# NSO

## SOF NATIONAL SCIENCE OLYMPIAD 2019-20

**CLASS 9**

QUESTION PAPER SET **B**

Total Questions: 50 | Time: 1 hr.

Name:......................................................................................................................................

Section:............ SOF Olympiad Roll No.:........................................ Contact No.:.................................

## 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
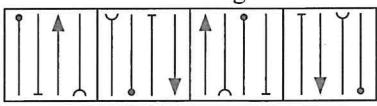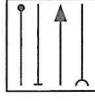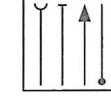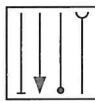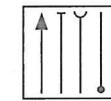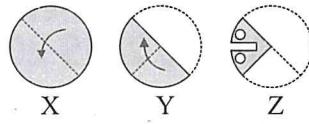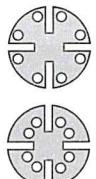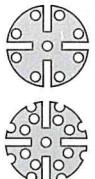
   A. Water vapour cooling down and turning into a liquid      B. Ice warming up and turning into a liquid

   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.

   16. ● Ⓑ Ⓒ Ⓓ

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.

## SOF

**SCIENCE OLYMPIAD FOUNDATION**

Inspiring Young Mind Through Knowledge Olympiads

1. A cube is painted red, green and blue on the opposite faces. Now the cube is divided into 216 smaller cubes of equal size. How many smaller cubes will have only one surface painted?
   - A. 36
   - B. 96
   - C. 72
   - D. 54

2. If '%' stands for 'addition', '#' stands for 'subtraction', '<' stands for 'division', '>' stands for 'multiplication' and '*' stands for 'equal to', then which of the following options is correct?
   - A. 18 < 6 > 7 # 5 % 2 * 8
   - B. 6 > 3 % 8 < 2 # 1 * 22
   - C. 16 < 8 # 4 % 5 > 2 * 8
   - D. 9 > 2 # 5 % 4 < 2 * 25

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

   Problem Figures

   

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

4. Which of the following figures will complete the given figure matrix?

   

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

5. Aruna is facing towards West, turning to her right she walks 90 m, then turns right and goes another 35 m. Then turning to the right, goes 60 m and then turning to her left and goes 25 m. How far and in which direction is she now from her starting point?
   - A. $30\sqrt{5}$ m, North-East
   - B. $30\sqrt{5}$ m, South-East
   - C. 38 m, East
   - D. $40\sqrt{3}$ m, North-West

6. The given question consists of a set of three figures X, Y and Z showing a sequence of folding of a piece of paper. Fig. (Z) shows the manner in which the folded paper has been cut. Select a figure from the options which would most closely resemble the unfolded form of Fig. (Z).

   

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

7. 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 operation on numbers progress from left to right.

   **Rules:**
   (i) If a two digit odd number is followed by a prime number, then the first number is to be multiplied by the prime number.
   (ii) If an even number is followed by another even number, then the first number is to be divided by the second number.
   (iii) If an odd number is followed by a composite odd number, then the first number is to be added to the second number.
   (iv) If an even number which is multiple of 5 is followed by another number which is also a multiple of 5, then the second number is to be subtracted from the first number.
   (v) If a number which is a perfect square is followed by another number which is also a perfect square, then the resultant number is the product of the square root of the two numbers.

   |  |  |  |
   |---|---|---|
   | 80 | 16 | 33 |
   | X | 2 | 5 |

   If X is the resultant of the first row, then find the resultant of the second row.
   - A. 80
   - B. 95
   - C. 3
   - D. 18

8. A word and number arrangement machine when given an input line of words and numbers, rearranges them by following a particular rule in each step. The following is an illustration of input and steps of rearrangement.

   **Input**  : quick star 15 28 home 12 win 53
   **Step I**  : 12 quick star 15 28 home win 53
   **Step II** : 12 home quick star 15 28 win 53

**Step III** : 12 home 15 quick star 28 win 53

**Step IV** : 12 home 15 quick 28 star win 53
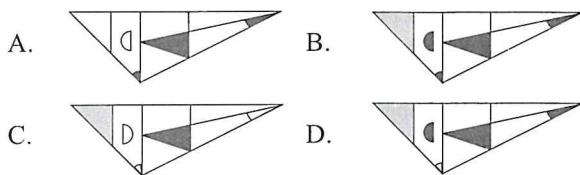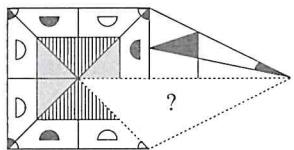
**Step V** : 12 home 15 quick 28 star 53 win

And step V is the last step.
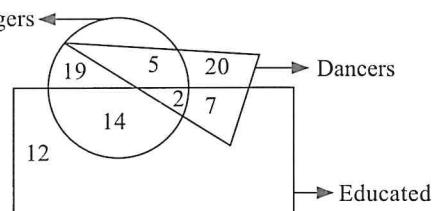
As per the rules followed in the above steps, if Step I of an input is "12 train 34 garden 48 hard versa 17", then which of the following steps will be the last step?

A. Step VII      B. Step V

C. Step IV      D. Step VI

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



10. Study the given Venn diagram carefully and answer the question that follows:



Which of the following numbers represents the persons who are dancers and singers but not educated?

A. 7      B. 2

C. 14      D. 5

## SCIENCE

11. Two bodies are in equilibrium when suspended in water from the arm of a balance. The mass of one body is 60 g and its density is 12 g cm$^{-3}$. If the mass of the other body is 72 g, its density in g cm$^{-3}$ is

A. 6.25      B. 6.75

C. 2.33      D. 4.23

12. The earth has a radius of 6400 km. The inner core of 1000 km radius is solid. Outside it, there is a region from 1000 km to a radius of 3500 km which is in molten state. Then again from 3500 km to 6400 km, the earth is solid. Only longitudinal ($P$) waves can travel inside a liquid. Assume that the $P$ wave has a speed of 8 km s$^{-1}$ in solid parts and of 5 km s$^{-1}$ in liquid parts of the earth. An earthquake occurs at some place close to the surface of the earth. Find the time after which it will be recorded in a seismometer at a diametrically opposite point on the earth if wave travels along diameter.

A. 41.25 min      B. 32.91 min

C. 16.45 min      D. 14.06 min

13. Five balls numbered 1 to 5 are suspended using separate threads. Pairs (5, 3), (3, 4) and (4, 5) show electrostatic attraction, while pairs (2, 3) and (4, 1) show repulsion. Therefore ball 5 must be

A. Positively charged

B. Negatively charged

C. Neutral

D. Cannot be determined.

14. A boy whose eyes are 150 cm above the ground looks at his reflection in a vertical mirror 200 cm away. The top and bottom of the mirror are 220 cm and 120 cm above the ground respectively. What length below his eyes can he see, of himself in the mirror?
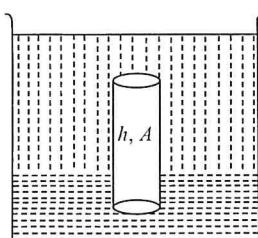
A. 60 cm      B. 75 cm

C. 100 cm      D. 120 cm

15. A body starts slipping down an incline with a small friction and moves half meter in half second. How long will it take to move the next half meter?

A. More than half second

B. Half second

C. Less than half second

D. Data not sufficient

16. A solid cylinder of height $h$, cross sectional area $A$ and density $1.40 \times 10^3$ kg m$^{-3}$ is immersed completely in a mixture of liquid such that it floats with its axis vertical at the liquid-liquid interface with length $3h/4$ in lesser dense liquid as shown in the figure. The lesser dense liquid is open to atmospheric pressure $P_0$. If the density of lesser dense liquid is $1.0 \times 10^3$ kg m$^{-3}$, then the density of denser liquid will be
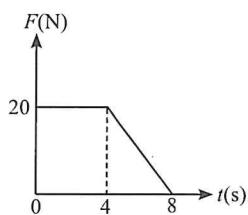


A. $1.5 \times 10^3$ kg m$^{-3}$    B. $2.0 \times 10^3$ kg m$^{-3}$

C. $2.6 \times 10^3$ kg m$^{-3}$    D. $3.2 \times 10^3$ kg m$^{-3}$

17. A child is swinging on a swing in sitting position. If he stands up, then the time period of the swing will
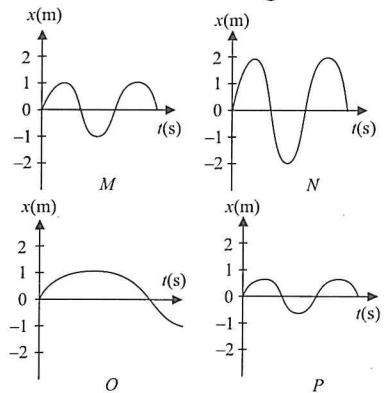
A. Increase

B. Decrease

C. Remain same

D. Increase if the child is tall and decrease if the child is short.

18. An object of mass 25 kg moves along a straight line on a smooth horizontal surface. A force $F$ acts on the object in its direction of motion. The graph of the force against time is shown here. What is the velocity of the object at $t = 8$ s, if its velocity at $t = 5$ s is 4 m s$^{-1}$?



A. 3.5 m s$^{-1}$
B. 4.9 m s$^{-1}$
C. 6.3 m s$^{-1}$
D. 0.9 m s$^{-1}$
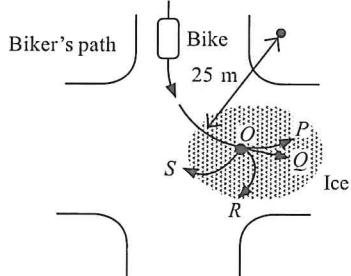
19. Four sound waves $M$, $N$, $O$ and $P$ are shown in the figures. Which of the following statements is correct?
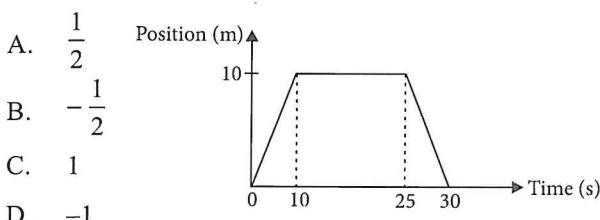


A. $M$ and $P$ have the same loudness.
B. $N$ and $O$ have the same loudness.
C. $N$ and $P$ have the same loudness.
D. $M$ and $O$ have the same loudness.

20. A motorbike travelling at a constant speed turns at an intersection. The bike follows a horizontal circular path with a radius of 25 m as shown in the figure. At point $O$, the bike hits an area of ice and loses all frictional forces on its tyres. Which path does the bike follow on the ice?



A. Along $P$
B. Along $R$
C. Along $S$
D. Along $Q$
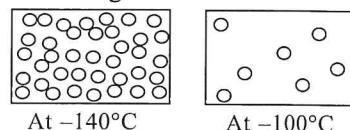
21. The given figure shows the position-time graph of an object. Find the ratio of the velocities at 5$^{th}$ and 27$^{th}$ second.

A. $\dfrac{1}{2}$

B. $-\dfrac{1}{2}$

C. 1

D. $-1$



22. The maximum vertical distance through which a fully dressed astronaut can jump on the earth is 0.7 m. Estimate the maximum vertical distance through which she can jump on a planet, which has a mean density (5/9) times that of the earth and radius one quarter that of the earth.

A. 2.35 m
B. 3.23 m
C. 4.10 m
D. 5.04 m
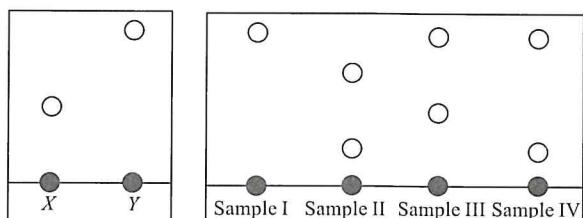
23. The arrangement of particles of an unknown substance at the same pressure at two different temperatures is shown in the diagrams :



At $-140°C$          At $-100°C$

Which of the following substances could the diagrams represent?

| | Substance | Melting point (°C) | Boiling point (°C) |
|---|---|---|---|
| A. | $P$ | $-189$ | $-98$ |
| B. | $Q$ | $-132$ | $-163$ |
| C. | $R$ | $-166$ | $-103$ |
| D. | $S$ | $-115$ | $-86$ |

24. Vishal tested a few samples of cold drinks for additives by using chromatography. He compared the chromatograms with those of artificial additives, $X$ and $Y$. The results are as follows :
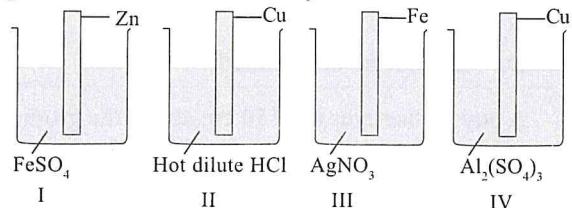


Which sample of cold drink does not contain any of the artificial additives $X$ and $Y$?

A. Sample I
B. Sample II
C. Sample III
D. Sample IV

25. Which of the following statements is correct?

A. Nowadays, bitumen is used in place of coal tar for metalling the roads.
B. Coke is used to manufacture producer gas.
C. Coal gas is mainly a mixture of hydrogen, methane, and carbon monoxide.
D. All of these

26. Soham has arranged the following experimental set-ups to observe the reactivity of different metals.

Reaction will occur in beakers
A. I and III only
B. II and IV only
C. III and IV only
D. All of these.

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

**Statement 1 :** Bakelite is used for making electrical switches and handles of various utensils.

**Statement 2 :** Bakelite is a good conductor of heat and electricity.

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 and statement 2 is false.
D. Both statements 1 and 2 are false.

28. Study the given table carefully and select the correct statement.

| Element/ Species | Number of protons | Number of neutrons | Number of electrons |
|---|---|---|---|
| $P$ | 11 | 12 | 10 |
| $Q$ | 20 | 20 | 20 |
| $R$ | 16 | 18 | 18 |
| $S$ | 20 | 19 | 18 |
| $T$ | 15 | 16 | 18 |
| $U$ | 10 | 10 | 10 |

A. $Q$ and $U$ are noble gases.
B. $S$ and $R$ will combine to form compound $SR$.
C. $Q$ and $S$ are anions.
D. $T$ is a trivalent cation.

29. Select the correct statements.

I. 50 g of Al contains more atoms than 50 g of Fe.
II. 32.5 g of Mg have the same number of moles of atoms as 40.5 g of Al.
III. 20 g of water contains more number of moles of water molecules as compared to 22 g of carbon dioxide.
IV. The ratio by mass of elements (Al : F) in aluminium fluoride is 9 : 19.
(Given : Atomic mass of H = 1 u, Mg = 24 u, O = 16 u, C = 12 u, F = 19 u, Al = 27 u and Fe = 56 u)

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

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

| Column I (Zones of candle flame) | | Column II (Characteristics) |
|---|---|---|
| P. | Dark zone | (i) Complete combustion |
| Q. | Luminous zone | (ii) No combustion |
| R. | Blue zone | (iii) Incomplete combustion |
| S. | Non-luminous zone | (iv) Where CO burns |

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

31. Calculate the concentration of a solution of sodium chloride, which was made by dissolving 1.16 g of solid sodium chloride in water and making the solution up to 250 cm³. (Atomic mass of Na = 23 u, Cl = 35 u)

A. 2 mol dm⁻³
B. 0.04 mol cm⁻³
C. 0.08 mol dm⁻³
D. 0.02 mol cm⁻³

32. An electron jumps from an orbit $P$ to $Q$ and loses energy. The same electron when jumps from $R$ to $Q$, gains energy. The increasing order of distance of these orbits from the nucleus is

A. $P < Q < R$
B. $R < P < Q$
C. $R < Q < P$
D. $P < R < Q$

33. Which of the following statements is correct?

A. Good ozone occurs naturally in the troposphere.
B. Nitrogen oxide is an example of suspended particulate matter or SPM.
C. $SO_2$ combines with haemoglobin and affects the oxygen carrying capacity of the blood.
D. Chlorofluorocarbons are the major ozone depleting substances which produce active chlorine in the presence of UV radiations.

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

I. The inner mitochondrial membrane is folded into numerous finger like processes called cristae.
II. Golgi apparatus is capable of self duplication and synthesises some of its own proteins.
III. Smooth endoplasmic reticulum mainly consists of tubules and vesicles whereas rough endoplasmic reticulum mainly consists of cisternae and a few tubules.
IV. Chromatin contains DNA and basic histone proteins in almost equal mass.

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

35. Read the given statements and select the option that correctly identifies them as true (T) and false (F) ones.
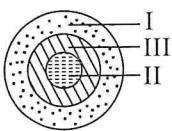
(i) Granum is the site of dark reaction during photosynthesis, whereas stroma is the site of light reaction during photosynthesis.
(ii) Lysosomes are formed by the joint activity of endoplasmic reticulum and Golgi complex.
(iii) Each 70S ribosome consists of a large 50S subunit and a small 30S subunit.
(iv) The chromosome in which the centromere is near the end and consequently its one arm is very short and the other arm very long, is called acrocentric chromosome.

| | (i) | (ii) | (iii) | (iv) |
|---|---|---|---|---|
| A. | T | T | F | F |
| B. | F | T | T | T |
| C. | F | F | F | T |
| D. | T | F | T | F |
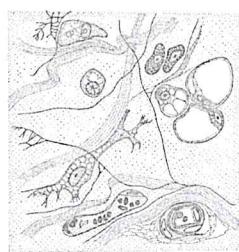
36. Read the following statements regarding the human reproductive system and select the correct option.
    (i) The expulsion of completely developed fetus from the uterus is known as ovulation.
    (ii) In case of human males, the primary reproductive organs are located inside the abdominal cavity in the scrotal sac.
    (iii) Ovaries are primary sex organs in human female.
    (iv) Development of breasts in females is the secondary sex character.
    A. Statements (i), (ii) and (iii) are false; while statement (iv) is true.
    B. Statements (i), (ii) and (iv) are true; while statement (iii) is false.
    C. Statements (i) and (ii) are true; while statements (iii) and (iv) are false.
    D. Statements (i) and (ii) are false; while statements (iii) and (iv) are true.

37. Identify zones I, II and III in the given diagrammatic representation of a biosphere reserve and select the incorrect statements regarding them.
    (i) Tourists can visit zones I and II but are not allowed in the zone III.
    (ii) Activities like settlements, cropping, recreation and forestry are allowed in zone I only.
    (iii) Human activities like research and environmental education are allowed in all zones I, II and III.
    (iv) The area of zone II is undisturbed and legally protected.
    A. (i) and (iii) only
    B. (ii) and (iii) only
    C. (i) and (ii) only
    D. (i), (iii) and (iv) only

38. Given below is the diagrammatic representation of a type of animal tissue 'X'. Identify the tissue and select the correct statement regarding it.

    Tissue X

    A. It is a dense connective tissue that stores fat and insulates the body against heat loss.
    B. It is a loose connective tissue that acts as packing and supporting tissue between organs lying in the body cavity.
    C. It is a loose connective tissue that connects skeletal muscles to bones.
    D. It is a dense connective tissue that is found beneath the skin and covering of the heart.

39. Refer to the given table and select the option that correctly fills the blanks in it.

| Animal | Indigenous breed | Exotic breed |
|---|---|---|
| Cow | X | Holstein-Friesian |
| Poultry | Aseel | Y |
| Honey bee | Z | A. adamsoni |

|   | X | Y | Z |
|---|---|---|---|
| A. | Red Sindhi | Busra | A. mellifera |
| B. | Jersey | Rhode island red | A. florea |
| C. | Sahiwal | Australorp | A. dorsata |
| D. | Brown Swiss | Kadaknath | A. indica |
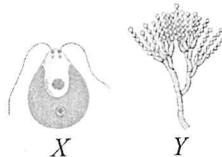
40. Refer to the given box containing names of some human diseases and select the incorrect statement regarding it.

    Diphtheria, Tetanus, Malaria, Addison's disease, Anthrax, Sleeping sickness, Poliomyelitis, Kala-azar, Hepatitis-B, Cretinism

    A. The given box contains two protozoan diseases and four bacterial diseases where all the protozoan diseases are vector borne.
    B. Out of the two hormonal disorders listed in the given box, one occurs due to hypersecretion of thyroid hormone.
    C. The given box contains two viral diseases and three bacterial diseases.
    D. Both A and B

41. Which of the following statements are true regarding organisms X and Y?

    X          Y

    (i) Organism X is a green alga.
    (ii) Organism Y is a parasitic protozoan.
    (iii) Organism Y yields an important antibiotic.
    (iv) Both organisms X and Y can synthesise their own food.
    A. (i) and (iii) only
    B. (ii) and (iv) only
    C. (ii) and (iii) only
    D. (ii), (iii) and (iv) only
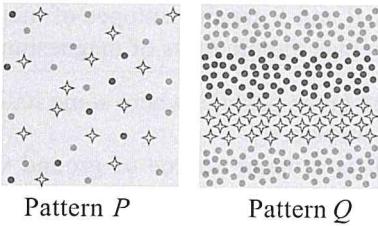
42. Read the given paragraph.
    Soil L is well aerated but cannot hold much water, soil M is well aerated and has a very good water holding capacity. Soil N has excellent water holding capacity but is poorly aerated.

    Select the incorrect statement regarding soils L, M and N.
    A. Soil M is commonly found in those regions where xerophytes are abundant.
    B. Soil N is best suited for growing garden plants.
    C. Soil L is best suited for making pots, statues and toys.
    D. All of these

43. The given diagrams show two different cropping patterns, P and Q. Identify these patterns and select the incorrect statement regarding them.
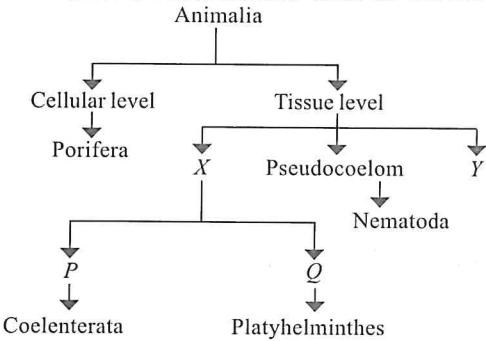
Pattern P          Pattern Q

A. In cropping pattern P, the crops should not have the same root pattern.

B. Crops selected for cropping pattern Q should have different types of nutrient requirement.

C. In cropping pattern P, the two crops could be mustard and wheat.

D. In cropping pattern Q, legumes like cowpea, mung bean and soybean should be grown simultaneously at a time.
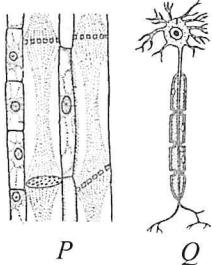
44. Riddhi drew a classification chart as shown.



Now, select the option that correctly identifies the characters X, Y, P and Q.

A. X is eucoelomic body cavity.

B. P is bilateral body symmetry.

C. Q is radial body symmetry.

D. Y is coelomic cavity lined by mesoderm.

45. Refer to the given diagrammatic representation of parts of two different types of tissues, P and Q.
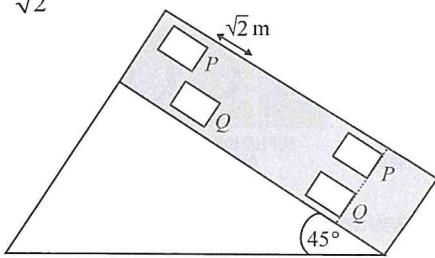


Read the following statements regarding these tissues and select the correct statements.

(i) P is a plant tissue whereas Q is an animal tissue.

(ii) P is the major water conducting tissue in vascular plants and provides mechanical strength to plant body.

(iii) Q is a specialised tissue in animals for receiving stimuli and transmitting messages.

(iv) P is composed of all dead cells whereas Q is composed of all living cells.

A. (i) and (ii) only

B. (iii) and (iv) only

C. (i) and (iii) only

D. (i), (iii) and (iv) only

## ACHIEVERS SECTION

**Direction (Q. No. 46 and 47) :** Read the given passage and answer the following questions.

Two blocks P and Q of equal masses 1 kg are placed on a rough inclined plane as shown in the figure. Initially the block P is $\sqrt{2}$ m behind the block Q. While moving down the incline, blocks P and Q experience retarding force $\sqrt{2}$ N and $\dfrac{3}{\sqrt{2}}$ N respectively.



46. If the two blocks are released simultaneously, then find the time taken by the blocks to come on the same line on the inclined plane as shown in the figure.

A. 4 s          B. 2 s

C. 3.5 s          D. 4.6 s

47. Find the distance travelled by the blocks along the incline till they come on the same line on the inclined plane.

A. 9.2 m, 7.79 m          B. $5\sqrt{3}$ m, $7\sqrt{2}$ m

C. $8\sqrt{2}$ m, $7\sqrt{2}$ m          D. 6.3 m, 4.89 m
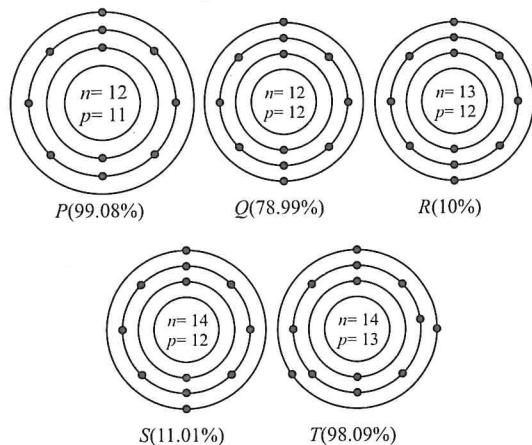
48. Read the given passage.

Charulata contracted chickenpox few days back and soon recovered from the infection. She got immune to any subsequent infection of chickenpox virus. Her younger brother Ajeet is just two months old and is mother fed. He has received some immunity from his mother *via* milk.

Which of the following is correct regarding Charulata and Ajeet's immunity?

A. Charulata's immune system has developed its own antibodies when encountered the pathogen or antigen, however Ajeet has received preformed antibodies from his mother.

B. Ajeet's immunity is long lasting but Charulata's immunity is for a brief period only.

C. Charulata is also immune to diseases like measles and polio, however Ajeet is immune to most of the pathogenic diseases.

D. Ajeet's immunity may cause some side effects in his body, however Charulata's immunity has no side effects.

49. Relative abundance and schematic atomic structures of a few atoms are given here.



P(99.08%)    Q(78.99%)    R(10%)

S(11.01%)    T(98.09%)

Study the given figures carefully and select the correct statement.

A. Q, R and S are the isotopes of magnesium and average atomic mass of magnesium is 23.92 u.

B. R and T are the isotopes of aluminium and average atomic mass of aluminium is 26.38 u.

C. P, Q and S, T represent pairs of isobars.

D. Q, R and S are the isotopes of magnesium and average atomic mass of magnesium is 24.32 u.
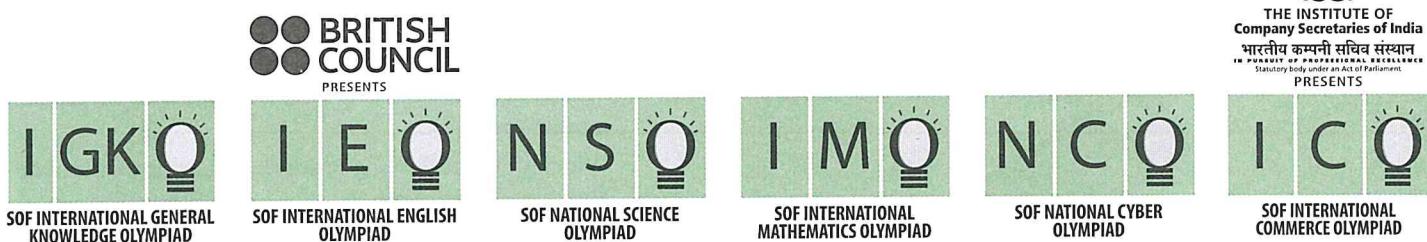
50. Read the given passage where some italicised words are put incorrectly.

*Rainfall* is a major source of ground water. When the rain falls, some water is lost as *run off*. The remaining water percolates into the ground through pore spaces of soil particles under the influence of gravity. Some water forms an extremely thin, tightly held film around soil particles and is termed *capillary* water. The down-moving water called *hygroscopic* water finally reaches the underground water table. Most of the water drawn by plants from the soil is the *gravitational* water.

Identify the incorrect italicised words and select the incorrect statement regarding them.

A. *Rainfall* and *runoff* should not be replaced as they are correctly mentioned.

B. *Capillary* should not be replaced as it is correctly mentioned.

C. *Hygroscopic* should be replaced by *gravitational*.

D. *Gravitational* should be replaced by *capillary*.

SPACE FOR ROUGH WORK