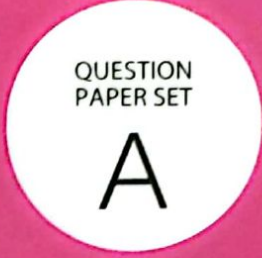




**SOF NATIONAL SCIENCE
OLYMPIAD 2023-24**

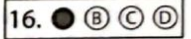


DO NOT OPEN THIS BOOKLET UNTIL ASKED TO DO SO

Total Questions: 50 | Time: 1 hr.

Guidelines for the Candidate

1. You will get additional ten minutes to fill up information about yourself on the OMR Sheet, before the start of the exam.
2. Write your **Name, School Code, Class, Section, Roll No.** and **Mobile Number** clearly on the **OMR Sheet** and do not forget to sign it. We will share your marks / result and other information related to SOF exams on your mobile number.
3. The Question Paper comprises three sections:
Logical Reasoning (10 Questions), **Science** (35 Questions) and **Achievers Section** (5 Questions)
Each question in Achievers Section carries 3 marks, whereas all other questions carry one mark each.
4. All questions are compulsory. There is no negative marking. Use of calculator is not permitted.
5. There is only ONE correct answer. Choose only ONE option for an answer.
6. To mark your choice of answers by darkening the circles on the OMR Sheet, use **HB Pencil** or **Blue / Black ball point pen** only. E.g.
Q.16: In the water cycle, condensation is the process of
A. Water vapour cooling down and turning into a liquid B. Ice warming up and turning into a liquid
C. Liquid cooling down and turning into ice D. Liquid warming up and turning into water vapour
As the correct answer is option A, you must darken the circle corresponding to option A on the OMR Sheet.
7. Rough work should be done in the blank space provided in the booklet.
8. Return the OMR Sheet to the invigilator at the end of the exam.
9. Please fill in your personal details in the space provided before attempting the paper.
10. **For classes 8, 9 & 10, "Innovation Challenge" is being conducted by Techfest IIT Bombay in association with SOF. For details, please visit : www.sofworld.org/sof-techfest-iit-bombay-innovation-challenge2023**



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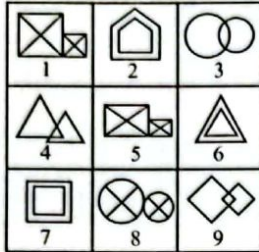
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LOGICAL REASONING

1. In a certain code language, 'LATEST' is written as 'VUGVCN'. How will 'SOURCE' be written in the same code language?

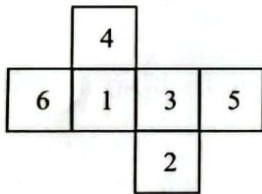
- A. GETWQU B. TEGUQW
C. GFWTEU D. UQWTEG

2. Group the given figures into three classes on the basis of their identical properties using each figure only once.



- A. 1, 5, 8; 2, 4, 9; 3, 6, 7
B. 1, 4, 8; 2, 6, 7; 3, 5, 9
C. 1, 5, 8; 2, 6, 7; 3, 4, 9
D. 1, 6, 7; 2, 5, 8; 3, 4, 9

3. Select a box from the options that is similar to the box formed when the given sheet of paper is folded to form a box.



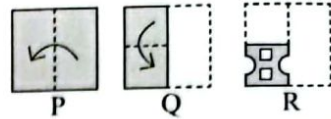
- A.
B.
C.
D.

4. Some letters are given which are numbered as 1, 2, 3, 4, 5 and 6. Select the combination of numbers so that the letters are arranged accordingly to form a meaningful English word.

N E D H I B
1 2 3 4 5 6

- A. 4, 5, 3, 2, 1, 6 B. 6, 2, 4, 5, 1, 3
C. 6, 2, 5, 4, 3, 1 D. 4, 5, 2, 3, 6, 1

5. A set of three figures P, Q and R showing a sequence of folding of a piece of paper is given. Fig. R shows the manner in which the folded paper has been cut. Select a figure from the options which shows the unfolded form of Fig. R.

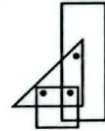


- A.
B.
C.
D.

6. Puneet is the father of Isha. Isha is the sister of Anjali and Ravi is the grandfather of Anjali. If Suman is the sister of Puneet, then how is Isha related to Suman?

- A. Niece B. Aunt
C. Mother D. Grandmother

7. Which of the following options satisfies the same conditions of placement of dots as in the given figure?



- A.
B.
C.
D.

8. Sameer runs 80 m towards North and then turns right and runs 40 m. He then turns right again and runs 20 m. Finally, he turns left and runs 40 m. How far is Sameer now from his starting point?

- A. 95 m B. 120 m
C. 100 m D. 85 m

9. Which of the following Venn diagrams best represents the relationship amongst, "Men, Brothers and Females"?

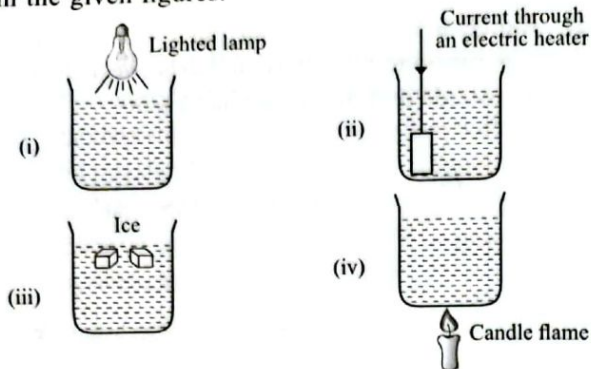
- A.
B.
C.
D.

10. Find the number of triangles formed in the given figure.

- A. 11
B. 12
C. 13
D. More than 13

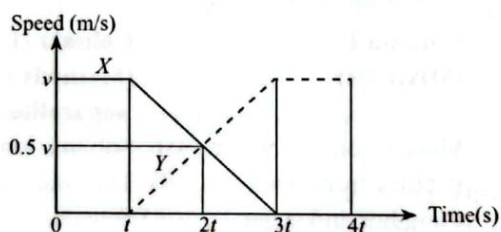


11. Four beakers of water with different setups are shown in the given figures.



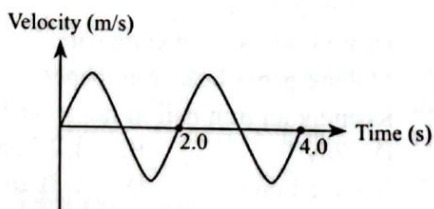
In which beaker(s) does/do the process of convection take(s) place?

- A. (ii) and (iv) only
 B. (iv) only
 C. (i) and (iv) only
 D. (ii), (iii) and (iv) only
12. A car X moving with speed v , passes a police car Y at time t seconds. After t seconds, the car decelerates uniformly until it stops, while the police car accelerates uniformly from rest as shown in the given speed-time graph.



At what time will the police car Y overtake the car X ?

- A. $3t$
 B. $2t$
 C. t
 D. $4t$
13. The bob of a simple pendulum is pulled to one side and released. The variation of velocity of the pendulum from the point of release with time is shown in the given figure.

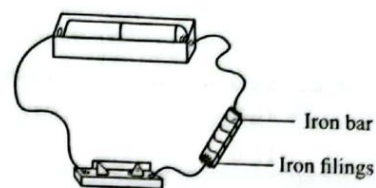


A car takes equal time to travel from a point P to a point Q as the time taken by the pendulum to complete five oscillations.

If the car is travelling at a constant speed of 20 m/s, then the distance between points P and Q is

- A. 200 m
 B. 150 m
 C. 100 m
 D. 75 m

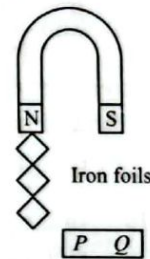
14. In the given figure, when the circuit is closed the iron bar attracts some iron filings.



Which of the following statements are correct?

- (i) The iron bar is demagnetised when electricity passes through it.
 (ii) The iron bar loses its magnetism when the switch is turned off.
 (iii) The experiment shows the magnetic effect of an electric current.
 (iv) The iron filings will not be attracted to the iron bar when the dry cells run out of energy.
- A. (i) and (ii) only
 B. (i) and (iv) only
 C. (ii), (iii) and (iv) only
 D. (ii) and (iv) only

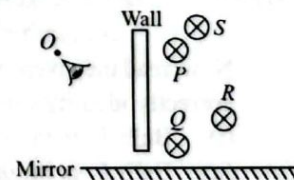
15. A magnet attracts some iron foils as shown in the given figure. A rod PQ is placed near the lowest piece of iron foil. The foil repels the rod.



What can be deduced from the given situation?

- A. Q is a north pole.
 B. P is a north pole.
 C. P and Q are unmagnetised.
 D. P and Q have same poles.

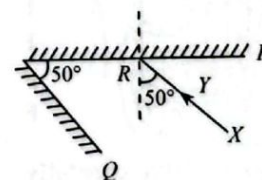
16. Four light bulbs P , Q , R and S are placed behind a wall as shown in the given figure. An observer (O) can see the bulbs



- A. P and R only
 B. Q and R only
 C. R and S only
 D. P , R and S only

17. Two plane mirrors P and Q are kept with an angle of 50° between them as shown in the given figure.

A light ray XY strikes the mirror P at ' R ', making an angle of 50° .



What will be the angle of reflection of the light ray for the mirror Q ?

- A. 60°
 B. 0°
 C. 50°
 D. 90°

18. A pellet of mass 10.0 g is shot from a gun. The velocity of the pellet for first 30 seconds is given in the table.

Time (s)	Velocity (m/s)
0	0
5.0	10
10.0	20
15.0	30
20.0	40
25.0	40
30.0	40

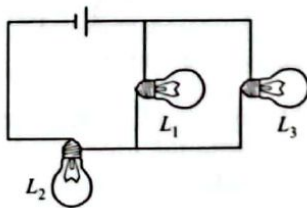
Using the given data, match column I with column II and select the correct option from the given codes.

Column I

Column II

- P. The average acceleration of the pellet in the first 20 seconds (i) 800 m
- Q. The distance travelled by the pellet in first 15 seconds (ii) 2 m/s²
- R. The distance travelled by pellet in first 30 seconds (iii) 225 m
- (iv) 900 m/s²
- A. P-(ii), Q-(i), R-(iii) B. P-(iv), Q-(iii), R-(i)
- C. P-(ii), Q-(iii), R-(i) D. P-(iv), Q-(i), R-(iv)

19. In the given circuit diagram, three identical bulbs are connected.



Now, read the given statements and select the option that correctly identifies them as true (T) and false (F) ones.

- (i) Bulb L_1 is the brightest.
- (ii) Bulb L_3 is brighter than L_2 .
- (iii) Bulbs L_1 and L_2 have the same current flowing through them.
- (iv) Bulb L_2 has twice the potential difference as compared to L_3 .

- | | (i) | (ii) | (iii) | (iv) |
|----|-----|------|-------|------|
| A. | T | F | F | T |
| B. | F | F | F | T |
| C. | T | T | F | F |
| D. | F | T | T | F |

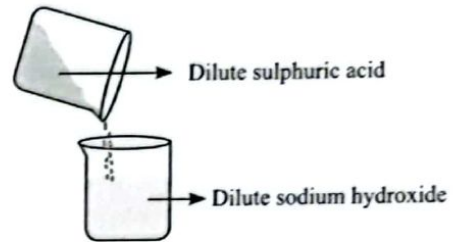
20. Observe the given table carefully.

Group P	Group Q	Group R
DVD player	Blender	Electric kettle
Television	Mixer	Electric iron

On the basis of the conversion of electrical energy, in which group would you put the electric stove?

- A. Group Q B. Group P
- C. Group R D. Both groups P and R

21. Rahul, a science teacher performed the following experiment to study the reaction between dilute sodium hydroxide and dilute sulphuric acid.



Select the correct statement(s) about the given experiment.

- I. On mixing these substances, three new products will be formed, including water.
- II. The chemical reaction involved is known as neutralisation reaction and is exothermic in nature.
- III. The salt formed in this reaction is acidic in nature.
- A. II only B. II and III only
- C. III only D. I and III only

22. Match column I with column II and select the correct option from the given codes.

Column I
(Mixtures)

Column II
(Methods of separation)

- P. Mustard oil and water (i) Sublimation
- Q. Pebbles from rice (ii) Threshing
- R. Camphor and sugar (iii) Separating funnel
- S. Grains from stalks (iv) Handpicking
- A. P-(i); Q-(iii); R-(ii); S-(iv)
- B. P-(iii); Q-(iv); R-(i); S-(ii)
- C. P-(ii); Q-(i); R-(iii); S-(iv)
- D. P-(iii); Q-(iv); R-(ii); S-(i)

23. Which of the following will lead to a chemical change?

- I. Making a fruit salad and keeping it in the open air for an hour.
- II. Heating of calcium carbonate.
- III. Making paper boat from paper.
- IV. Keeping an iron nail in moist air for few days.
- A. IV only B. I, III and IV only
- C. II and III only D. I, II and IV only

24. Which of the following statements are incorrect?

- I. A dry leaf floats on water.
- II. Glass and copper are magnetic materials.
- III. Sandpaper and flower petals are smooth materials.
- IV. Usually metals are good conductors of heat.
- A. II and III only B. I and III only
- C. I and IV only D. II and IV only

25. Read the following statements carefully and select the option that correctly identifies them as true (T) and false (F) ones.

- I. Lime water turns milky, when carbon dioxide gas is passed through it.
- II. Heat, light or any other radiation may be given off or absorbed during a physical change.
- III. Stainless steel is made by mixing iron with sulphur and metals like nickel, zinc and aluminium.
- IV. The ash obtained after burning of magnesium ribbon is acidic in nature and this process is a physical change.

	I	II	III	IV
A.	T	F	T	F
B.	T	T	F	F
C.	T	F	F	F
D.	F	T	F	T

26. Read the given passage carefully and fill in the blanks by selecting the correct option.

- (i) is used to separate bran from wheat flour.
 (ii) is used to separate tea leaves from tea.
 (iii) is used to separate husk from wheat.
 (iv) is used to separate two miscible liquids.

	(i)	(ii)	(iii)	(iv)
A.	Handpicking	Sieving	Threshing	Separating funnel
B.	Winnowing	Evaporation	Sieving	Separating funnel
C.	Sieving	Filtration	Winnowing	Distillation
D.	Winnowing	Evaporation	Threshing	Distillation

27. A brief description about four substances W, X, Y and Z is given as:

W : Colourless in acidic solution

X : Main component of vitamin C

Y : Used in lead storage batteries

Z : Gives tamarind its sour taste

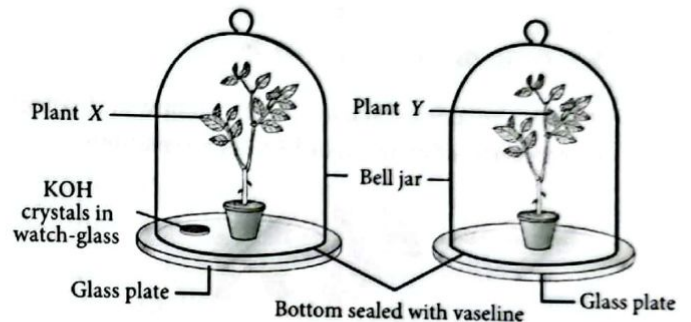
Which of the following best represents W, X, Y and Z?

	W	X	Y	Z
A.	Methyl orange	Citric acid	Sulphuric acid	Tartaric acid
B.	Phenolphthalein	Ascorbic acid	Sulphuric acid	Tartaric acid
C.	Phenolphthalein	Citric acid	Hydrochloric acid	Ascorbic acid
D.	Methyl orange	Ascorbic acid	Hydrochloric acid	Citric acid

28. Radhika tested the nature of three different substances with different indicators and recorded her observations as shown :

- Substance X turned phenolphthalein indicator pink.
 - Substance Y turned China rose indicator green.
 - Substance Z turned methyl orange indicator red.
- X, Y and Z could be respectively
- A. Sugar solution, Spinach juice, Baking soda
 - B. Window cleaner, Apple juice, Soap solution
 - C. Lemon juice, Window cleaner, Aerated drink
 - D. Lime water, Milk of magnesia, Curd.

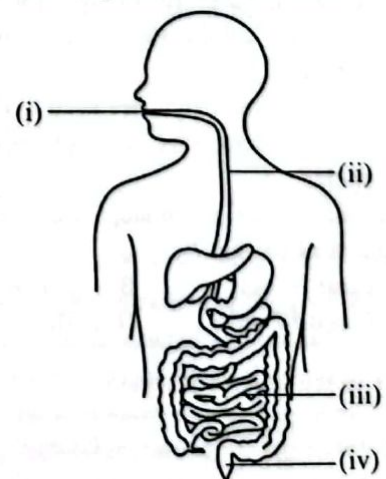
29. Two healthy potted plants of nearly the same size were taken and destarched for 2-3 days. After this, they were placed on two separate glass plates, covered with bell jar and kept in Sun (as shown in the given experimental set-up).



What will be the result if one leaf from both the plants are tested for presence of starch after 4-6 hours?

- A. Leaves of both the plants will turn blue-black in colour.
- B. Leaf of only plant X will turn blue-black in colour.
- C. Leaf of only plant Y will turn blue-black in colour.
- D. Leaves of both the plants will not turn blue-black in colour.

30. Refer to the given diagram of human digestive system. Identify the labelled parts (i)-(iv) and select the incorrect match of labelled part and its function.



- A. (i) – Helps in mechanical breakdown of food
- B. (ii) – Secretes bile that aids in digestion of fats
- C. (iii) – Absorbs nutrients from the digested food
- D. (iv) – Stores faeces temporarily

31. Match column I with column II and select the correct option from the given codes.

Column I	Column II
(i) Omasum	P. Chamber where anaerobic bacteria act on the food
(ii) Abomasum	Q. Second chamber which receives the cud
(iii) Reticulum	R. Third chamber where water absorption occurs
(iv) Rumen	S. Known as true stomach as it has enzymes needed for digestion of food

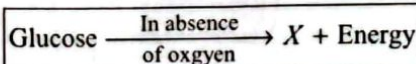
A. (i)-S; (ii)-Q; (iii)-R; (iv)-P
 B. (i)-R; (ii)-Q; (iii)-P; (iv)-S
 C. (i)-Q; (ii)-P; (iii)-R; (iv)-S
 D. (i)-R; (ii)-S; (iii)-Q; (iv)-P

32. Identify the animal shown in the picture and select the correct statement regarding its adaptations.



- A. Colour of its fur helps it to camouflage with the surroundings.
 B. Small ears and tail minimise heat loss from the body.
 C. Wide and large paws help it to walk on the snow.
 D. All of these
33. Given below are few steps related to sewage treatment.
- I. Strainers or bar screens are used to separate large solids, *i.e.*, leaves, rags, plastics, etc.
 - II. Aerobic bacteria act on sewage in the aeration tanks.
 - III. As wastewater flows through sedimentation tanks, the solid materials gradually settle at the bottom.
 - IV. Chlorine and ozone are used to disinfect water.
 - V. Action of bacteria causes formation of activated sludge.
- Which among the given steps are related to primary treatment of sewage?
- A. I and III only B. I, II and III only
 C. II and IV only D. III, IV and V only

34. Refer to the given equation.



What can be X if the above reaction is occurring in humans?

- A. Ethyl alcohol B. Lactic acid
 C. Carbon dioxide D. Glycogen

35. Given below is a list of few organisms.

Cockroach, Pigeon, Turtle, *Hydra*,
Leech, Crocodile, Shark, Human

How many among them are ureotelic?

- A. 2 B. 4
 C. 3 D. 5

36. Which among the given statements is incorrect regarding anaerobic respiration?

- A. It takes place in the absence of oxygen.
 B. Less energy is released during this process.
 C. Food is broken down into carbon dioxide, water and energy in this process.
 D. Yeast, some bacteria and parasitic flatworms perform this type of respiration.

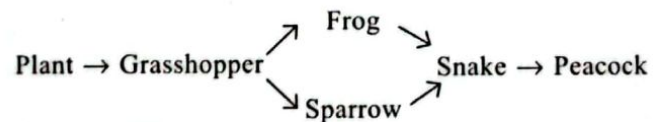
37. Read the following statements and select the correct option.

Statement 1 : Haemoglobin present in RBCs helps to transport oxygen from lungs to different body cells.

Statement 2 : Haemoglobin combines with oxygen to form oxyhaemoglobin.

- A. Both statements 1 and 2 are true and statement 2 is the correct explanation of statement 1.
 B. Both statements 1 and 2 are true but statement 2 is not the correct explanation of statement 1.
 C. Statement 1 is true but statement 2 is false.
 D. Both statements 1 and 2 are false.

38. Refer to the given food web.



What will be the consequence if the population of snake increases?

- A. Population of peacock will decrease.
 B. Population of grasshopper will increase.
 C. Population of frog will decrease whereas that of sparrow will increase.
 D. None of these

39. Select the incorrect match.

- A. Vitamin B₁ – Thiamine
 B. Vitamin B₆ – Pyridoxine
 C. Vitamin B₉ – Niacin
 D. Vitamin B₁₂ – Cobalamin

40. Identify the dietary component X from the given statements and select the option that correctly identifies it.

- X is found only in food materials obtained from plants.
- X helps in regular bowel movement.
- X does not provide nutrients to our body.

X could be

- A. Proteins
- C. Minerals

- B. Vitamins
- D. Roughage.

41. Select the odd one out on the basis of lifespan of plants.

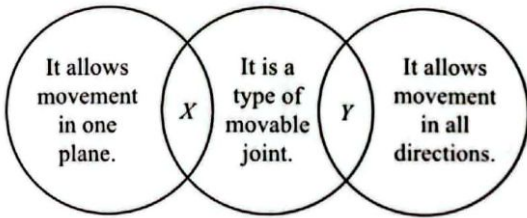
- A. Mango
- C. Turnip
- B. Guava
- D. Neem

42. Read the given statement and select the option that correctly fills the blanks.

Underground food storing stem of ginger is called (i) whereas that of onion and garlic is called (ii).

- | | |
|------------|-------|
| (i) | (ii) |
| A. Rhizome | Bulb |
| B. Rhizome | Tuber |
| C. Bulb | Eye |
| D. Eye | Tuber |

43. Refer to the given Venn diagram and select the correct statement regarding it.



- A. Joint X is gliding joint and is found between the bones of wrist.
- B. Joint Y is pivot joint and is found between the bones of knee.
- C. Joint Y is ball and socket joint and is found between the bones of shoulder and upper arm.
- D. Joint X is hinge joint and is found between the bones of skull and first vertebra of backbone.

44. Which among the following is not an adaptation of a submerged aquatic plant?

- A. Flexible stem
- B. Plant takes in dissolved oxygen through its body surface
- C. Long and narrow leaves
- D. Stomata are present only on the upper side of the leaves

45. Select the plants which can be pollinated by air.

- | | |
|------------------------|---------------------|
| (i) <i>Vallisneria</i> | (ii) <i>Zostera</i> |
| (iii) Maize | (iv) Date palm |
| (v) Wheat | (vi) Paddy |

- A. (i), (ii), (iii) and (iv) only
- B. (ii), (iii), (v) and (vi) only
- C. (i), (ii), (iv) and (v) only
- D. (iii), (iv), (v) and (vi) only

ACHIEVERS SECTION

46. Refer to the given dichotomous key and select the correct statement regarding P-S.

- I. (a) It is the male reproductive part of a flower. -Go to (II)
- (b) It is the female reproductive part of a flower. -Go to (III)
- II. (a) It is the sterile male part. - P
- (b) It is the fertile male part. - Q
- III. (a) It forms seeds after fertilisation. - R
- (b) It forms fruit after fertilisation. - S
- A. S contains one or more R, inside which female gamete is formed.
- B. During pollination, pollen grains from P are transferred to R of same flower.
- C. Q is a two-lobed structure that contains single layered pollen grains.
- D. R is a tubular stalk that connects stigma to the S.

47. Read the given paragraph where few words have been italicised and select the correct statement regarding them.

Small intestine is the longest part of digestive system. *Small intestine* contains finger-like projections

called *vesicles* that help in absorbing nutrients after digestion. *Small intestine* also receives bile juice from *pancreas* that helps in the breakdown of fats into *amino acids*.

- A. *Small intestine* should be replaced with *large intestine*.
- B. *Vesicles* should be replaced with *valves*.
- C. *Pancreas* should not be changed as it is correctly mentioned.
- D. *Amino acids* should be replaced with *fatty acids*.

48. Given below are few events related to breathing.

- I. Diaphragm contracts and becomes flat.
- II. Ribs move downward and inward.
- III. Air pressure in the lungs decreases.
- IV. Volume of thoracic cavity increases.
- V. Diaphragm becomes dome-shaped.

Which among the given events occur during inhalation?

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

49. Observe the following figure carefully and select the incorrect statements.

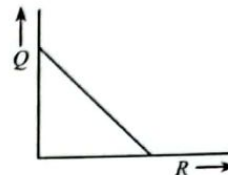


- I. Y must be an acid like acetic acid.
 - II. Gas X is hydrogen and it turns lime water milky.
 - III. The milky of lime water after passing gas X is due to the formation of calcium hydrogen carbonate, which is insoluble in water.
 - IV. The process involves a chemical change as only the colour and state of the original substances have changed.
- A. I and III only
 B. III and IV only
 C. II, III and IV only
 D. I and II only

50. A parachutist P of combined mass m , jumps from a plane as shown in the given figure. Initially speed of P increases and then becomes constant (terminal speed v).



The given graph depicts variation of a certain quantity Q with another quantity R for P.



What are the quantities Q and R, and what is represented by the magnitude of the slope of the graph?

	Q	R	Magnitude of slope
A.	Height	Time	Velocity of the parachutist
B.	Velocity	Time	Acceleration of free fall
C.	Height	Potential energy	Combined mass, m
D.	Potential energy	Time	Weight of the parachutist

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