

**Aga Khan University**

**Resource: Science Reasoning Practice Questions**

**MBBS Programme**

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**Questions 1- 2 refer to the following information**

**The hydrosphere has strange characteristics because water has properties unlike those of any other liquid. One anomaly is that water upon freezing expands by about 9 percent, whereas most liquids contract on cooling. For this reason, ice floats on water instead of sinking to the bottom. If the ice sank, the hydrosphere would soon be frozen solidly. Thus, all aquatic life would be destroyed.**

**1. Which of the following characteristics of water are mentioned in the passage?**

- I. water contracts on freezing
- II. water is a neutral substance
- III. water can absorb a sufficient amount of heat
- IV. water shows unusual behaviour upon freezing

- A. I only
- B. I and II only
- C. III and IV only
- D. IV only

**2. According to the passage, fish can survive in the oceans because:**

- A. they do not need oxygen
- B. ice floats
- C. evaporation and condensation create a water cycle
- D. water absorbs heat

Questions 3-4 refer to the following information.

Electrolysis is an important industrial method for the preparation of various chemicals, in which electrical energy is used to cause a non spontaneous chemical reaction to occur. Electrolysis may be accomplished in aqueous solution or in fused salt depending on the products desired. Oxidation reaction occurs at Anode and reduction takes place at Cathode.

3. During the electrolysis of aqueous sodium chloride the chemical collected at cathode is:

- I. hydrogen
- II. sodium
- III. chlorine
- IV. oxygen

- A. I only
- B. II only
- C. I and II both
- D. III and IV both

4. When fused sodium chloride is electrolyzed the chemical obtained at cathode is:

- A. chlorine
- B. sodium
- C. hydrogen
- D. sodium hydroxide

Questions 5-7 refer to the following information

Photosynthesis and photography both involve light sensitive reactions. The leaves of plants contain a green pigment called chlorophyll. This can absorb radiation in the visible region of the electromagnetic spectrum and use this energy to synthesize chemicals and provide food for the plant.

During photosynthesis, plants transform carbon dioxide and water into oxygen and sugars such as glucose:



In the absence of sunlight, energy is no longer provided and photosynthesis ceases.

5. Photosynthesis is a/an

- A. Exothermic reaction
- B. Endothermic reaction
- C. Addition reaction
- D. Substitution reaction

6. The sugar which is produced during photosynthesis is supposed to be oxidized in the human body. The oxidation of sugar in the body is a / an

- I. decomposition reaction
- II. exothermic reaction
- III. endothermic reaction
- IV. addition reaction

- A. I only
- B. I and II only
- C. II only
- D. III and IV only

7. **Photo synthesis is a process**

- I. **by which plants synthesize their food**
- II. **by which energy is stored by plants**
- III. **which can take place without light**
- IV. **which require some sort of radiation to take place**

- A. I only
- B. I and II only
- C. II and III only
- D. I, II and IV only

**Questions 8-10 refer to the following:**

**Gases consist of molecules which are in a state of rapid motion. The fact that the molecules are in motion is evident from the fact that if a small quantity of an odorous gas, such as hydrogen sulphide is liberated at any point in a laboratory the smell of the gas soon pervades the whole room.**

**Suppose a balloon has been filled with an unknown odourless gas. Having no sophisticated equipment at hand, it is decided to bubble the gas through calcium hydroxide**

8. **If a precipitate forms the gas is identified as:**

- A. sulphur dioxide
- B. carbon dioxide
- C. carbon monoxide
- D. ammonia

9. **Another portion of the unknown gas is passed over a flame if the gas does not ignite, this tells us that the gas is:**

- A. carbon monoxide
- B. carbon dioxide
- C. methane
- D. oxygen

10. A portion of the gas is cooled and then used to fill a gas jar when a lighted matchstick is introduced into the gas jar, the stick is extinguished. This tells us that the gas does not contain a high concentration of:

- A. carbon dioxide
- B. carbon monoxide
- C. oxygen
- D. nitrogen

Questions 11 -12 refer to the following information

The three basic crystal structures are called Hexagonal Close Packed (HCP), Face Centred Cubic (FCC) and Body Centred Cubic (BCC).

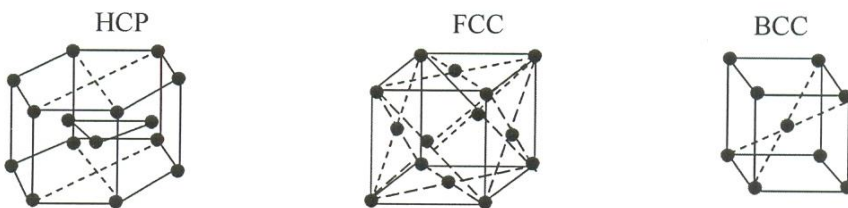
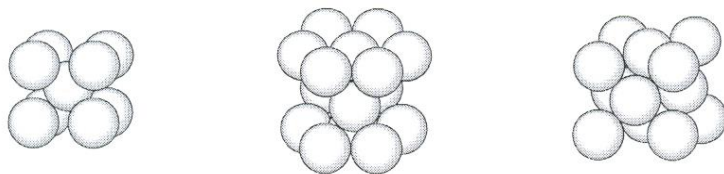


Figure 1

11. Shown below are alternative representations of the structures in Figure 1



The order in which they are represented is

- A. BCC, HCP, FCC
- B. BCC, FCC, HCP
- C. FCC, HCP, BCC
- D. HCP, BCC, FCC

12. In the BCC arrangement of Figure 1, the spheres are spaced farther apart than in the other two structures. Consequently, the atoms in the same layer do not touch each other. The total number of atoms touching any one atom is therefore

- A. 3
- B. 6
- C. 8
- D. 12

Question 13 -15 refers to the following information:

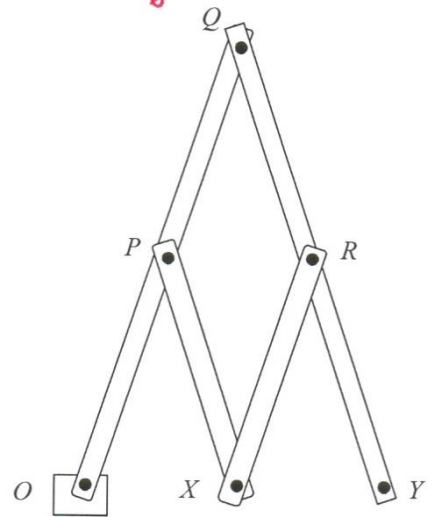
A pantograph is a four-bar linkage mechanism used for drawing. It consists of two long bars and two short bars pivoted to one another so that they can move freely in the plane. In the version shown in Figure 3 below the short bars are half the lengths of the long ones.

The point  $O$  is held fixed. There is a pointer at  $X$  and a pencil at  $Y$ . As the pointer at  $X$  is traced over a shape, the pencil at  $Y$  draws the shape enlarged by a factor of two.

13. In Figure 3 if  $O$  and  $Q$  are both held fixed, the point  $Y$ .

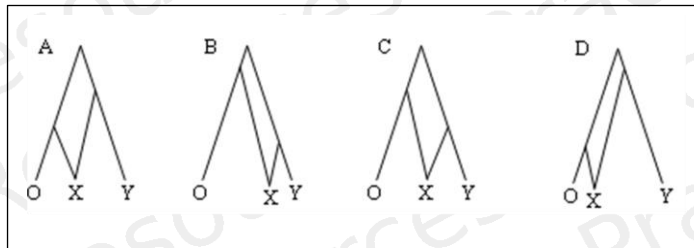
- A. cannot move
- B. can move on a circular path
- C. can move in a straight line
- D. can move freely

Figure 3: A Pantograph



For Questions 14 and 15 select the answer from the diagrams labeled A to D in Figure 4

Figure 4



The size of the drawing traced out by the pencil depends upon the relative lengths of the bars in the pantograph.

14. Which of the pantographs in Figure 4 will produce the biggest enlargement of the original shape?
15. Which of the pantographs in Figure 4 will produce an enlargement with all the lengths two-and-a-half times the length of the original shape?



Questions 16-17 refer to the following information:

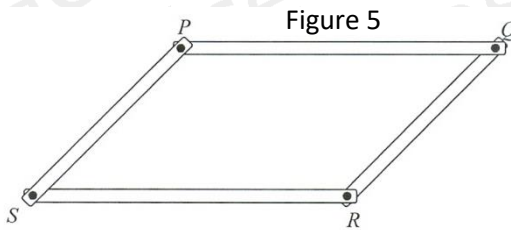
### Linkages

Linkages can change one form of motion (such as circular motion) to another (such as oscillating motion). They can also change the direction, speed or timing of motion. They form the basis of many mechanisms.

A four linkage consists of four bars of various lengths pivoted at their ends or elsewhere.

In the four-bar linkage shown below  $P, Q, R$  and  $S$  are pivots about which the four bars can move freely in the plane of the paper

$PQ = SR = 6\text{cm}$        $QR = PS = 4\text{cm}$   
(Assume that the bars can move over each other if necessary)



16. The maximum possible distance between  $P$  and  $R$  is
- A. 4 cm
  - B. 6 cm
  - C. 7.2 cm
  - D. 10 cm
17. If  $PQ$  is fixed and  $PS$  rotates clockwise  $360^\circ$ ,  $R$  can move
- A. in a clockwise circle.
  - B. in an anticlockwise circle.
  - C. in a clockwise non-circular ellipse.
  - D. in an anticlockwise non-circular ellipse.

**Questions 18 – 23 refer to the following information:**

An ideal gas is a hypothetical gas whose pressure – volume – temperature behavior can be completely accounted for by the ideal gas equation (General gas equation). The molecules of an ideal gas do not attract or repel one another, and their volume is negligible compared with the volume of the container. Experiments show that under the STP conditions, one mole of an ideal gas occupies a volume of  $22.4\text{dm}^3$ .

**18. What will happen if 50ml of air at STP in a balloon is taken to a location where the pressure is lower?**

- A. Balloon will burst
- B. Balloon will become smaller
- C. Balloon will become larger
- D. No change in the appearance of the balloon

**19. If the molecular mass of an ideal gas is twice the molecular mass of  $\text{CO}_2$ . The volume occupied by the ideal gas at STP is:**

- A.  $11.2\text{ dm}^3$
- B.  $22.4\text{ dm}^3$
- C.  $44.8\text{ dm}^3$
- D.  $89.6\text{ dm}^3$

**20. Which of the following pairs of ideal gases has identical rates of diffusion?**

- A.  $\text{N}_2\text{O}$  and  $\text{CO}_2$
- B.  $\text{NO}$  and  $\text{CO}$
- C.  $\text{NH}_3$  and  $\text{PH}_3$
- D.  $\text{O}_2$  and  $\text{CH}_4$

**21. A real gas most closely approaches the behavior of an ideal gas at:**

- A.  $0.25\text{atm}$  and  $1000\text{K}$
- B.  $0.5\text{atm}$  and  $500\text{K}$
- C.  $1\text{atm}$  and  $273\text{K}$
- D.  $2\text{atm}$  and  $100\text{K}$

22. A tin can is sealed at a pressure of 100mmHg. If the can is taken to STP, the can may:

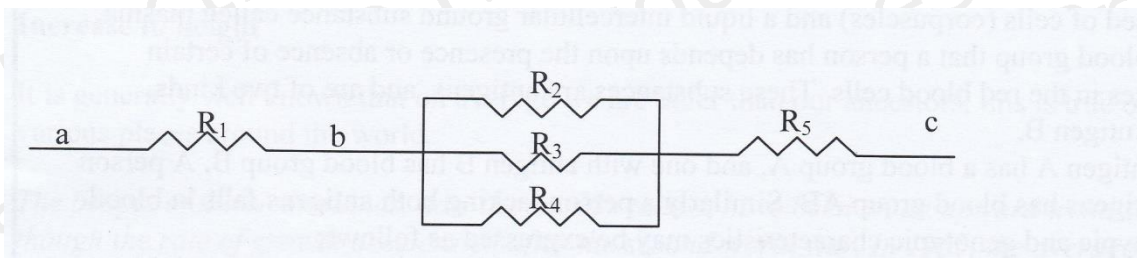
- A. Explode
- B. Collapse
- C. Get larger
- D. Get chilled

23. Which of the following changes in volume of an ideal gas takes place, if the absolute temperature is doubled and the pressure is reduced to one half?

- A. Reduces four times
- B. Increases to become double
- C. Increases four times
- D. Remain unchanged

Question 24-28 refer to the following information:

Given below is part of a circuit diagram:



If the resistors  $R_1 = 5$  ohms,  $R_2 = 2$  ohms,  $R_3 = 4$  ohms,  $R_4 = 12$  ohms,  $R_5 = 5$  ohms and the current passing through the circuit is 10 amperes.

24. Select from following the potential difference across  $R_1$

- A. 20 volts
- B. 30 volts
- C. 40 volts
- D. 50 volts

**25. Which of the following will be the resistance in the parallel resistors?**

- A. 1.2 Ohms
- B. 5.6 Ohms
- C. 6.0 Ohms
- D. 18 Ohms

**26. In the given circuit, the potential difference across the parallel resistors will be:**

- A. 12 Volts
- B. 24 Volts
- C. 48 Volts
- D. 96 Volts

**27. What is the total resistance in this circuit?**

- A. 1.5 Ohms
- B. 5 Ohms
- C. 6.2 Ohms
- D. 11.2 Ohms

**28. What is the potential difference across a to c?**

- A. 10 Volts
- B. 11.2 Volts
- C. 112 Volts
- D. 50 Volts

**Questions 29-32 refer to the following information:**

Blood is composed of cells (corpuscles) and a liquid intercellular ground substance called Plasma.

The type of the blood group that a person has depends upon the presence or absence of certain specific substances in the red blood cells. These substances are antigens, and are of two kinds, Antigen A and Antigen B.

a person with antigen A has a blood group A, and one with antigen B has blood group B. A person with A and B antigens has blood group AB. Similarly a person lacking both antigens falls in blood group O. phenotypic and genotypic characteristics may be expressed as follows;

Phenotype	Genotype
A	A/A, A/O
B	B/B, B/O
O	O/O
AB	A/B

**29. Which of the following blood groups is known as universal donor?**

- A. Blood group A
- B. Blood group B
- C. Blood group AB
- D. Blood group O

**30. With the help of the given blood grouping system, transfusions have become relatively safe. Which of the following types is considered to be the universal recipients?**

- A. A
- B. B
- C. O
- D. AB

**31. Which of the following blood types can a person of blood type A receive?**

- A. A only
- B. B; A
- C. A; O
- D. A; AB

**32. Two people are planning to have a family. The woman has blood genotype A/A and the man B/B. their children might have.**

- A. A and B
- B. A/B only
- C. B only
- D. A and B and A/B

**Question 33-35 refer to the following information:**

**Increase in height**

It is generally well known that on average we are taller than our ancestor; this is true of people in various places around the world.

*The people of the Netherlands, now the world's tallest, have been on an upward trend since 1851, though the rate of growth accelerated after the second world war. In 1965, the average Dutchman was 1.78m tall. By 1997, he was 6cm taller. The average Dutch woman grew from 1.66m to 1.71m.*

The Spanish grew 2.4cm per decade between 1960 and 1990. In Western Europe this growth has now slowed to about 1cm per decade but Western Europe and Japan are increasing by up to 3cm per decade. However, on average, women are increasing in height more slowly than men so the gap in height between the sexes is widening.

It has been found that it is the first two years of life which are the most important for height, when the leg bones are growing rapidly. Not only increased food supply but also general health improvement brought about antibiotics and vaccinations have had an effect. Your final height, however, is still dependent on the height of your parents and grandparents.

**33. In 1965, the gap in average height between men and women in Holland was**

- A. 6cm
- B. 7cm
- C. 12cm
- D. 13cm

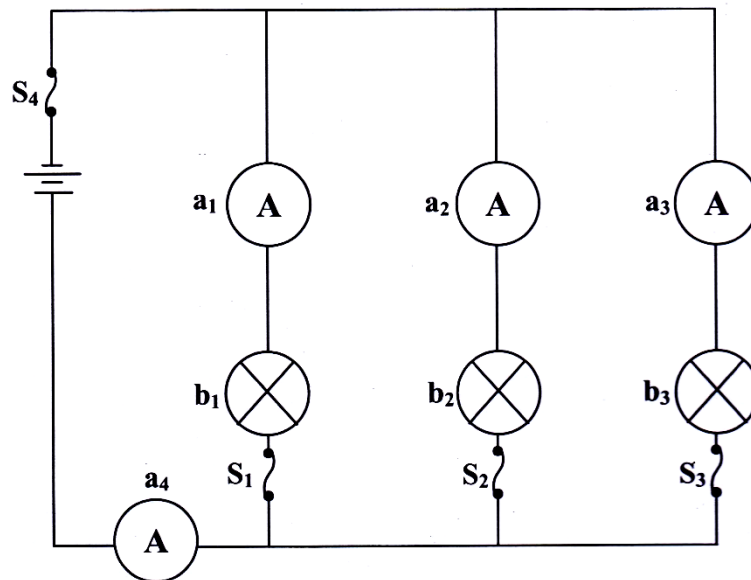
**34. Between 1960 and 1990 the average height of a Spaniard increased overall by about**

- A. 3cm
- B. 5cm
- C. 7cm
- D. 10cm

35. According to the passage, which of the following are likely reasons for the increased average height of women in the last 50 years?

1. They have a better diet.
  2. They have fewer childhood illnesses.
  3. They do more exercise.
- A. If 1 and 2 only are correct.  
B. If 1 and 3 only are correct.  
C. 2 and 3 only are correct.  
D. If all are correct.

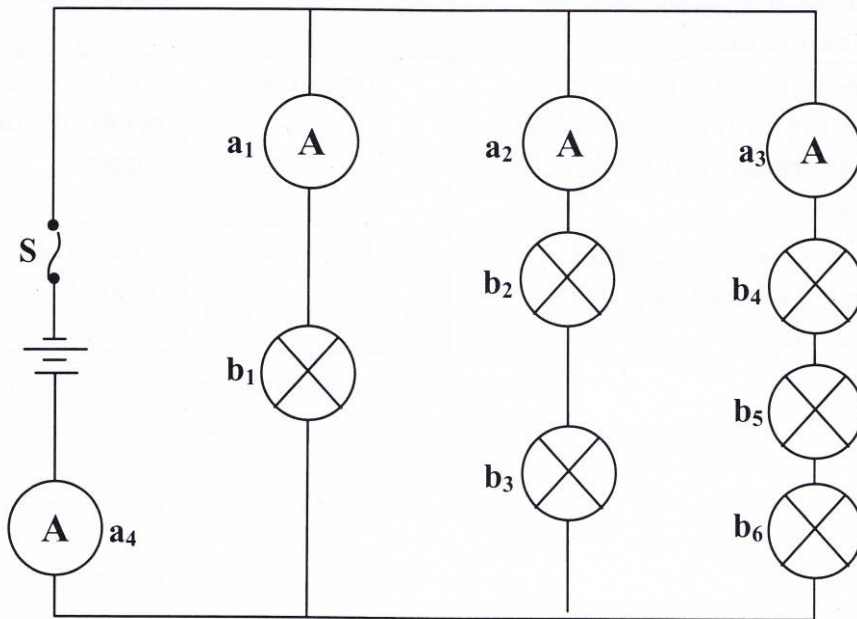
36. The given circuit shows how three bulbs and four ammeters are wired together. The bulbs are not identical and all four switches are closed. If ammeter  $a_1$  reads 2A,  $a_2$  reads 1A and  $a_3$  reads 4A, then what will be the current on ammeter  $a_4$ ?



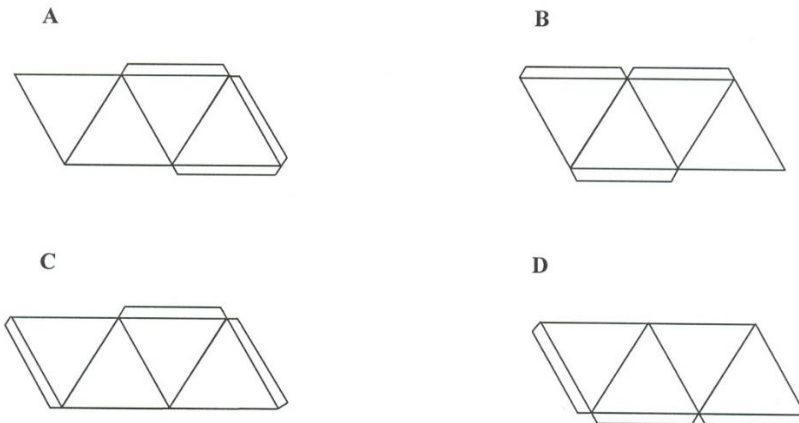
- A. 7A  
B. 6A  
C. 5A  
D. 4A

37. In the given circuit diagram, if bulb  $b_5$  blows, then what happens to the other bulbs?

- A. All remaining bulbs will go out.
- B.  $b_1$ ,  $b_2$ , and  $b_3$  stay lit but  $b_4$  and  $b_6$  go out.
- C. All remaining bulbs will stay lit.
- D.  $b_1$ ,  $b_2$ ,  $b_3$  and  $b_6$  stay lit but  $b_4$  also goes out.

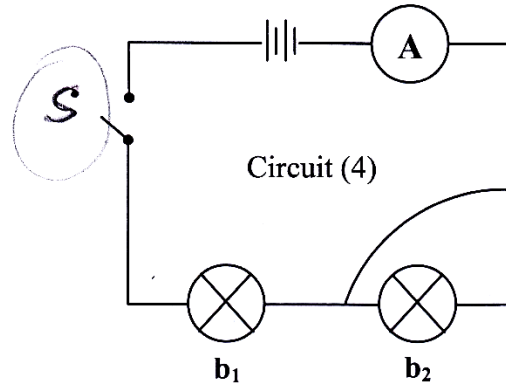
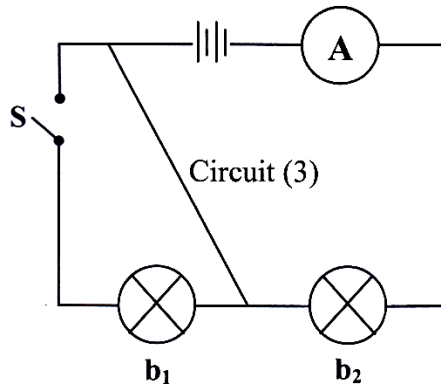
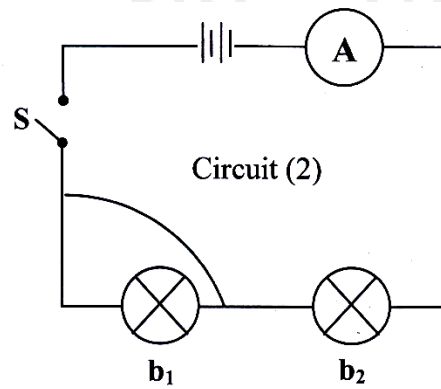
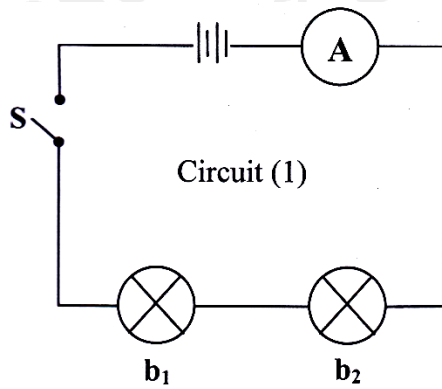


38. The net of a tetrahedron that shows an arrangement of flaps so that each edge may be glued is





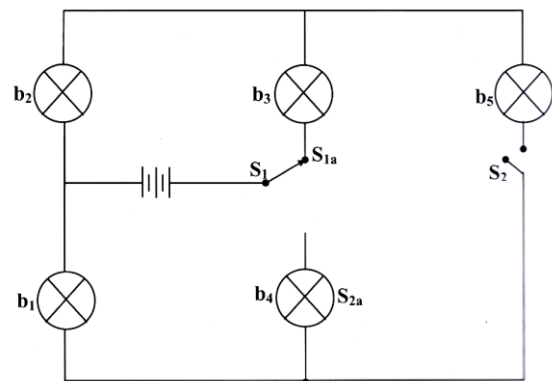
39. In the given circuit (1) two cells two bulbs and a switch are wired in series, an extra wire has been added to the similar circuit (2), (3) and (4). In which circuits will only bulb  $b_2$  light up if switch  $S$  is closed and not when it is open?



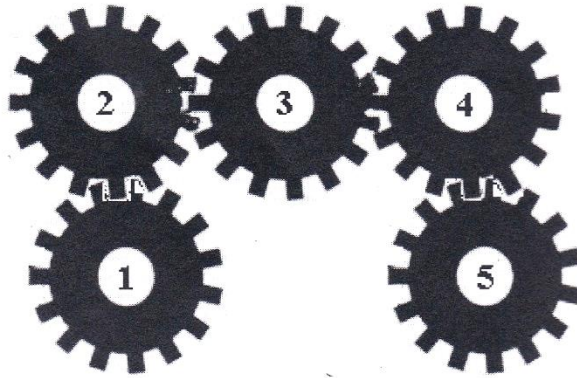
- A. Circuit 1
- B. Circuit 2
- C. Circuit 3
- D. Circuit 4

40. In the given circuit a two way switch  $S_1$  and a simple switch  $S_2$  are connected to a power with five bulbs ( $b_1$  to  $b_5$ ). Which of the following bulbs will be ON when only switch  $S_{1a}$  is closed?

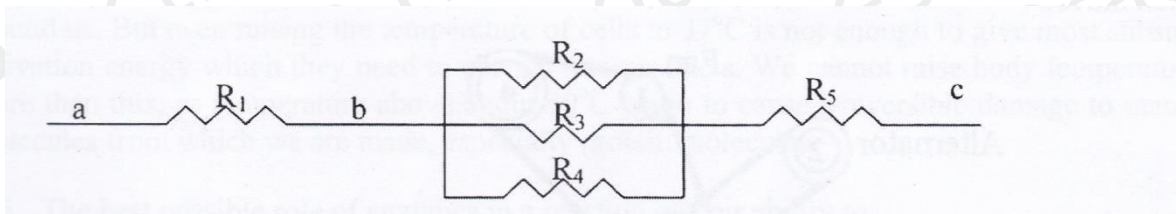
- A.  $b_1, b_2, b_3$  and  $b_5$
- B.  $b_1$  and  $b_4$
- C.  $b_1, b_2, b_4$  and  $b_5$
- D.  $b_2$  and  $b_3$



41. In the given diagram, if gear (3) rotates anti-clockwise, then in which directions will gear (1) and gear (5) rotate?



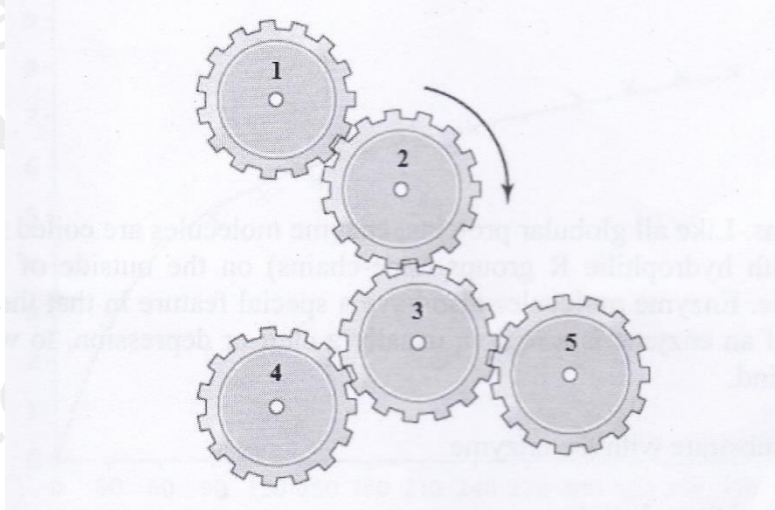
- A. Gear (1) moves in clockwise and gear (5) moves in anti-clockwise direction.  
B. Both (1) and (5) move in anti-clockwise direction.  
C. Both (1) and (5) move in clockwise direction.  
D. Gear (1) moves in anti-clockwise and gear (5) moves in clockwise direction.
42. Given below is part of a circuit diagram.



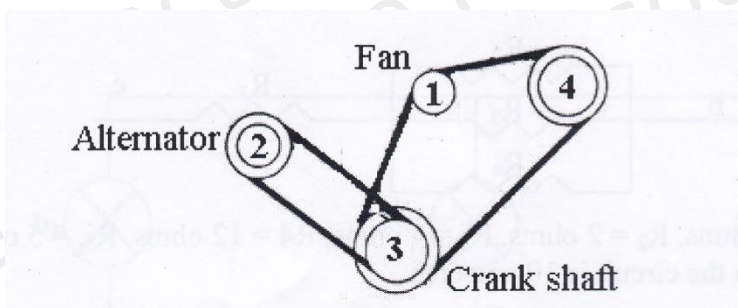
If the resistors  $R_1 = 5$  ohms,  $R_2 = 2$  ohms,  $R_3 = 4$  ohms,  $R_4 = 12$  ohms,  $R_5 = 5$  ohms and the current passing through the circuit is 10 amperes. What is the potential difference across b and c?

- A. 112V  
B. 62V  
C. 58V  
D. 280V

43. If gear (2) moves clockwise, then which of the following directions will be similar to the direction of gear (4)?



- A. Direction of (2) and 5  
B. Direction of (1) and (2)  
C. Direction of (1), (3) and (5)  
D. Direction of (1), (2) and (5)
44. If the given crank shaft moves clockwise, then in which directions will the alternator and the fan move?



- A. Both move anti-clockwise.  
B. Anti-clockwise and clockwise respectively.  
C. Clockwise and anti-clockwise respectively.  
D. Both move clockwise.

45. Which genotype does NOT occur amongst the children of a mother with A and father with B blood group?

- A.  $I^A I^A$
- B.  $I^A I^B$
- C.  $I^A i$
- D.  $ii$

46. Enzymes are globular proteins. Like all globular proteins, enzyme molecules are coiled into a precise three-dimensional shape, with hydrophilic R groups (side-chains) on the outside of the molecule ensuring that they are soluble. Enzyme molecules also have a special feature in that they possess an active site. The active site of an enzyme is a region, usually a cleft or depression, to which another molecule or molecules can bind.

**The interaction of the substrate with the enzyme**

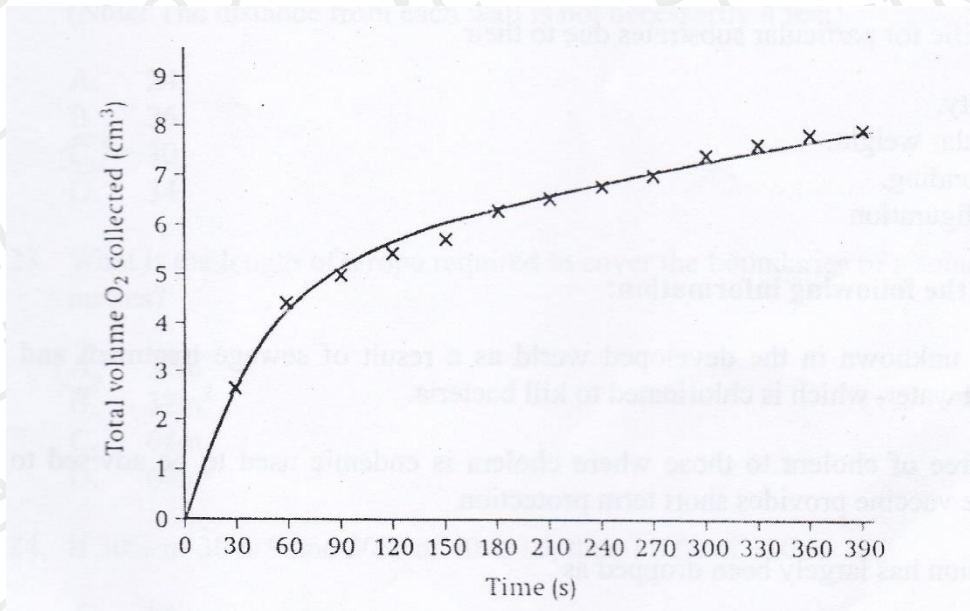
- A. Increases the size of the substrate.
- B. Decreases the size of the substrate.
- C. Brings modification in the active site.
- D. Breaks the enzymes apart.

47. Mammals, such a human, use this method of speeding up their metabolic reactions. Our body temperature is maintained at  $37^{\circ}\text{C}$ , which is usually much warmer than the temperature of the air around us. But even raised the temperature of cells to  $37^{\circ}\text{C}$  is not enough to give most substrates the activation energy which they need to change into products. We cannot raise body temperature much more than this, as temperature above about  $40^{\circ}\text{C}$  begin to cause irreversible damage to many of the molecules from which we are made, especially protein molecules.

**The best possible role of enzymes in a reaction is their ability to**

- A. Increase the activation energy
- B. Decrease the activation energy
- C. Stabilize the activation energy.
- D. Increase body temperature.

The diagram shows the course of an enzyme-catalysed reaction. Catalase was added to hydrogen peroxide at time 0. The gas released was collected in a gas syringe, the volume being read at 30s intervals.



48. The rate of an enzyme controlled reaction is always fastest at the beginning. This can be explained by the fact that initially there is:

- A. A lessen number of substrate molecules.
- B. A large number of substrate molecules.
- C. High temperature of the medium.
- D. A lesser quantity of enzyme available.

49. An example of competitive inhibition occurs in the treatment of a person who has drunk ethylene glycol. Ethylene glycol is used as antifreeze, and is sometimes drunk accidentally. Ethylene glycol rapidly converted in the body to oxalic acid, which can cause irreversible kidney damage. However, the active site of the enzyme which converts ethylene glycol to oxalic acid will also accept ethanol. If the poisoned person is given a large dose of ethanol, the ethanol acts as a competitive inhibitor, slowing down the action of the *enzyme* on ethylene glycol for long enough to allow the ethylene glycol to be excreted.

**A person poisoned with ethylene glycol is treated by giving large amounts of ethanol which acts as a competitive inhibitor. Here, ethanol has which of the mentioned characteristics when compared to the substrate?**

- A. Similar formula
- B. Similar shape
- C. Similar concentration
- D. Similar pH

50. **Enzymes are specific for particular substrates due to their**

- A. pH sensitivity.
- B. High molecular weight.
- C. Hydrogen bonding
- D. Surface configuration.