

**SOF NATIONAL SCIENCE
OLYMPIAD 2022-23**



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, 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 on this page before attempting the paper.

16. ● (B) (C) (D)



Name:.....

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LOGICAL REASONING

1. If '-' stands for '+', '+' stands for 'x', 'x' stands for '÷' and '÷' stands for '-', then what is the value of $30 - 5 + 4 \times 7 \div 9$?

- A. 20
- B. 21
- C. 22
- D. 23

2. In a certain code language, "sky is blue" is written as "324", "flowers are beautiful" is written as "759" and "sky always beautiful" is written as "365". How will "always" be written in the same code language?

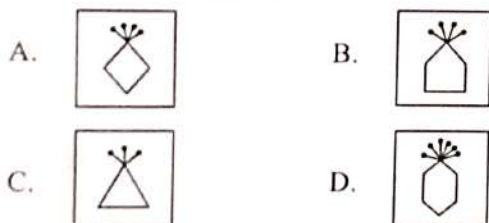
- A. 6
- B. 3
- C. 5
- D. 9

3. How many such 4's are there in the given series each of which is immediately preceded by 3 but not immediately followed by 8?

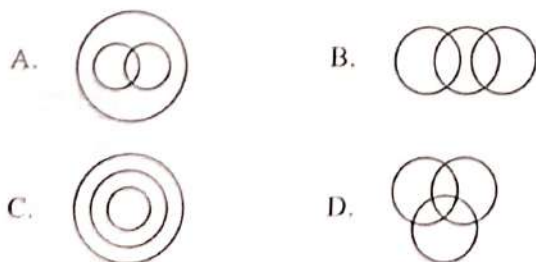
6 4 8 5 6 3 4 9 7 6 4 8 7 3 4 2 8 5 3 4 7

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

4. Select the odd one out.



5. Which of the following Venn diagrams best represents the relationship amongst, "Chess players, Hockey players and Students"?



6. In the given question, two rows of numbers are given. The resultant number in each row is to be worked out separately based on the following rules and the question below the rows of numbers is to be answered.

The operations on numbers progress from left to right.

Rules:

- I. If an odd number is followed by a two-digit even number, then they are to be added.
- II. If an odd number is followed by a two-digit odd number, then the second number is to be subtracted from the first number.
- III. If an even number is followed by a number which is a perfect square of a number, then the second number is to be divided by the first number.
- IV. If an even number is followed by a two-digit even number, then the first number is to be multiplied by the second number.

19 15 12

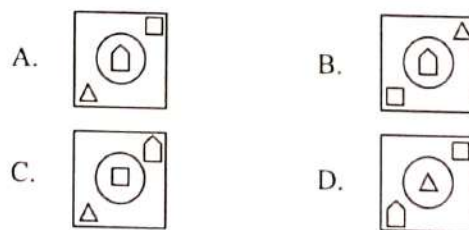
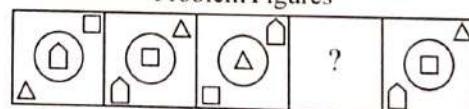
15 12 23

If the resultant of the first row is divided by the resultant of the second row, then what will be the outcome?

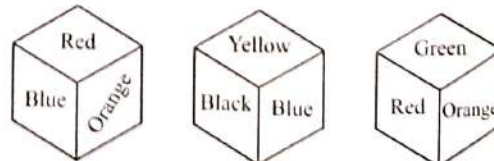
- A. 29
- B. 40
- C. 12
- D. None of these

7. Select a figure from the options which will continue the same series as established by the Problem Figures.

Problem Figures



8. Three different positions of a cube are shown below. Which colour will be on the face that is opposite to the face having red colour?



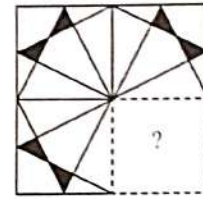
- A. Blue
- B. Black
- C. Yellow
- D. Orange

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



- A.
- B.
- C.
- D.

10. Which of the following options will complete the pattern in the given figure?



- A.
- B.
- C.
- D.

SCIENCE

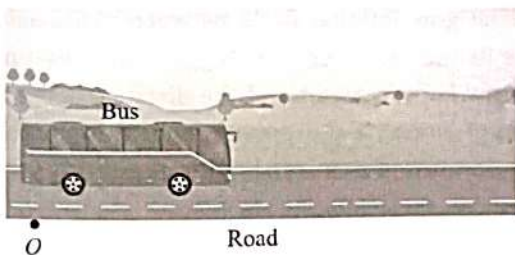
11. Read the given statements and select the correct option.

Statement 1 : The weight of a body becomes zero at the centre of the Earth.

Statement 2 : As the distance from centre of the Earth increases, acceleration due to gravity decreases.

- A. Both statement 1 and statement 2 are true.
 B. Both statement 1 and statement 2 are false.
 C. Statement 1 is true but statement 2 is false.
 D. Statement 1 is false but statement 2 is true.

12. A bus starts from rest and moves away from the point O with uniform acceleration as shown in the given figure.



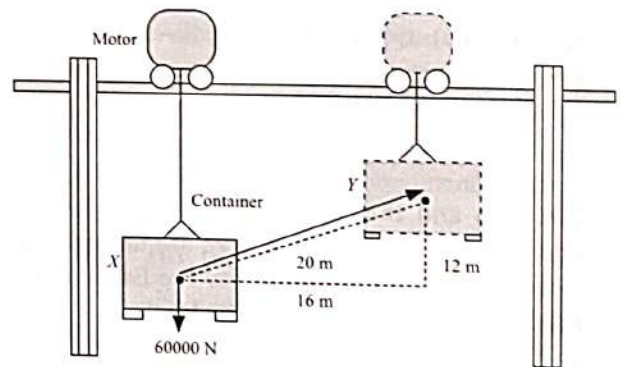
Which of the following graphs correctly describes motion of the bus?

- A.
- B.
- C.
- D. Both B and C

13. A boy standing at a certain distance from a wall produces a loud sound. He hears echo of the sound after 2.2 s. Velocity of sound in air is 340 m s^{-1} . Distance between the wall and the boy is

- A. 340 m
 B. 748 m
 C. 374 m
 D. 680 m

14. At the PSA container port, a motor runs on a horizontal rail at a constant speed while raising a 60000 N container from X to Y as shown in the diagram.

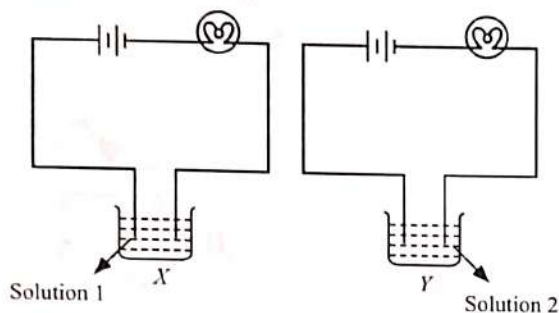


Which of the following statements is/are correct?

- I. Work done by the motor during this process is 90 kJ.
 II. Work done by the motor during this process is 720 kJ.
 III. Work done by gravity during this process is -720 kJ .
 IV. Work done by gravity during this process is -1200 kJ .
- A. I only
 B. II and III only
 C. I and IV only
 D. II and IV only

15. Kriti performed experiments taking identical bulbs and cells, but two different solutions 1 and 2 as shown in the figure.

She found that the bulb in the set up X glows brighter as compared to that in the set up Y . From this experiment, we would conclude that



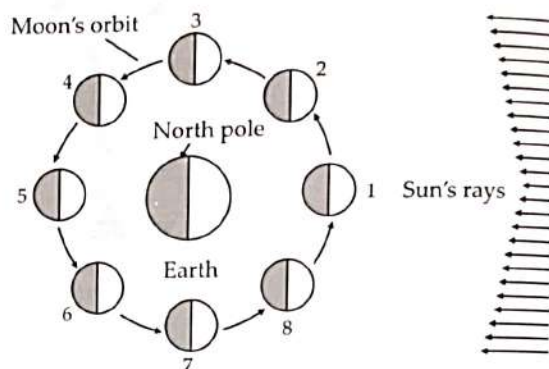
- A. Higher current is flowing through the circuit in set up X as compared to set up Y
 B. Higher current is flowing through the circuit in set up Y as compared to set up X
 C. Equal current is flowing through both the circuits
 D. The current flowing through the circuits in the two set ups cannot be compared in this manner.
16. Match column I with column II and select the correct option from the given codes.

	Column I		Column II
P.	Definition of force	(i)	Newton's third law
Q.	Measure of force	(ii)	Impulse
R.	Effect of force	(iii)	Newton's second law
S.	Recoiling of gun	(iv)	Newton's first law

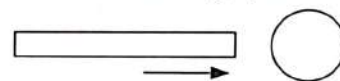
- A. P - (ii), Q - (i), R - (iii), S - (iv)
 B. P - (i), Q - (ii), R - (iii), S - (iv)
 C. P - (iv), Q - (iii), R - (ii), S - (i)
 D. P - (iv), Q - (ii), R - (iii), S - (i)
17. The Sun and the Earth attract each other due to gravitational force. If F_1 and F_2 are the gravitational forces acting on the Sun due to the Earth and on the Earth due to the Sun respectively, then
- A. $F_1 = F_2$
 B. $F_2 > F_1$
 C. $F_1 > F_2$
 D. $F_1 = F_2 = 0$
18. Two notes are played on a piano. The second note is louder and has a lower pitch. The second note has (i) amplitude and (ii) frequency.

	(i)	(ii)
A.	Higher	Lower
B.	Higher	Higher
C.	Lower	Higher
D.	Lower	Lower

19. The given diagram shows the Moon orbiting the Earth as viewed from space above the North pole. The Moon is shown at eight different positions in its orbit. At which of the following two respective positions of the Moon is an eclipse of the Sun and the Moon possible?



- A. 1 and 5
 B. 2 and 6
 C. 3 and 7
 D. 4 and 8
20. A negatively charged rod moves from left to right, near a conducting sphere as shown in the given figure. How will be the movements of the electrons and protons in the conducting sphere?



- | | Electrons | Protons |
|----|---------------|---------------|
| A. | Move to left | Move to right |
| B. | Move to right | Move to left |
| C. | Move to right | Does not move |
| D. | Does not move | Move to left |
21. The gravitational force between two masses kept at a certain distance is p N. The same two masses are now kept in water and the distance between them is kept same. If the gravitational force between these two masses in water is q N, then
- A. $p = q$
 B. $p < q$
 C. $p > q$
 D. None of these

22. A submarine sends out a signal and receives an echo from an object 5 s later. Calculate the speed of sound in water if the distance of the object from the submarine is 3630 m.
- A. 1400 ms^{-1}
 B. 1452 ms^{-1}
 C. 1530 ms^{-1}
 D. 1480 ms^{-1}

23. Find the incorrect match.
- A. Calcium oxide - Basic oxide
 B. Sulphur dioxide - Neutral oxide
 C. Sulphur - Poor conductor of heat and electricity
 D. Silver - Noble metal

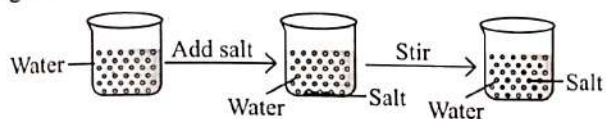
24. A few mixtures are given in the box.

- | | |
|------------------------------|-----------------|
| (i) Shaving cream | (ii) Clouds |
| (iii) Chalk powder and water | (iv) Smoke |
| (v) Muddy water | (vi) Face cream |

Which of the following options indicates the correct classification of these mixtures?

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

25. An experiment is performed as shown in the given figure.



The conclusion we can draw from the given experiment is that

- Nature of matter is continuous
- Matter is made up of particles
- Particles of salt get into the spaces between the particles of water
- Both B and C.

26. An element X forms a chloride with the formula, XCl_3 . The formula of its nitride will be

- XN_3
- XN
- XN_2
- X_3N

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

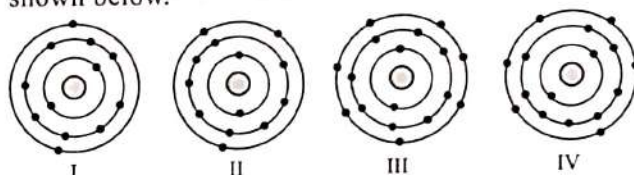
- Plastics are used to store various chemicals as they are not corroded easily and are non-reactive.
- Polythene, a thermosetting plastic is used for manufacture of floor tiles and kitchenware.
- Teflon is a special plastic which resists fire and can tolerate heat better than other plastics.
- Bakelite is used for making electrical switches as it is a poor conductor of electricity.

- I and IV only
- III only
- II and III only
- II and IV only

28. Which of the following represents the correct decreasing order of calorific values of the given fuels?

- Wood > Coal > Diesel > Methane
- LPG > Petrol > Hydrogen > Kerosene
- Hydrogen > LPG > Methane > Petrol
- Hydrogen > Wood > Coal > Kerosene

29. The schematic atomic structures of few elements are shown below.



Which of these elements will form cation and anion?

- | Cations | Anions |
|--------------|------------|
| A. I and IV | II and III |
| B. I and II | III and IV |
| C. II and IV | I and III |
| D. I and III | II and IV |

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

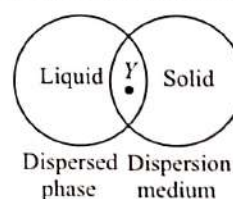
- | Column I | Column II |
|---|------------------------------------|
| P. Diesel | (i) Fuel for lamps |
| Q. Petrol | (ii) Chemicals and fertilisers |
| R. Natural gas | (iii) Fuel in heavy motor vehicles |
| S. Kerosene | (iv) Aviation fuel |
| A. P - (ii), Q - (iii), R - (iv), S - (i) | |
| B. P - (iii), Q - (i), R - (ii), S - (iv) | |
| C. P - (iv), Q - (ii), R - (iii), S - (i) | |
| D. P - (iii), Q - (iv), R - (ii), S - (i) | |

31. Read the given statements and select the option that correctly identifies them as true (T) and false (F) ones.

- The dissolution of crystals of potassium permanganate in water signifies that particles of matter have spaces between them.
- With an increase in the temperature of the system, the kinetic energy of the particles increases.
- The liquefaction of gases can be carried out by increasing pressure and decreasing temperature.
- Evaporation is a bulk phenomenon that causes cooling effect.

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

32. Study the given Venn diagram carefully.



Y can be

- Milk of magnesia
- Jelly
- Face cream
- Mist.

33. Which of the following statements regarding artificial insemination in cattle is incorrect?
- Artificial insemination can be effective on any day in the female animal.
 - Artificial insemination gives high rate of successful fertilisation.
 - Artificial insemination method is economical as semen from a single bull can be used to impregnate several thousands cows.
 - Artificial insemination method is used to raise animal with desired characteristics.

34. Read the given statements and select the option that correctly identifies them as true (T) and false (F) ones.
- Cells of parenchymatous tissue have large central vacuole in each cell.
 - In young dicotyledonous stems, collenchyma is the chief supporting tissue.
 - Collenchymatous tissue is present at the margin of some leaves and resist tearing effect of the wind.
 - Cell wall in sclerenchyma cells show localised thickening in the corners.

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

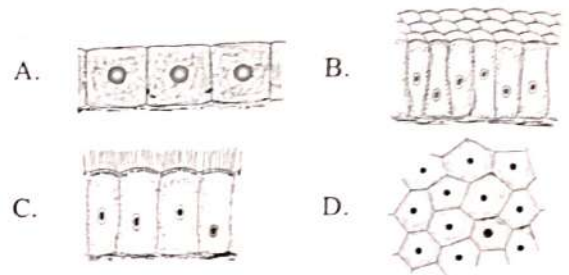
35. Identify the given cell organelle and select the correct statement regarding its function.



- It is engaged in synthesis and transport of proteins.
 - It takes part in natural defence of the body.
 - It is concerned with the synthesis of energy rich compound ATP.
 - It packages materials synthesised in the cell and dispatches them either to intracellular or extracellular targets.
36. Which among the following is not a living part of a plant cell?
- Ribosomes
 - Cell wall
 - Lysosome
 - Plastids

37. Given below are few statements related to chemical fertilisers.
- They are human-made substances containing inorganic salts.
 - They are voluminous and bulky as compared to manures.
 - They are nutrient specific.
 - They add a great amount of humus to the soil.
- Which among the given statements are incorrect?
- I and II only
 - I and IV only
 - II and IV only
 - I and III only

38. 'Epithelium X covers the ovaries and lines the sperm producing tubules'. Select the option that correctly identifies epithelium X.



39. Select the incorrect match.

Human disease	Causative organism
A. Polio	- Virus
B. Athlete's foot	- Fungus
C. Chicken pox	- Bacteria
D. Tetanus	- Bacteria

40. Select the incorrect statement.

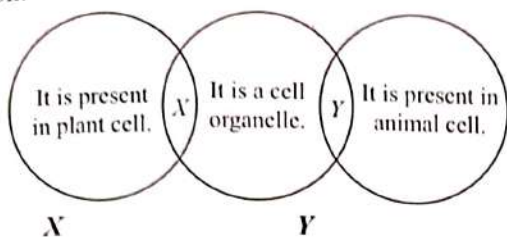
- Method of sowing seeds by scattering them over the surface of the soil is called broadcasting.
- Rahat* is a method of irrigation that is based on lever system.
- Silos are tall, cylindrical containers that are used to store grains in bulk.
- MCPA (2-methyl-4-chlorophenoxy acetic acid) is a rodenticide that is used to kill rats.

41. Read the given statements and fill in the blanks by selecting the correct option.

- Core zone is also known as _____.
- Zone of a biosphere reserve where several human activities are permitted is _____.

(i)	(ii)
A. Buffer zone	Natural zone
B. Natural zone	Manipulation zone
C. Manipulation zone	Buffer zone
D. Buffer zone	Manipulation zone

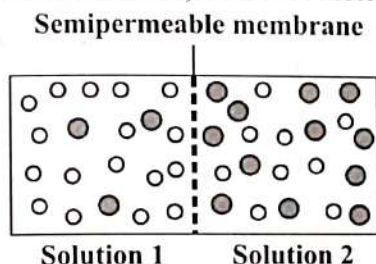
42. Refer to the given Venn diagram and select the correct option.



- A. Plastids Centriole
 B. Mitochondria Lysosome
 C. Plastids Vacuole
 D. Peroxisome Endoplasmic reticulum

43. Study the given figure carefully. In which direction the net movement of water will take place?

[Key : ○ Water molecule; ● Solute molecule]

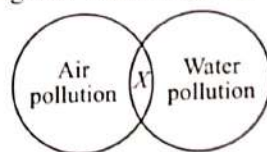


- A. From solution 1 to solution 2
 B. From solution 2 to solution 1
 C. Both A and B
 D. No movement will take place

44. Embryo inside a hen's egg takes about 3 weeks to develop into a chick. Hen provides sufficient warmth to the egg to incubate it by sitting over it. This is called

- A. Brooding B. Parturition
 C. Broadcasting D. Fumigation.

45. Refer to the given Venn diagram.



Select the correct option regarding X.

- A. Burning of fossil fuels
 B. Use of CFCs
 C. Dumping of sewage into river.
 D. Spilling petroleum oil during drilling and shipping

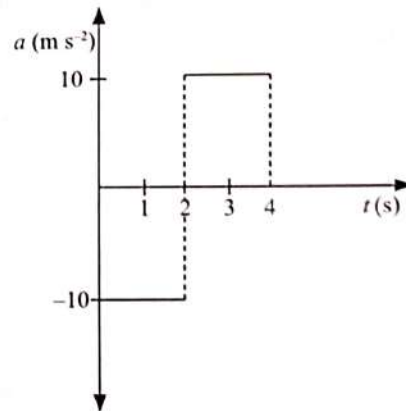
ACHIEVERS SECTION

46. Fill in the blanks by selecting an appropriate option. Two girls Divya and Amrita each of mass 50 kg climb up identical ropes suspended from the ceiling of a gymnasium. Each rope is 12 m long. Divya reaches the top twice quickly as Amrita does. When climbing up from the floor to the ceiling, both the girls do (i) work. Both the girls start from rest at the floor and stop near the ceiling. The net energy transfer during this process is from (ii) to (iii). When Divya has fallen $\left(\frac{2}{3}\right)^{\text{rd}}$ of the way from the ceiling to the floor, her kinetic energy is approximately (iv) J.

- | | (i) | (ii) | (iii) | (iv) |
|----|-----------|-----------|-----------|------|
| A. | Same | Potential | Kinetic | 5000 |
| B. | Same | Chemical | Potential | 4000 |
| C. | Different | Kinetic | Potential | 4500 |
| D. | Different | Potential | Kinetic | 5000 |

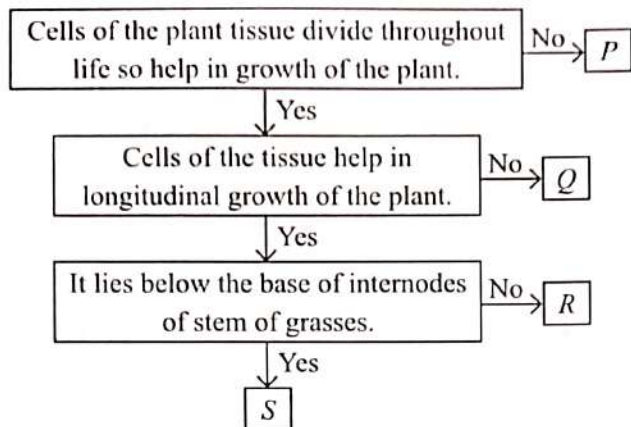
47. The acceleration-time graph of a particle that starts from rest and moving on a straight line is shown in the given figure.

Match the quantities of column I with the values in column II and select the correct option from the given codes.



- | Column I | Column II |
|---|--|
| P. Displacement of particle at $t = 2$ s, in SI units | (i) 20 |
| Q. Displacement of particle at $t = 4$ s, in SI units | (ii) -40 |
| R. Speed of particle at $t = 2$ s, in SI units | (iii) -20 |
| S. Velocity of particle at $t = 4$ s, in SI units | (iv) 0 |
| | (v) 40 |
| A. | P - (iii), Q - (iv), R - (iv), S - (v) |
| B. | P - (iv), Q - (ii), R - (i), S - (v) |
| C. | P - (ii), Q - (iv), R - (v), S - (i) |
| D. | P - (iii), Q - (iv), R - (i), S - (iv) |

48. Refer to the given flow chart and select the correct option regarding it.



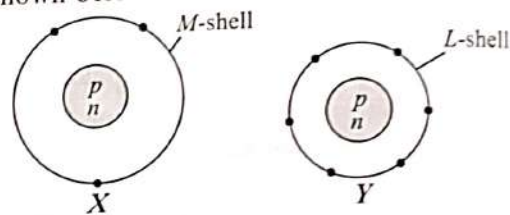
- | | <i>P</i> | <i>Q</i> | <i>R</i> | <i>S</i> |
|----|--------------|----------------------|----------------------|----------------------|
| A. | Parenchyma | Lateral meristem | Apical meristem | Intercalary meristem |
| B. | Sclerenchyma | Apical meristem | Lateral meristem | Intercalary meristem |
| C. | Parenchyma | Intercalary meristem | Apical meristem | Lateral meristem |
| D. | Collenchyma | Lateral meristem | Intercalary meristem | Apical meristem |

49. Read the given statements and select the option that correctly fills the blanks in any two of them.

- (i) _____ is called as the ribosome factory of the cell.

- (ii) _____ plays an important role in the biosynthesis of glycolipids, phospholipids and cholesterol.
- (iii) Cristae are studded with small rounded bodies known as _____.
- (iv) Granum is the site of _____ reaction during photosynthesis.
- A. (i) Plastid, (iii) ATP
 B. (ii) Smooth endoplasmic reticulum, (iii) F_1 particles
 C. (i) Endoplasmic reticulum, (iv) Dark
 D. (ii) Rough endoplasmic reticulum, (iv) Light

50. The outer electronic configurations of two elements are shown below :



Which of the following statements are incorrect regarding *X* and *Y*?

- I. *X* can have valency 2.
 - II. *X* and *Y* combine to form X_2Y_3 type of compound.
 - III. *Y* will form divalent anion to acquire stable configuration.
 - IV. The valency of *X* and *Y* is the same.
- A. I and III only B. II and IV only
 C. II and III only D. I and IV only

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