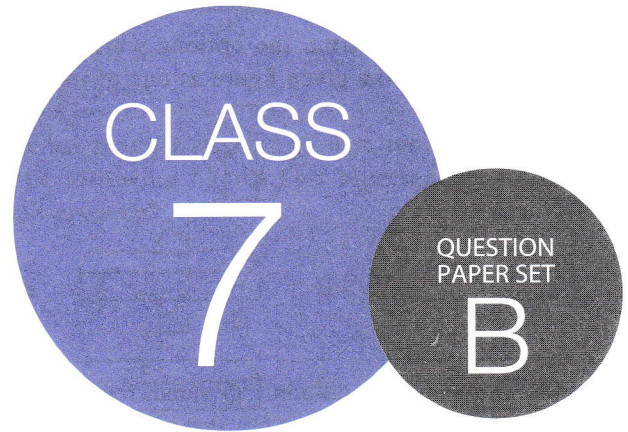


**SOF NATIONAL SCIENCE  
OLYMPIAD 2023-24**



**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](http://www.sofworld.org/sof-techfest-iit-bombay-innovation-challenge2023)**

16. ● (B) (C) (D)

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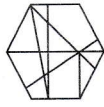
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## LOGICAL REASONING

1. Select a figure from the options which is exactly embedded in the given figure as one of its parts.

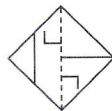


- A. B.   
 C. D.

2. If 'P' stands for 'addition', 'Q' stands for 'subtraction', 'R' stands for 'division' and 'S' stands for 'multiplication', then find the value of  $84 R 12 P 7 S 4 Q 18$ .

- A. 21  
 B. 17  
 C. 18  
 D. 15

3. A transparent sheet with a pattern and a dotted line on it is given. Select a figure from the options as to how the pattern would appear when the transparent sheet is folded along the dotted line.

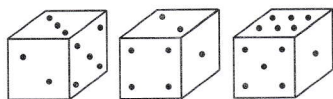


- A. B.   
 C. D.

4. There is a certain relationship between the pair of terms on the either side of  $::$ . Identify the relationship on the left pair and find the missing term.

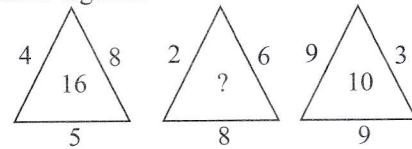
$LWT : NUV :: HRQ : ?$

- A. JPS  
 B. JTS  
 C. FPO  
 D. FTS
5. Three different positions of a dice are shown below. How many dots will be there on the face opposite to the face having four dots?



- A. 6  
 B. 5  
 C. 3  
 D. 2

6. Find the missing number, if same rule is followed in all the three figures.



- A. 5  
 B. 3  
 C. 4  
 D. 6

7. Pointing towards a girl, Raj said, "She is the daughter of my son's brother's wife." How is the girl's mother related to Raj?

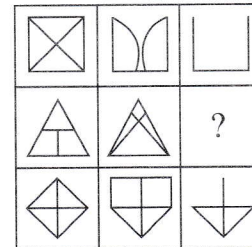
- A. Daughter-in-law  
 B. Aunt  
 C. Granddaughter  
 D. Daughter

8. Select the correct water image of the given figure.



- A. B.   
 C. D.

9. Select a figure from the options which will complete the given figure matrix.

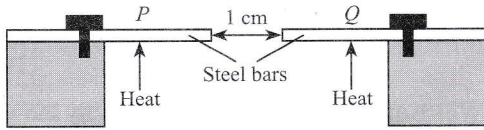


- A. B.   
 C. D.

10. How many such pairs of letters are there in the word **FUTURE** each of which has the same number of letters between them in the word as in the English alphabets?

- A. One  
 B. Two  
 C. Three  
 D. More than three

11. In the arrangement, two identical steel bars  $P$  and  $Q$  are fixed and heated as shown in the given figure.

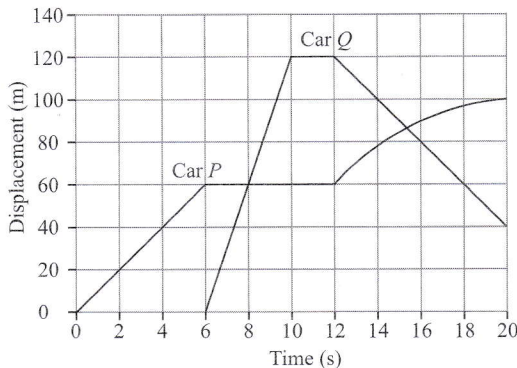


On heating the bars, following observations are made.

- (i) The space between the bars decreases.
- (ii) Matter contracts on heating.
- (iii) Length of bar  $P$  increases while that of  $Q$  decreases.
- (iv) Metals are good conductor of heat.

Which of the given observation(s) is/are correct?

- A. (i) and (iii) only
  - B. (i) and (iv) only
  - C. (ii) only
  - D. (ii), (iii) and (iv) only
12. The given figure represents the displacement time graphs of two cars  $P$  and  $Q$ .

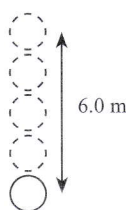


Now, read the given statements and select the option which correctly identifies them as true (T) and false (F) ones.

- (i) Car  $Q$  overtakes car  $P$  at  $t = 9$  s.
- (ii) Both cars,  $P$  and  $Q$  are at rest between  $t_1 = 10$  s to  $t_2 = 12$  s.
- (iii) Car  $Q$  starts turning back at  $t = 14$  s.
- (iv) The average velocity of car  $P$  is  $8$  m/s for the whole journey.

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

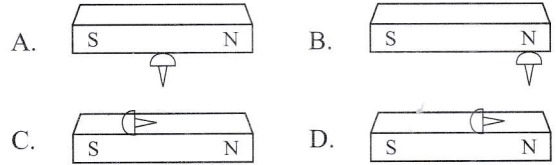
13. A ball is falling with a constant velocity as shown in the given figure. A camera is taking images of its motion at the rate of 12 images per second. The speed of the ball is



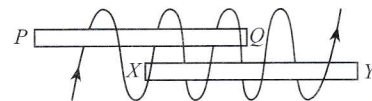
- A.  $12.5$  m/s
- B.  $10$  m/s

- C.  $16.2$  m/s
- D.  $18$  m/s

14. A bar magnet attracts an iron nail. Which one of the following figures best represents the possible observation?



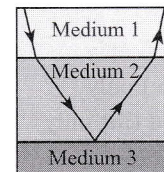
15. In an experiment, a wire is coiled around two iron bars  $PQ$  and  $XY$  as shown in the given figure.



The poles at parts  $P$ ,  $Q$ ,  $X$  and  $Y$  are

	$P$	$Q$	$X$	$Y$
A.	N	S	N	S
B.	S	N	N	S
C.	S	N	S	N
D.	N	S	S	N

16. A light ray travels from medium 1 to medium 3 as shown in the given figure. The descending order of medium's refractive indices is



- A. Medium 3, medium 1, medium 2
- B. Medium 1, medium 2, medium 3
- C. Medium 2, medium 1, medium 3
- D. Medium 2, medium 3, medium 1

17. Read the given statements and select the correct option.

**Statement 1 :** When an object is placed between two plane mirrors, then all the images formed are of equal intensity.

**Statement 2 :** When an object is placed in between two plane parallel mirrors, only three images are possible.

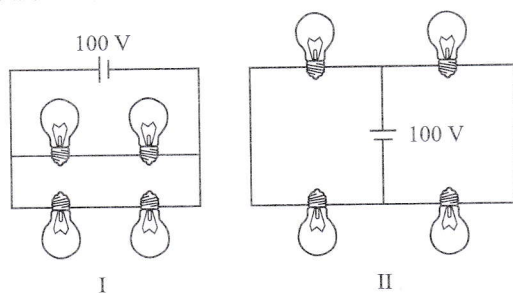
- A. Both statements 1 and 2 are true and statement 2 is the correct explanation of statement 1.
- B. Both statements 1 and 2 are true but statement 2 is not the correct explanation of statement 1.
- C. Statement 1 is true but statement 2 is false.
- D. Both statements 1 and 2 are false.

18. A thermometer registers a temperature reading of  $-1.0^{\circ}\text{C}$  when placed in a bowl of pure melting ice. It registers a temperature reading of  $99^{\circ}\text{C}$  when being placed in pure steam. A student then uses it to measure the temperature of a cup of water.

The temperature of the water measured by the student is

- $1.0^{\circ}\text{C}$  higher than the true temperature
- The same as the true temperature
- $1.0^{\circ}\text{C}$  lower than the true temperature
- $3.0^{\circ}\text{C}$  higher than the true temperature.

19. Four identical bulbs are connected through two combinations as shown in the given diagrams I and II.



Which of the following statement(s) is/are incorrect?

- The light bulbs in the diagram II are dimmer.
- The light bulbs in the diagram I are dimmer.
- The light bulbs in the diagram I will not light up.
- All the light bulbs in both the diagrams I and II have equal brightness.

- (i) only
- (ii) and (iii) only
- (ii) and (iv) only
- (i), (ii) and (iii) only

20. Read the given statements carefully and select the correct option.

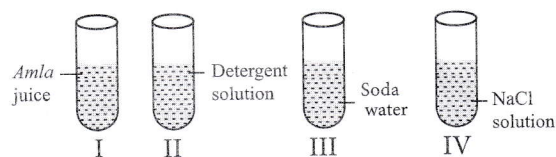
- In case of an electric cell, chemical energy is converted into electrical energy.
- When positive and negative terminals of a given number of cells are connected together separately, they are said to be in series combination.

- Only (i) is correct.
- Only (ii) is correct.
- Both (i) and (ii) are correct.
- Both (i) and (ii) are incorrect.

21. Select the correct match of the mixtures and their methods of separation.

- Sand and crushed sugar – Handpicking
- Toothpicks and allpins – By using a magnet
- Naphthalene powder and salt – Sieving
- Pebbles and pulses – Filtration

22. Mr. Ashok, a science teacher demonstrated the effect of methyl orange indicator on the following solutions :



Which of the following options correctly shows the colour change in all these test tubes?

- |    | I         | II     | III       | IV        |
|----|-----------|--------|-----------|-----------|
| A. | Yellow    | Red    | No change | No change |
| B. | No change | Red    | Yellow    | No change |
| C. | Red       | Yellow | Red       | No change |
| D. | Red       | Yellow | Yellow    | Red       |

23. Rekha grouped together a few common substances on the basis of their property mentioned in bracket:

*P* – Rubber band, Wooden block, Plastic ball, Safety pin (Magnetic; Non-magnetic)

*Q* – Kerosene, Glycerine, Coconut oil, Diesel (Miscibility; Immiscibility in water)

*R* – Paper, Wood, Cotton, Steel (Lustrous; Non-lustrous)

The odd ones in the groups *P*, *Q* and *R* are respectively

- Rubber band, Diesel and Paper
- Wooden block, Glycerine and Cotton
- Safety pin, Glycerine and Steel
- Rubber band, Coconut oil and Wood.

24. Which of the following statements is correct about the given changes?

- Beating aluminium to make aluminium foil
- Cutting a log of wood into pieces
- Heating an iron nail till red hot
- Crystallisation of pure copper sulphate crystals from an impure sample

- (i) and (ii) are chemical changes while (iii) and (iv) are physical changes.
- (ii) and (iii) are chemical changes while (i) and (iv) are physical changes.
- All are physical changes.
- All are chemical changes.

25. Select the correct statement(s).

- A wasp sting consists of formic acid, that can be neutralised by rubbing magnesium hydroxide.
- Ammonium chloride is an acidic salt while sodium acetate is a basic salt.
- The tarnished surface of copper articles can be treated by rubbing lemon on them.
- If the soil becomes too acidic, then organic matter is added to the soil which releases bases on decomposition.

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

26. The given table indicates the classification of different materials based on their properties. Which of the following sets are incorrectly matched?

Set	Hard	Transparent	Sinks in water
I	Wooden block	Air	Gold coin
II	Sponge	Oil	Honey
III	Iron nail	Frosted glass	Petrol
IV	Cotton ball	Metal ball	Glass ball

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

27. Which of the following statements is/are correct?

- I. Manure formation from leaves is a chemical change.
- II. Chemically iron and rust are same.
- III. Breakdown of ozone to oxygen is a chemical change.
- IV. Zinc-coated iron pipes rust easily.

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

28. During a group discussion on the topic, "Rusting" four students Neha, Kritika, Avantika and Sachin gave the following statements.

**Neha** : The salty water makes the process of rusting faster.

**Kritika** : The process of depositing a layer of carbon on iron is known as galvanisation.

**Avantika** : Applying a coat of paint on an iron article cannot prevent rusting.

**Sachin** : For rusting, the presence of both oxygen and water (or water vapour) is essential.

The correct statements were given by

- A. Neha and Sachin
- B. Sachin and Avantika
- C. Kritika and Avantika
- D. Neha and Kritika.

29. *X* type of organisms get their nutrition from dead and decaying organic matter. Which among the following can be *X*?

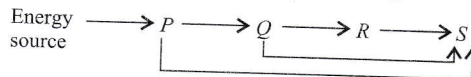
- A. Yeast
- B. Mushroom
- C. Bread mould
- D. All of these

30. Which of the following adaptations is not shown by camel?

- A. Long eyelashes

- B. Thick layer of subcutaneous fat
- C. Hump at the back to store fat
- D. Excretes very little water in the form of urine

31. Refer to the given food chain showing flow of energy.



Select the correct statement regarding *P*, *Q*, *R* and *S*.

- (i) *S* helps in cleaning of environment as well as recycling of nutrients.
- (ii) The role of *Q* comes when plants and animals die.
- (iii) *P* operates at all levels of food chain.
- (iv) *R* eats other animals and gets its food indirectly from *P*.

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

32. Select the incorrect match.

- A. Bronchitis – Inflammation of bronchi
- B. Emphysema – Infection in trachea
- C. Flu – Infection of nose and throat
- D. Bronchial asthma – Allergic reaction to foreign substances that affect respiratory tract

33. Mahi took a small amount of crushed food sample '*P*' in a test tube and added Benedict's solution to it. She then heated the food sample and observed that the colour of food sample changes to red. The food sample '*P*' could be

- A. Apple
- B. Cheese
- C. Butter
- D. Black gram.

34. Read the given statement and select the option that correctly fills in the blank.

\_\_\_\_\_ is the coldest layer in Earth's atmosphere.

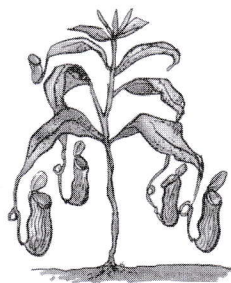
- A. Stratosphere
- B. Mesosphere
- C. Thermosphere
- D. Troposphere

35. Which among the following is/are post-fertilisation event(s)?

- I. Transfer of pollen grains from anther to stigma.
- II. Formation of male gametes inside the pollen grains.
- III. Formation of fruit from the ripened ovary.
- IV. Germination of pollen tubes from pollen grains.

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

36. Which among the given statements is correct regarding the plant shown in the given figure?



- A. Leaves of this plant are modified to reduce water loss from the plant.  
 B. Buds that grow on the leaf of this plant can grow into a new plant.  
 C. Leaves of this plant are modified to trap insects to fulfill the nitrogen demand of the plant.  
 D. Leaves of this plant store extra food and are eaten as vegetables.

37. Refer to the given table and select the option that correctly identifies *P*, *Q* and *R*.

Place of digestion	Enzyme	Digestion activity
<i>P</i>	Lipase	Changes fats into fatty acid and glycerol
Mouth	<i>Q</i>	Changes starch to sugar
Stomach	Pepsin	<i>R</i>

- | <i>P</i>           | <i>Q</i>         | <i>R</i>                         |
|--------------------|------------------|----------------------------------|
| A. Small intestine | Salivary amylase | Breaks proteins into peptones    |
| B. Small intestine | Trypsin          | Breaks peptides into amino acids |
| C. Large intestine | Salivary amylase | Changes maltose to glucose       |
| D. Large intestine | Sucrase          | Changes glucose to fructose      |

38. Select the incorrect match of mineral and its sources.

- A. Iron – Dates, Green vegetables  
 B. Calcium – Milk, Cheese  
 C. Potassium – Meat, Banana  
 D. Iodine – Citrus fruits, Honey

39. Which among the given plants are mostly pollinated by insects?

(i) Wheat, (ii) *Zostera*, (iii) *Acacia*,  
 (iv) *Bougainvillea*, (v) Maize, (vi) *Mimosa*

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

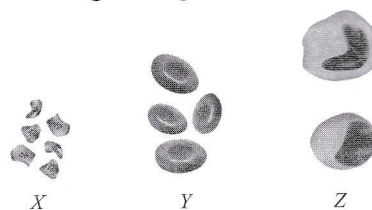
40. Select the incorrect characteristic regarding adaptation in birds.

- A. Exoskeleton is made up of tough but light material called chitin  
 B. Body covered with feathers  
 C. Hollow and light bones  
 D. Streamlined body

41. Select the incorrect match.

- A. *Amoeba* – Tracheal respiration  
 B. Salmon – Branchial respiration  
 C. Earthworm – Cutaneous respiration  
 D. Penguin – Pulmonary respiration

42. Refer to the given figures.



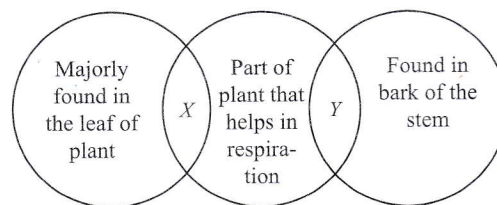
Identify *X*–*Z* and select the incorrect statement regarding them.

- A. *X*, *Y* and *Z* are known as thrombocytes, erythrocytes and leucocytes respectively.  
 B. *X* help in clotting of the blood whenever there is a wound on the body.  
 C. *Y* help to transport oxygen to the cells, all over the body.  
 D. *Z* contain haemoglobin and granules in their cytoplasm.

43. Select the incorrect statement.

- A. Chlorine from CFCs, when reaches ozone layer, splits ozone to form oxygen.  
 B. UV radiations that reaches the Earth from Sun can cause serious problems like skin cancer and cataract.  
 C. Smoke and harmful gases along with condensed water vapour form smog in winters.  
 D. None of these

44. Refer to the given Venn diagram and select the incorrect statement regarding *X* and *Y*.



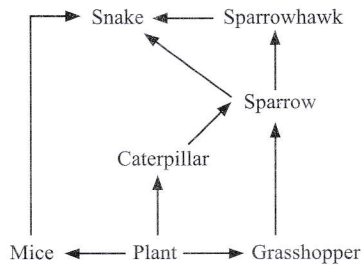
- A. *X* also helps in transpiration in plants.  
 B. *Y* is also found on the skin of fruits.  
 C. *X* is surrounded by two bean-shaped guard cells.  
 D. Both *X* and *Y* open and close due to the flow of water in and out of cell.

45. Select the incorrect statement.
- The position of left kidney is little higher than the right kidney in human body.
  - Urinary bladder is situated in the pelvic region of the abdominal cavity of humans.

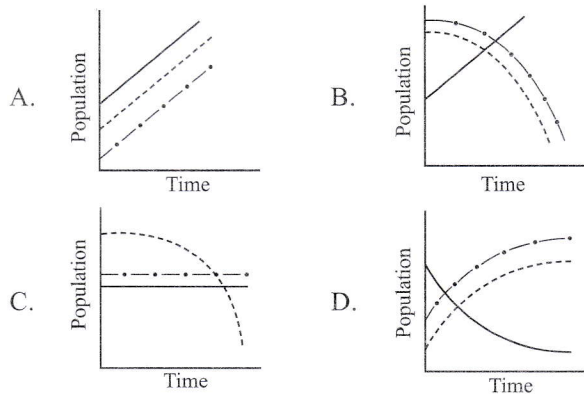
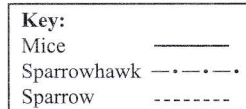
- The presence of excessive water in urine indicates diabetes mellitus.
- Ammonia is a nitrogenous waste formed from the breakdown of protein.

### ACHIEVERS SECTION

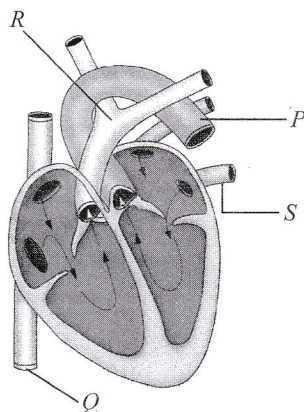
46. Refer to the given food web.



Which graph correctly depicts the change in population of mice, sparrow and sparrowhawk, if the population of grasshopper and caterpillar decrease due to spraying of insecticides?



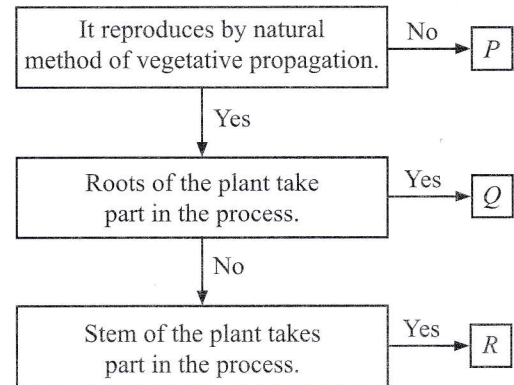
47. Refer to the given figure of heart. Identify the labelled parts *P*, *Q*, *R* and *S* and select the incorrect statement regarding them.



- P* refers to aorta that supplies the oxygenated blood from left ventricle to all the body parts.

- Q* refers to vena cava that brings deoxygenated blood from body parts to right atrium.
- R* refers to pulmonary artery that carries blood from right ventricle to lungs for oxygenation.
- S* refers to pulmonary vein that brings deoxygenated blood to left atrium.

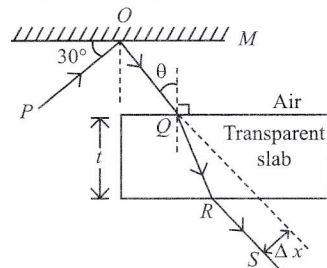
48. Refer to the given flow chart.



Identify *P*, *Q* and *R* and select the correct option regarding them.

- P* could be mango whereas *Q* could be *Dahlia*.
- Q* could be *Asparagus* whereas *R* could be ginger.
- P* could be papaya whereas *R* could be garlic.
- All of these

49. A ray of light is incident on a plane mirror *M* at the point *O*, as shown in the given figure. After reflection, it passes through a transparent slab.



Which of the given statements are incorrect?

- The ray *RS* will be parallel to the ray *OQ*.
  - The value of angle  $\theta$  is  $30^\circ$ .
  - We can increase  $\Delta x$  by decreasing  $t$ .
  - $\Delta x$  can be decreased by using another transparent slab of lesser refractive index.
- I and II only
  - II and III only
  - I and IV only
  - I, II, III and IV

50. A list of few substances is given below :
- (a) Soft drink                      (b) Tamarind juice  
(c) Milk of magnesia              (d) Tomato juice  
(e) Lime water                      (f) Sodium chloride solution  
(g) Window cleaner              (h) Calamine solution
- Read the following statements carefully and select the incorrect statement(s).

I. (a), (c) and (d) turn turmeric paper red, while no change occurs on turmeric paper when it is dipped in (b), (e), (f) and (g).

- II. China rose indicator turns green in (c), (e), (g) and (h) and magenta in (a), (b) and (d).
- III. (b), (c) and (e) turn red litmus blue while (a), (f), (g) and (h) turn blue litmus red.
- IV. Methyl orange indicator turns red in (b), (e) and (f) and yellow in (a), (c), (d) and (h)
- A. I, II and III only  
B. I, III and IV only  
C. III and IV only  
D. II only

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