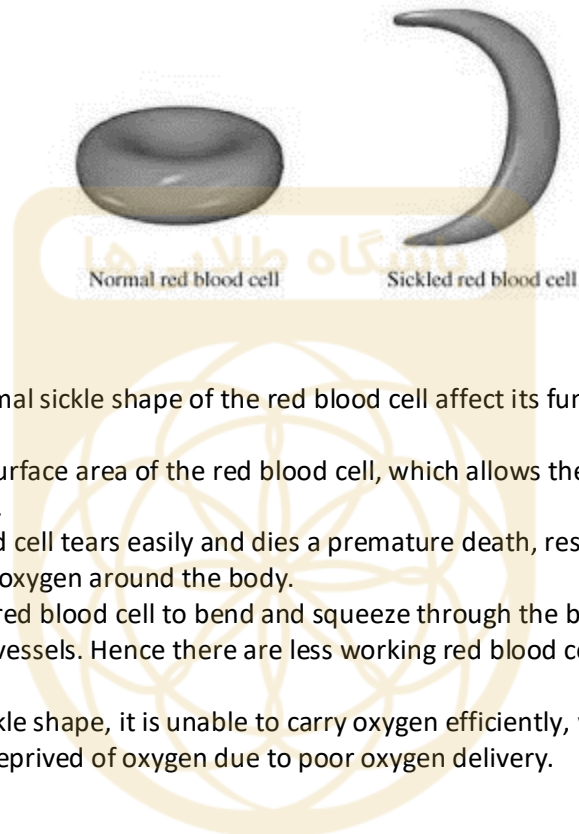
- A) The hot water with purple dye rose upwards while the cold icy water sank, setting up a convection current.
- B) The hot water with purple dye contracted because it was hot and filled up the water with purple dye.
- C) The purple dye took up the space in the ice water and combined with it hence turning the water purple.
- D) All of the ice water entered the small conical flask and forced the purple dye and hot water to spill outwards, turning the water purple.

- Q18) Study the diagram below. Why does the number of water droplets formed on the underside of the cling wrap decrease over time?



- A) Heat is lost quickly through the plastic container and the hot water in it cools down quickly, hence the rate of evaporation slows down and the number of water droplets formed decreases over time.
- B) The cling wrap gains heat over time from the hot water vapour and is no longer as cool as before. This prevents the hot water vapour from being able to lose heat to it and condense. Hence the rate of condensation decreases and less water droplets are formed over time.
- C) Heat is absorbed quickly through the plastic container, causing the cling wrap to become warmer. This prevents the hot water vapour from being able to lose heat to it and condense. Hence the rate of condensation decreases and less water droplets are formed over time.
- D) The cling wrap loses heat over time and is no longer as cool as before. This prevents the hot water vapour from being able to lose heat to it and condense. Hence the rate of condensation decreases and less water droplets are formed over time.

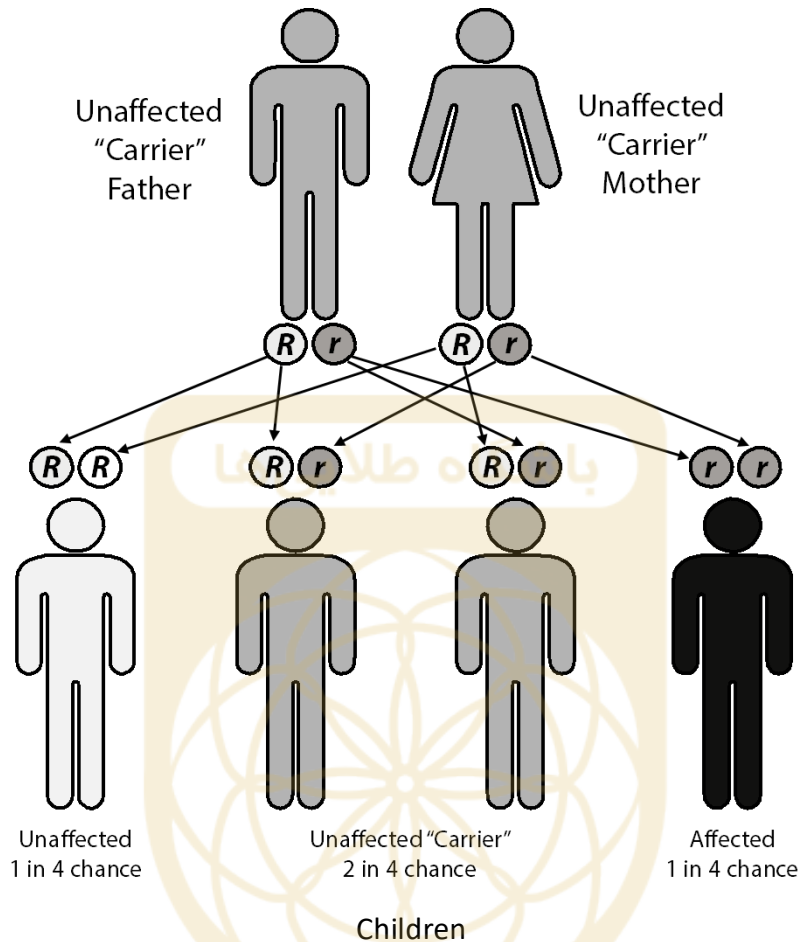
- Q19) Sickle cell anaemia is a disease of the blood that is hereditary. An abnormal type of haemoglobin, haemoglobin S, causes the red blood cell to have a sickle shape. Children may have early symptoms of jaundice (which is a yellowish colour of the skin), anaemia and fatigue as well as painful swelling in parts of the body. These can develop into severe anaemia, complications of the organs in the body and acute or chronic pain if untreated.



How does the abnormal sickle shape of the red blood cell affect its function?

- A) It increases surface area of the red blood cell, which allows the red blood cell to carry more oxygen.
- B) The red blood cell tears easily and dies a premature death, resulting in lesser red blood cells to carry oxygen around the body.
- C) It allows the red blood cell to bend and squeeze through the blood vessels as well as out of the blood vessels. Hence there are less working red blood cells to carry oxygen efficiently.
- D) Due to its sickle shape, it is unable to carry oxygen efficiently, which leads to parts of the body being deprived of oxygen due to poor oxygen delivery.

Q20) Below is an example of how sickle cell disease can be passed from parent to child.



The abnormal haemoglobin S, is coded for by the haemoglobin S gene. People who have the sickle cell trait (known as carriers) are generally healthy, very rarely do they have complications similar to people with sickle cell disease. Based on the above diagram, which of the following outcomes is possible?

- A) Parents who are not sickle cell patients or do not have the sickle cell trait can have children with sickle cell disease.
- B) If both parents are sickle cell patients, all their children will technically be diagnosed with sickle cell disease.
- C) There is a 50% chance that the children of parents (one of whom does not have sickle cell disease nor has the sickle cell trait and the other having the sickle cell trait) will be diagnosed with sickle cell disease.
- D) There is a 25% chance that the children of parents (one of whom does not have sickle cell disease nor has the sickle cell trait and the other having the sickle cell trait) will have the sickle cell trait.

Rough Working



Rough Working

