



Inspiring Young Minds
Through Knowledge Olympiads

CLASS
10

SET-B

DO NOT OPEN THIS BOOKLET UNTIL ASKED TO DO SO

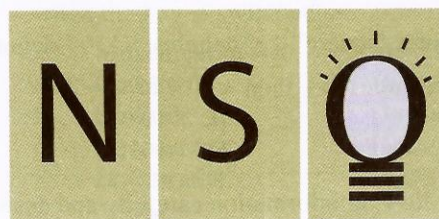
Name:

Section: Roll No.:

Contact No.

Total Questions: 50

Time: 1 hr.



**19TH SOF NATIONAL
SCIENCE OLYMPIAD**

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 **% of marks/grade** in last class clearly on the **OMR Sheet** and do not forget to sign it.

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 in 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

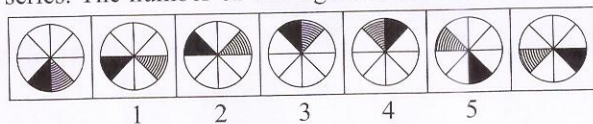
As the correct answer is option A, you must darken the circle corresponding to option A in the OMR Sheet.

16. ● (B) (C) (D)

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 space on top of this page before attempting the paper.

LOGICAL REASONING

1. There are seven figures, the first and the last of which are un-numbered and the remaining are numbered as 1, 2, 3, 4 and 5. These seven figures form a series. However, one of the five numbered figures does not fit into the series. The number of that figure is the answer.

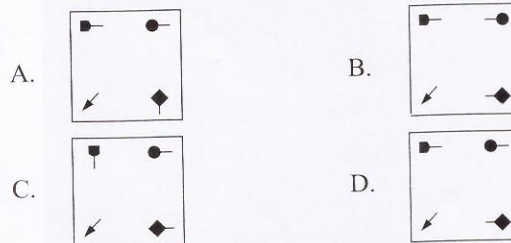
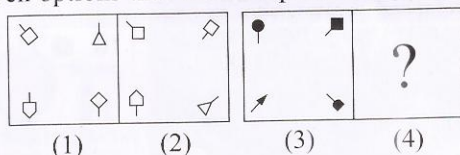


- A. 3
C. 5
- B. 4
D. 1
2. If ' $\sqrt{\quad}$ ' denotes 'square', ' \times ' denotes '+', ' $-$ ' denotes ' \times ' and ' $+$ ' denotes ' \div ', then $\sqrt{20} + 25 \times 5 - 3 = ?$
- A. 63
C. 31
- B. 10
D. 1015

3. Study the following information carefully and answer the question given below:
Eight friends Q, R, S, T, V, W, Y and Z are sitting around a circular table, facing the centre. There are three males and five females in the group of friends. No two males are immediate neighbours of each other.
- V sits second to the right of his wife.
 - S sits third to the right of V.
 - W sits second to the right of her husband Z. Z is not an immediate neighbour of V's wife.
 - T is a male and Y is not an immediate neighbour of V.
 - R sits second to the right of Q.
- Which of the following statements regarding S is definitely correct?
- A. S is one of the male members of the group.
B. Both the immediate neighbours of S are females.
C. S sits third to the left of T.
D. W is an immediate neighbour of S.

4. Sunil walks towards the East from point A, turns right at point B and walks the same distance as he walked towards the East. He now turns left, walks the same distance again and finally makes a left turn and stops at point C after walking the same distance. The distance between A and C is how many times as that of A and B?
- A. Four
B. Two
C. Three
D. Can't be determined

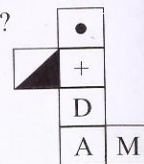
5. There is a certain relationship between figures (1) and (2). Establish a similar relationship between figures (3) and (4) by selecting a suitable figure from the given options that would replace the (?) in fig. (4).



6. How many such 5's are there in the given below arrangement each of which is immediately preceded as well as followed by an even digit?
- 9 4 9 2 3 2 5 9 5 8 5 8 5 4 3 1 8 1 7 4 7 6 5 2 1 2 6
1 3 2 4 6 2
- A. None
C. Two
- B. One
D. Three

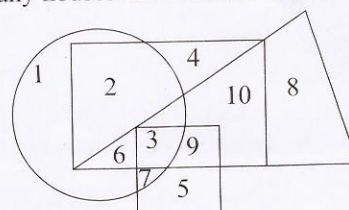
7. If 'A \$ B' means 'A is father of B', 'A # B' means 'A is daughter of B', 'A @ B' means 'A is sister of B', then how is K related to M in H @ K \$ L # M?
- A. Husband
B. Uncle
C. Father
D. Can't be determined

8. Which of the following options show the face opposite to the face having $+$ in the given net?
- A. D
B. M
C. •
D. A



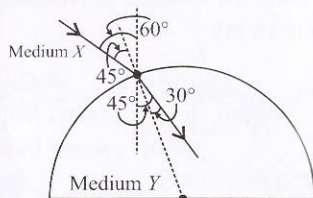
9. If it is possible to make only one meaningful English word with the second, the seventh, the eighth and the ninth letters of the word HOARDINGS which of the following will be the third letter of that word? If no such word can be made, give 'X' as the answer and if more than one such word can be made, give 'Y' as the answer.
- A. N
C. Y
- B. S
D. X

10. In the given Venn diagram, the triangle represents the houses having scooter, the square represents the houses having bike, the rectangle represents the houses having car and the circle represents the houses having washing machines. How many houses have scooter and car only?



- A. 18
C. 10
- B. 22
D. 14

11. The given diagram shows a ray of light travelling from medium X to medium Y .



Which of the following statements is not correct ?

- The refractive index of medium Y with respect to medium X is $\sqrt{2}$.
- The speed of light ray is slower in medium X than that in medium Y .
- Optical density of medium Y is greater than that of medium X .
- Frequency of light ray remains same in both media X and Y .

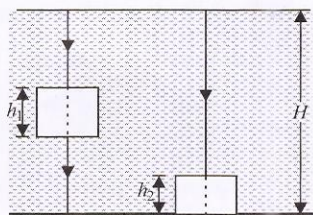
12. If a wire of resistance R is melted and recast into a wire of $\frac{2}{5}$ th its original length, then resistance of the new wire will be

- R
- $\sqrt{\frac{2}{5}} R$
- $\frac{2}{5} R$
- $\left(\frac{2}{5}\right)^2 R$

13. A force of magnitude F_1 accelerates a body of mass m from rest to a speed v . Another force F_2 accelerates a body of mass $2m$ from rest to a speed $2v$. The ratio of work done by force F_2 to that by force F_1 is

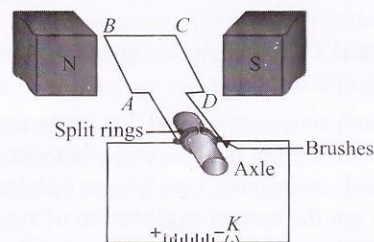
- 1 : 16
- 16 : 1
- 1 : 8
- 8 : 1

14. Two rays of light are incident normally on water. Both the rays pass through glass slabs of different heights, as shown in the figure. Refractive indices of water and glass are $\frac{4}{3}$ and $\frac{3}{2}$ respectively. If c is the speed of light in vacuum, then the time difference between the rays of light to reach the bottom is



- $\frac{H}{2c}$
- $\frac{8H}{9c}$
- $\frac{H - h_1 - h_2}{3c}$
- $\frac{h_1 - h_2}{6c}$

15. The given diagram shows an electric motor.



State the direction of movement of sides AB and CD when the key is switched on.

- | | Movement of AB | Movement of CD |
|----|------------------|------------------|
| A. | Upwards | Upwards |
| B. | Upwards | Downwards |
| C. | Downwards | Upwards |
| D. | Downwards | Downwards |

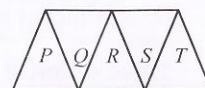
16. Which of the following statements is incorrect?

- The minimum wind velocity for a windmill to function is 15 km h^{-1} .
- For the operation of the ocean thermal energy conversion plants, the temperature difference between the water at the surface and water at depth upto 2 km should be 2°C .
- The value of solar constant is approximately 1.4 kW m^{-2} .
- Nuclear energy is expressed in electron volts where $1 \text{ electron volt} = 1.6 \times 10^{-19} \text{ joules}$.

17. A spring is compressed between two toy carts of masses m_1 and m_2 . When the toy carts are released, then spring exerts equal and opposite average force for the same time on both the toy carts. If there is no friction between the toy carts and the ground, then the velocity of toy carts are

- In opposite directions but in inverse ratio of masses
- In opposite directions but in direct ratio of masses
- Equal but in opposite directions
- Equal but in same direction.

18. A given ray of light suffers minimum deviation in an equilateral prism P .



Additional prisms Q , R , S and T of identical shape and of the same material as P are now added as shown in the given figure. The same ray will now suffer

- Greater deviation
- Lesser deviation
- No deviation
- Same deviation.

19. A raft of wood of density $0.8 \times 10^3 \text{ kg m}^{-3}$ and mass 120 kg floats in water. How much weight should be put on the raft to make it just sink?

- 20 kg
- 30 kg
- 40 kg
- 80 kg

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

Statement 1 : For a given time interval, average velocity has single value while average speed can have many values.

Statement 2 : Velocity is the speed of an object moving in a definite direction.

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

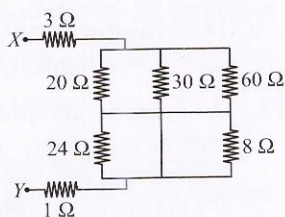
21. Match the column I with column II and select the correct option.

Column I		Column II
P.	Inner ear	1. Hammer
Q.	Outer ear	2. Auditory canal
R.	Middle ear	3. Pinna
		4. Anvil
		5. Auditory nerve
		6. Cochlea

P	Q	R
A. (1, 2)	(3, 4)	(5, 6)
B. (2, 6)	(3, 5)	(1, 4)
C. (5, 6)	(2, 3)	(1, 4)
D. (2, 6)	(1, 5)	(3, 4)

22. The equivalent resistance of the given network of resistances between points X and Y is

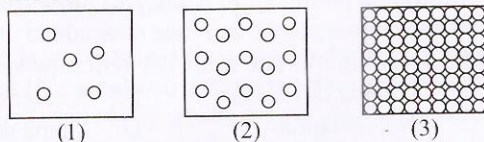
- 4 Ω
- 14 Ω
- 20 Ω
- 68 Ω



23. Which of the following statements is correct?

- When a salt is dissolved in water, neutralisation reaction takes place.
- KNO_3 when dissolved in water will give solution having $\text{pH} < 7$.
- When CuSO_4 is dissolved in water, it gives a solution having $\text{pH} < 7$.
- Aqueous solution of Na_2CO_3 has $\text{pH} = 7$.

24. Three different states of matter are shown in figures 1, 2 and 3.



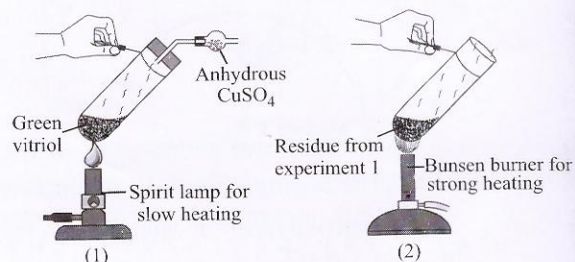
Melting and boiling points of three substances are given in the table :

Substance	m.pt.($^{\circ}\text{C}$)	b.pt.($^{\circ}\text{C}$)
X	-40	60
Y	613	1214
Z	-180	-160

Substances which exist in state 1 and 3 at room temperature are respectively

- X and Y
- X and Z
- Z and Y
- None of these.

25. Rahul, a class 10 student performed the following experiments in lab :



Which of the given observations are incorrect?

- Colour of CuSO_4 changes from white to blue in experiment 1.
 - Colour of green vitriol changes from green to blue in experiment 1.
 - A mixture of SO_2 and CO_2 is evolved in experiment 2.
 - White residue is left behind in test tube in experiment 2.
- I and IV only
 - I, II and III only
 - III and IV only
 - II, III and IV only

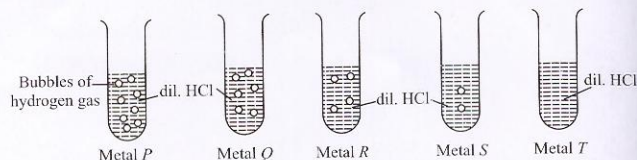
26. The given table shows the number of electrons, neutrons and protons in some atoms or ions of elements :

Atom or ion	Electron	Neutron	Proton
P	10	12	11
Q	17	20	17
R	10	10	8
S	10	10	10
T	17	18	17

Which of the following statements is incorrect?

- P is a cation while R is an anion.
- Q and T are atoms of different elements.
- S has a nucleon number 20 and it is a noble gas.
- None of these.

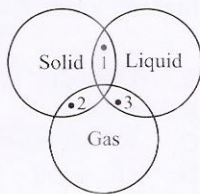
27. Observe the rate of evolution of hydrogen gas with five metals P, Q, R, S and T at room temperature.



Identify metals P, Q, R, S and T.

	P	Q	R	S	T
A.	Zn	Al	Mg	Cu	Fe
B.	Mg	Al	Zn	Fe	Cu
C.	Al	Zn	Mg	Fe	Cu
D.	Fe	Zn	Mg	Al	Cu

28. In the given Venn diagram, points 1, 2 and 3 represent different colloidal systems : Which of the following best represents points 1, 2 and 3?

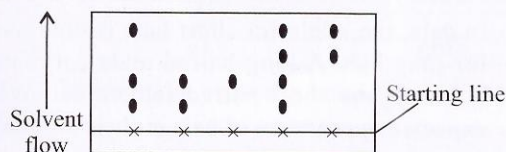


- | | 1 | 2 | 3 |
|----|------------------|--------------|-------------|
| A. | Boot polish | Smoke | Mist |
| B. | Whipped cream | Dust fumes | Hair cream |
| C. | Coloured glasses | Fog | Soap lather |
| D. | Milk | Pumice stone | Paints |
29. A compound 'P' having molecular formula, $C_3H_6O_2$ reacts with Na metal to form a compound 'Q' and evolves a gas which burns with a pop sound. Compound 'P' on treatment with an alcohol 'R' in presence of an acid forms a sweet smelling compound 'S' having molecular formula, $C_5H_{10}O_2$. On addition of NaOH to 'P', it gives 'Q' and water. 'S' on treatment with NaOH solution gives back 'Q' and 'R'.

Identify P, Q, R and S.

- | | P | Q | R | S |
|----|----------------|-------------------|------------------|-------------------|
| A. | Ethanoic acid | Ethanol | Sodium ethanoate | Ethyl ethanoate |
| B. | Propanoic acid | Sodium propanoate | Methanol | Methyl propanoate |
| C. | Propanoic acid | Sodium propanoate | Ethanol | Ethyl propanoate |
| D. | Ethanoic acid | Sodium ethanoate | Ethanol | Ethyl ethanoate |
30. The number of atoms of Mg, S and O present in 0.5 moles of $MgSO_4$ are respectively
(Given : Atomic mass of O = 16 u, Mg = 24 u, S = 32 u)
- A. 3.01×10^{23} , 3.01×10^{23} and 12.04×10^{23}
 B. 3×10^{23} , 3×10^{23} and 1.2×10^{23}
 C. 3.01×10^{23} , 2.05×10^{23} and 12.04×10^{23}
 D. 3×10^{23} , 12.05×10^{23} and 12.04×10^{23}
31. X, Y and Z are elements of the same period in the periodic table. 'X' forms an acidic oxide, 'Y' forms a basic oxide and 'Z' forms an amphoteric oxide. Which of the following represents the correct order of increasing atomic numbers?
- A. X, Y, Z B. X, Z, Y
 C. Y, X, Z D. Y, Z, X

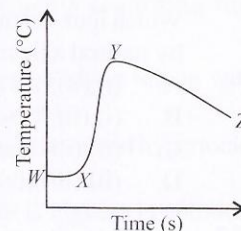
32. The given chromatogram was prepared using spots of five different inks :



How many different types of dyes were used to make these five inks?

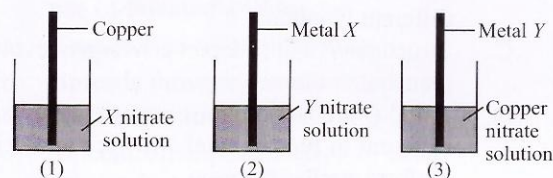
- A. 3 B. 5
 C. 4 D. 10

33. Excess of sodium hydroxide pellets are added to dilute hydrochloric acid and the temperature change of the mixture was measured over a period of time. The given graph shows the temperature change with time.



What can be inferred from the graph?

- A. Bonds are broken only during XY, so the temperature rises.
 B. Bonds are formed only during YZ, so the temperature drops.
 C. The reaction is exothermic as the temperature increases from X to Y.
 D. Both A and B.
34. The given set-up was arranged by Sachita to find the reactivity order of metals :



She recorded her observations as follows :

- Clean copper metal did not react with 1 molar solution of metal X nitrate.
- Clean metal X dissolved in 1 molar solution of metal Y nitrate and metal Y was deposited.
- Clean metal Y did not react with 1 molar copper nitrate solution.

Metals X and Y could be respectively

- A. Gold and aluminium B. Zinc and iron
 C. Lead and silver D. Gold and silver.
35. Which of the following comparisons of the two birth control methods used by women are correct?

Contraceptive pills

Tubal ligation

- | | |
|------------------------------|-------------------------------|
| A. No implantation of embryo | Implantation of embryo occurs |
| B. No menstruation | Menstruation occurs |
| C. Reversible | Reversibility is very poor |
| D. Ovulation occurs | No ovulation |

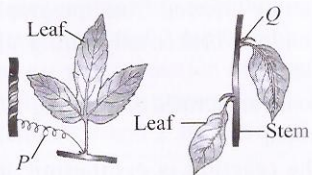
36. Read the given statements that refer to natural selection.

- Competition between organisms alters their genes.
- Parent organisms transmit useful and adaptable characteristics to the next generation.
- Organisms vary in their adaptations.
- Only one species can occupy an ecological niche.
- Well-adapted organisms survive and reproduce.

Which four statements summarise the theory of evolution by natural selection?

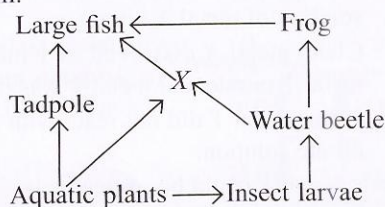
- (i),(ii),(iii) and (v) only
- (i),(ii),(iv) and (v) only
- (ii),(iii) and (v) only
- (ii),(iii),(iv) and (v) only

37. Refer to the given figures and select the correct option.



- Structures *P* and *Q* provide morphological and anatomical evidence to trace evolutionary relationships.
- P* and *Q* are analogous organs as they have similar basic structural design and origin but perform different functions.
- Structures *P* and *Q* depict convergent evolution in plants.
- P* and *Q* are homologous organs as they are quite different in fundamental structure and origin but perform similar function.

38. Refer to the given food web operating in an ecosystem.

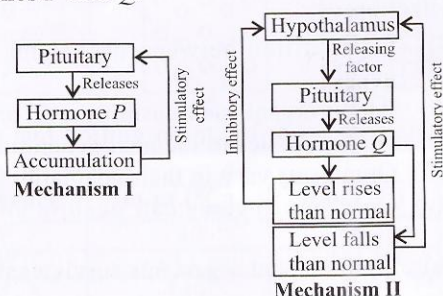


A new species *Y* was introduced in this community which exclusively drove away species *X* from this area.

What could be correctly assumed about species *X* and *Y*?

- Species *Y* could be a competitor of species *X* and competitively excluded the latter.
- Species *Y* could be a predator of species *X* and exclusively preyed upon it.
- Species *X* is a carnivore but species *Y* is an omnivore therefore is exposed to more food options.
- Both A and B

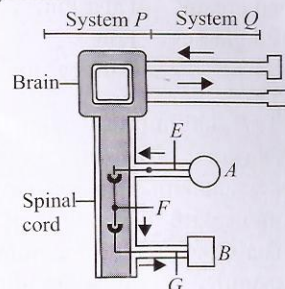
39. Shown here are feedback control mechanisms of two hormones *P* and *Q*.



Identify hormones *P* and *Q*.

- | <i>P</i> | <i>Q</i> |
|---------------|-------------|
| A. Oxytocin | Thyroxine |
| B. Insulin | Thymosin |
| C. Adrenaline | Oxytocin |
| D. Glucagon | Vasopressin |

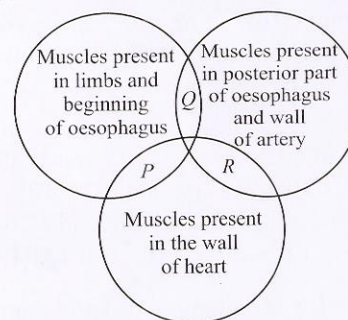
40. Refer to the diagram showing an overview of the human nervous system.



Based on the diagram which of the following observations is incorrect?

- The flow of nerve impulse through a reflex arc will be from $A \rightarrow E \rightarrow F \rightarrow G \rightarrow B$.
- Pain receptor could be an example of structure *A*.
- System *P* is central nervous system and system *Q* is peripheral nervous system.
- E* is motor neuron, *F* is sensory neuron and *G* is relay neuron.

41. Refer to the given Venn diagram of types of muscles and select the correct option regarding their characteristics *P*, *Q* and *R*.

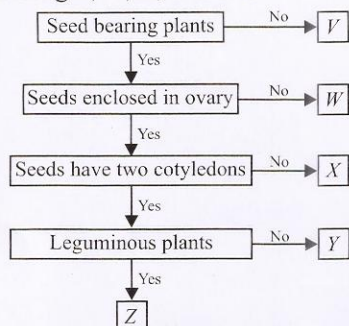


- P* – Presence of light and dark bands, *Q* – Unbranched, *R* – Uninucleate and involuntary
- P* – Multinucleate and voluntary, *Q* – Branched, *R* – Never get fatigued
- P* – Branched, *Q* – Presence of light and dark bands, *R* – Uninucleate and involuntary
- P* – Unbranched, *Q* – Never get fatigued, *R* – Multinucleate and involuntary

42. In cats, the allele for short hair is dominant to that for long hair. A long-haired male cat mates with a homozygous short-haired female cat. What is the expected appearance of hair in their progeny?

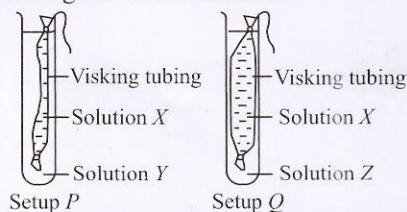
- 100% short-haired
- 100% long-haired
- 50% long-haired and 50% short-haired
- 75% short-haired and 25% long-haired

43. Refer to the given flow chart and select the correct option regarding V , W , X , Y and Z .



- A. Species V consists of male and female cones formed by aggregation of micro and megasporophylls.
 B. In W , xylem consists of only vessels and tracheids are absent, however phloem consists of only companion cells.
 C. Species X may show parallel venation in leaves and scattered vascular bundles in stem.
 D. Y could be pea or beans whereas Z could be rice or wheat.

44. 10 cm^3 each of solution X was poured into two separate Visking tubings. One Visking tubing was then placed in a test tube filled with 20 cm^3 of solution Y , while other was placed in a boiling tube filled with 20 cm^3 of solution Z . It may be assumed that the solutes in the solutions are too large to pass through the Visking tubing. The diagram shows the appearance of the Visking tubings after 20 minutes.



Which of the following statements regarding the experiment is true?

- A. The amount of solute in each Visking tubing will change at the end of experiment.
 B. Solution X is hypotonic to solution Y and hypertonic to solution Z .
 C. The concentration of solute is highest in solution Z followed by X and Y .
 D. Both B and C
45. Refer to the given dichotomous key and identify P , Q , R , S , T and U .
- I. (a) It is a communicable disease. – Go to II
 (b) It is a non-communicable disease. – Go to V
- II. (a) Direct transmission – Go to III
 (b) Indirect transmission – Go to IV
- III. (a) Spreads through sexual contact – P
 (b) Spreads through physical contact and use of infected articles – Q
- IV. (a) Transmitted through vectors – R
 (b) Spreads through contaminated food and water – S
- V. (a) Uncontrolled proliferation of cells – T
 (b) Hypersensitivity to certain antigens such as dust, pollen, etc. – U
- A. P – Gonorrhoea, Q – Measles, R – Malaria, S – Cholera, T – Cancer, U – Hay fever
 B. P – Syphilis, Q – Small pox, R – Elephantiasis, S – Tetanus, T – Cancer, U – AIDS
 C. P – Hepatitis – B, Q – Syphilis, R – Tuberculosis, S – Kala azar, T – Plague, U – Cretinism
 D. P – AIDS, Q – Rabies, R – Sleeping sickness, S – Dengue, T – Yellow fever, U – Conjunctivitis

ACHIEVERS SECTION

Direction: Refer to the given paragraph and answer questions 46 and 47.

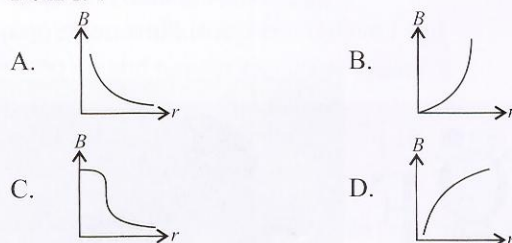
The table shows the melting points and boiling points of six elements P , Q , R , S , T and U . These elements represent consecutive members of periods 3 and 4 of the periodic table.

Element	Melting point ($^{\circ}\text{C}$)	Boiling point ($^{\circ}\text{C}$)
P	44	280
Q	120	445
R	-101	-35
S	-189	-186
T	64	760
U	851	1494

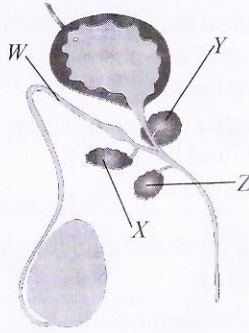
46. If S is a noble gas, then the bond formed between T and R is
- A. Ionic
 B. Covalent
 C. Coordinate
 D. No bond is formed between T and R .

47. 0.2 mol of the chloride of element U reacts with excess of silver nitrate to form 57.4 g of silver chloride. The formula of chloride is
 (Given : Atomic mass of $\text{N} = 14\text{ u}$, $\text{O} = 16\text{ u}$, $\text{Cl} = 35.5\text{ u}$, $\text{Ag} = 108\text{ u}$)
- A. UCl
 B. UCl_2
 C. UCl_3
 D. UCl_5

48. Which of the following graphs correctly represents the variation of magnetic field (B) produced by a current carrying straight wire with the distance (r) from it?

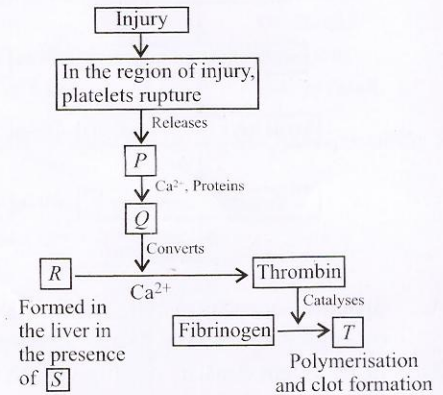


49. Refer to the given diagram of a part of human male reproductive system and select the correct option regarding structures W, X, Y and Z.



- During vasectomy a small portion of Z is cut to prevent transport of sperms.
- W carries urine at the time of urination and semen at the time of ejaculation.
- Y and Z are paired structures which secrete an alkaline fluid that helps in lubrication of penis.
- If X is absent in a male then fructose sugar will be absent in his semen and sperms will not get sufficient energy to move in the female reproductive tract.

50. Refer to the given flow chart which summarises the process of formation of blood clot. Identify P, Q, R, S and T.



- P – Prothrombin, Q –Thromboplastin, R – Prothrombinase, S – Vitamin K, T – Fibrin
- P – Thromboplastin, Q –Prothrombinase, R – Prothrombin, S – Vitamin K, T – Fibrin
- P – Thromboplastin, Q –Prothrombin, R – Prothrombinase, S – Vitamin B, T – Fibrin
- P – Prothrombin, Q –Prothrombinase, R – Thromboplastin, S – Vitamin K, T – Fibrin

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