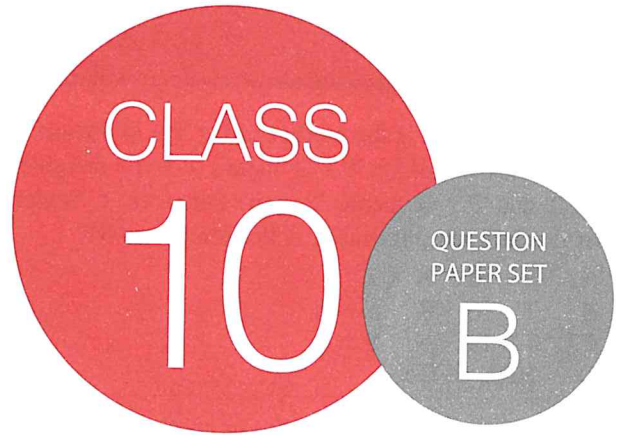


**SOF NATIONAL SCIENCE
OLYMPIAD 2019-20**



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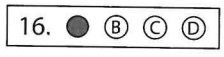
Total Questions: 50 | Time: 1 hr.

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.
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.



LOGICAL REASONING

1. 'P × Q' means 'P is the mother of Q'; 'P + Q' means 'P is the husband of Q'; 'P - Q' means 'P is the daughter of Q' and 'P ÷ Q' means 'P is the father of Q'. Which of the following means S is the brother of T?
- A. $S \div M \times N \times T$
 B. $T - M + R \times N \times S$
 C. $T - M + N \times S \div R$
 D. None of these

2. 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:

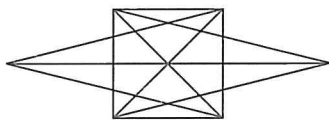
- (i) If an odd number is followed by another odd number which is a perfect square, then they are to be added.
 (ii) If an even number is followed by an odd number or an odd number is followed by an even number, then they are to be multiplied.
 (iii) If an even number is followed by another even number, then the first number is to be divided by the second number.
 (iv) If an even number which is a multiple of 5 is followed by an odd number which is also a multiple of 5, then the second number is to be subtracted from the first number.

6 5 15
42 6 30

Find the number obtained on dividing the resultant of the second row by the resultant of the first row.

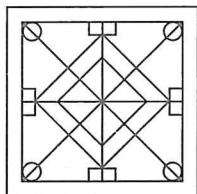
- A. 12 B. 14
 C. 18 D. 16

3. How many triangles are there in the given figure?



- A. 42 B. 40
 C. 48 D. None of these

4. Select a figure from the options which is not exactly embedded in the given figure as one of its parts.



- A.  B. 

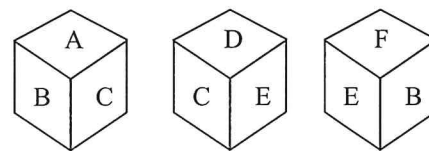
- C.  D. 

5. Find the missing number, if a certain rule is followed either row-wise or column-wise.

8	2	22
4	3	17
5	9	?

- A. 15 B. 45
 C. 37 D. 35

6. The six faces of a dice have been marked with alphabets A, B, C, D, E and F.



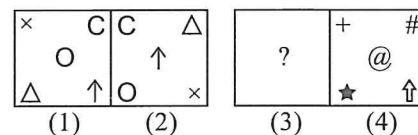
Find the alphabet on the face opposite to the face having alphabet A.

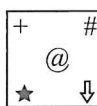
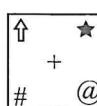
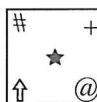
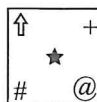
- A. C B. D
 C. E D. F

7. How many pairs of letters are there in the word PURPOSEFUL which have as many letters between them in the word as in the English alphabets?

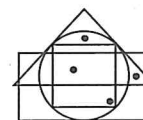
- A. None B. One
 C. Three D. More than three

8. 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 options which will replace the (?) in fig. (3).



- A.  B. 
 C.  D. 

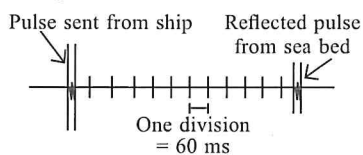
9. Which of the following options does not satisfy the same conditions of placement of the dots as in the given figure?



- A.  B. 

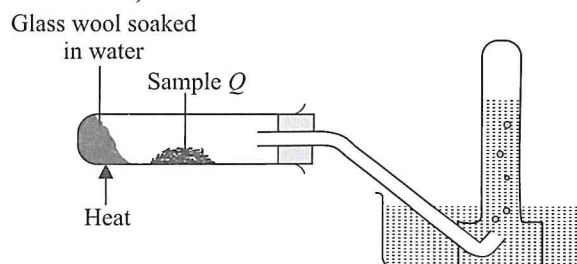
19. A sound wave is used to measure the distance from the ship to the sea bed. An electronic device placed in the ship traces a pulse sent from the ship and reflected pulse that returns. The time-base setting for the x -axis is 60 ms per division. The speed of sound wave in water is 1500 m s^{-1} . Find the distance from the ship to the sea bed.

- A. 1500 m
B. 1080 m
C. 900 m
D. 540 m



24. Select the incorrect statement.
- A. Latent heat of fusion is used to overcome the forces of attraction between molecules in solid state.
B. During the phase change, from liquid to solid and from gas to liquid, the temperature increases.
C. Neon sign bulb is an example of plasma.
D. If a few spoons of common salt are dissolved in pure water then its freezing point becomes less than 0°C .

25. The given diagram shows an experimental set-up for sample Q which contains 4.0 g of lead and 3.5 g of zinc. (Atomic mass of Zn = 65 u, O = 16 u and Pb = 207 u)



The composition of the sample at the end of the reaction will be

- A. 4.0 g of Pb and 3.5 g of Zn
B. 3.71 g of PbO and 3.5 g of ZnO
C. 4.0 g of Pb and 4.36 g of ZnO
D. 3.71 g of PbO and 4.36 g of Zn.

26. Boiling points of some gases are given in the table.

Gas	B.pt. ($^\circ\text{C}$)
Kr	-153
Ne	-246
N	-196
O	-183

The gases which will distil over first and last during fractional distillation of the mixture containing these gases are respectively _____.

- A. Kr and N
B. Ne and N
C. Ne and Kr
D. O and N

27. Three hydrocarbons P , Q and R are shown below:
 P : $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$; Q : $\text{CH}_3-\text{C}\equiv\text{C}-\text{CH}_2\text{CH}_3$
 R : $\text{CH}_3\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_3$
Identify the correct statement(s) about these three hydrocarbons.
- I. P and Q both differ by a $-\text{CH}_2$ unit.
II. Q and R are saturated hydrocarbons.
III. P , Q and R , all have different general formulae.
IV. Q and R are isomers.
- A. I and II only
B. II and III only
C. I and IV only
D. III only

20. An experimental spacecraft is found to have weight W when assembled before launching from a rocket site. It is placed in a circular orbit at a height $h = 6R$ above the surface of the earth (of radius R). The gravitational force acting on the spacecraft in this orbit is _____.

- A. $W/6$
B. $W/7$
C. $W/36$
D. $W/49$

21. An object is projected vertically upwards. Neglecting air resistance, which one of the following statements is correct?

- A. According to the principle of conservation of energy, total energy of the object is constant throughout the motion.
B. According to the principle of conservation of momentum, the momentum of the object is constant throughout the motion.
C. The object travels equal distance in equal intervals of time during the ascent and descent.
D. The gravitational potential energy of the object increases uniformly with time during the ascent.

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

- I. A person with myopia can see nearby objects clearly.
II. Twinkling of stars is due to scattering of light by dust particles.
III. The change in focal length of an eye lens is caused by the action of retina.
IV. At noon the sun appears white as light is least scattered.
- A. I only
B. II and III only
C. III and IV only
D. I and IV only

23. Study the given reactions carefully.

- I. $\text{Mg}_{(s)} + \text{Zn}^{2+}_{(aq)} \rightarrow \text{Mg}^{2+}_{(aq)} + \text{Zn}_{(s)}$
II. $\text{CH}_{4(g)} + 2\text{O}_{2(g)} \rightarrow \text{CO}_{2(g)} + 2\text{H}_2\text{O}$
III. $\text{NaOH}_{(aq)} + \text{HCl}_{(aq)} \rightarrow \text{NaCl}_{(aq)} + \text{H}_2\text{O}_{(l)}$
IV. $\text{Cl}_{2(g)} + \text{S}^{2-}_{(aq)} \rightarrow \text{S}_{(s)} + 2\text{Cl}^{-}_{(aq)}$

The reaction(s) which do(es) not represent a redox process is/are

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

28. The electronic configuration of an ion X^{3-} is 2, 8, 8. If the nucleon number of the parent atom 'X' is 31, then the number of neutrons present in 'X' is _____.
- A. 16 B. 19
C. 20 D. 15

29. An ore on heating in air produces sulphur dioxide. The process which is used for its concentration and the two steps involved in the conversion of this ore into related metal are respectively
- A. Hydraulic washing, chemical separation and refining
B. Baeyer's process, electrorefining and reduction
C. Froth floatation process, conversion to metal oxide and reduction of metal oxide
D. None of these.

30. A part of the periodic table is shown here. (The letters are not the actual chemical symbols of the elements.)

Groups	1	2	13	14	15	16	17	18
Periods								
2			Q		L	R	S	
3				M				
4		N						P
5	O							

Which of the following statements is incorrect about the given elements?

- A. Q and S combine together to form a compound, QS_3 .
B. N forms a divalent cation while L forms trivalent anion.
C. Atomic size of O is the biggest among the given elements.
D. M always forms ionic compounds.
31. Observe the given reactions carefully.
- $$\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2 + \text{NH}_3 \rightarrow \text{NH}_4\text{Cl} + W$$
- $$\text{Ca}(\text{OH})_2 + \text{Cl}_2 \rightarrow X + \text{H}_2\text{O}$$
- $$2\text{NaCl} + 2\text{H}_2\text{O} \rightarrow Y + \text{Cl}_2 + \text{H}_2$$
- Which of the following shows the correct uses of products W, X and Y?
- A. W → Faster cooking, X → Fire extinguishers, Y → In water treatment
B. W → Ingredient in antacids, X → For bleaching clothes, Y → Paper making
C. W → Disinfecting water, X → Baking powder, Y → Fertilisers
D. W → Oxidising agent, X → Softening of hard water, Y → Toy making

32. The melting and boiling points of four different substances are given in the table.

Substance	M. pt. (°C)	B. pt. (°C)
W	-35	120
X	-55	25
Y	104	240
Z	24	124

If all the given substances are heated from 0 °C to 100 °C, substance (i) will remain in solid state only, substance (ii) will change from liquid to gas and substance (iii) will change from solid to liquid. (i), (ii) and (iii) are respectively

- A. Y, X and Z B. W, X and Y
C. Y, W and Z D. W, X and Z.

33. 3.42 g of sucrose ($\text{C}_{12}\text{H}_{22}\text{O}_{11}$) contains

- I. 7.22×10^{22} atoms of C
II. 1.325×10^{21} atoms of H
III. 66.24×10^{21} atoms of oxygen
IV. 6.022×10^{21} molecules of sucrose
- A. I and III only
B. II and IV only
C. I, III and IV only
D. I, II, III and IV.

34. In which of the following reactions, water is not formed as one of the products?

- I. Propanol is oxidised by acidified $\text{K}_2\text{Cr}_2\text{O}_7$.
II. Ethanol undergoes complete combustion.
III. Methanoic acid reacts with anhyd. Na_2CO_3 .
IV. Methanol reacts with sodium metal.
- A. III only
B. I, II and III only
C. III and IV only
D. IV only

35. In a plant species, tall plant (T) characteristic is dominant over dwarf plant (t) and violet flower characteristic (V) is dominant over white flower (v). A homozygous plant which is tall and bears violet flowers is crossed with a dwarf plant bearing white flowers. The F_1 offsprings are self-crossed to produce F_2 generation. If a total of 176 offsprings are produced, how many plants are expected to be dwarf and bearing white flowers in F_2 generation, according to a typical Mendelian cross?

- A. 11 B. 26
C. 33 D. 99

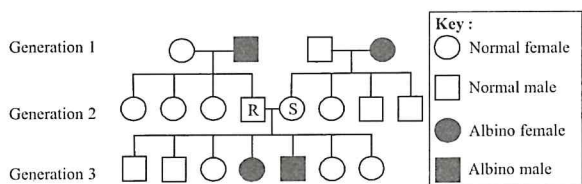
36. The function of seminal vesicles is

- A. To help neutralise the acidic environment of the female reproductive tract
B. To make transport of sperms easier within female reproductive tract
C. To provide nutrition to sperms
D. All of these.

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

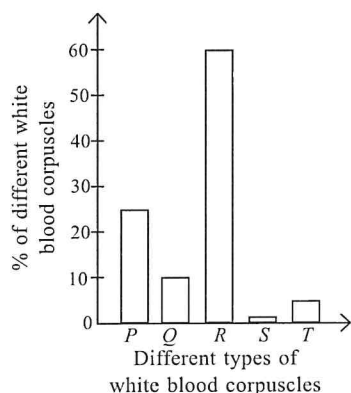
- | Column I | Column II |
|---------------|--|
| (a) Kala-azar | (i) A water-borne bacterial disease |
| (b) Mumps | (ii) Caused by a protozoan |
| (c) Tetanus | (iii) A viral disease that affects salivary glands |
| (d) Dengue | (iv) Prevented by DPT vaccine |
| (e) Typhoid | (v) A viral disease transmitted by mosquito |
- A. (a) – (v), (b) – (iii), (c) – (iv), (d) – (ii), (e) – (i)
 B. (a) – (ii), (b) – (iii), (c) – (iv), (d) – (v), (e) – (i)
 C. (a) – (ii), (b) – (v), (c) – (i), (d) – (iii), (e) – (iv)
 D. (a) – (i), (b) – (ii), (c) – (iv), (d) – (iii), (e) – (v)

38. Albinism is an inherited condition caused by a recessive allele 'a'. 'A' is the dominant allele for the normal condition. Study the given pedigree chart and identify the genotypes of individuals R and S.



- | R | S |
|-------|----|
| A. AA | AA |
| B. AA | Aa |
| C. Aa | Aa |
| D. aa | aa |

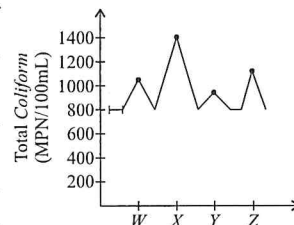
39. Refer to the given graph showing percentage(%) of different types of white blood corpuscles in a normal man. Identify P, Q, R, S and T and select the incorrect statement regarding them.



- A. P could produce antibodies to destroy microbes and their toxins.
 B. Q could be phagocytic in nature whereas S could release histamine and heparin.
 C. Nucleus of R is many lobed whereas nucleus of T is two lobed.

D. Cytoplasm of S does not contain granules whereas that of P contains granules.

40. In a study, water samples of Yamuna river were collected from four different cities (W, X, Y and Z) to check the presence of Coliform bacteria. The result obtained was plotted in the given graph.



Select the incorrect statement regarding this.

- A. People living in city X are more prone to water-borne diseases like cholera, etc.
 B. The river water of city Y could contain more number of fish than that of river X.
 C. The biological oxygen demand in river of city W is more than that found in city X.
 D. Dissolved oxygen content of river Y will be more than that of river Z.

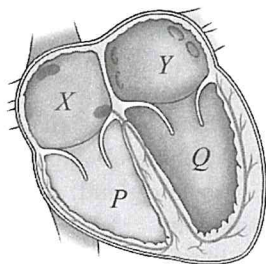
41. Read the following statements about the transmission of nerve impulse and select the correct statements.

- (i) In a neuron, nerve impulse travels from the dendrite along the axon to its end.
 (ii) The chemicals released from the axonal end of one neuron cross the synapse and generate a similar electrical impulse in the axon of another neuron.
 (iii) Impulses travel across the neurons only in one direction.
 (iv) The neurotransmitter released at the post-synaptic membrane, diffuses across the synapse and comes into contact with the chemoreceptor sites in the pre-synaptic membrane.
- A. (i) and (ii) only
 B. (i) and (iii) only
 C. (iii) and (iv) only
 D. (ii) and (iv) only

42. Which of the following is an incorrect match of phylum, type of coelom present in it and a characteristic feature?

- | | Phylum | Coelom | Feature |
|-----|---------------|-----------------|------------------------|
| (P) | Annelida | Coelomate | Metameric segmentation |
| (Q) | Echinodermata | Pseudocoelomate | Water vascular system |
| (R) | Arthropoda | Coelomate | Chitinous exoskeleton |
| (S) | Aschelminthes | Acoelomate | Flame cells |
- A. (Q) only
 B. (S) only
 C. (Q) and (S) only
 D. (P) and (R) only

43. Refer to the given figure of heart and select the correct option.



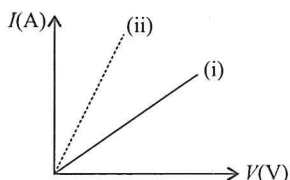
- A. The blood from *Y* reaches lungs.
 B. The blood from body enters heart through *P*.
 C. *Y* receives blood from lungs.
 D. *Q* receives blood from body.
-
44. Read the given paragraph.
 Photosynthesis in plants consists of two phases: *P* and *Q*. Phase *P* requires light energy and occurs in grana region of chloroplast whereas phase *Q* is light independent and occurs in stroma of chloroplast.
 Which of the following holds true regarding phases *P* and *Q* of photosynthesis?

- A. In phase *Q*, light energy is used up in photolysis of water and molecular oxygen is evolved.
 B. Phase *Q* utilises assimilatory power produced during *P* phase.
 C. Phase *P* is influenced by temperature whereas phase *Q* is not affected by changes in temperature.
 D. Phase *P* utilises carbon dioxide gas of atmosphere whereas phase *Q* evolves oxygen gas that escapes into atmosphere.

45. Rohan suggests that plant cells do not require mitochondria since they have chloroplasts. Which of the following statements would you use to convince him otherwise?
- A. Having both chloroplasts and mitochondria would maximise the rate of photosynthesis.
 B. Having both chloroplasts and mitochondria would maximise the rate of energy production.
 C. Mitochondria would be necessary at night when chloroplasts are no longer able to photosynthesise.
 D. The chemical energy stored in glucose cannot be efficiently utilised in the cell without mitochondria.

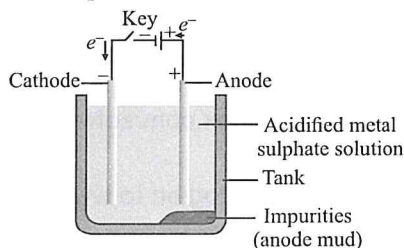
ACHIEVERS SECTION

46. The given figure shows the *I-V* curve (i) for a conductor of given length and cross-section.



- Which of the following changes will yield the curve (ii)?
- A. Increase the length of conductor
 B. Decrease the thickness of conductor
 C. Decrease the length of conductor
 D. Both A and B

47. The given figure shows the most commonly employed method for the purification of metals.



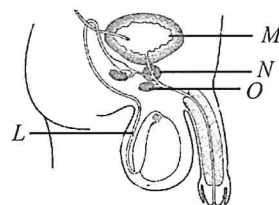
- When an aqueous solution containing ions of metal *M* is electrolysed
- A. *M* forms negative ions
 B. *M* ions gain electrons at the cathode
 C. Pure *M* is deposited at the anode
 D. Cathode becomes thinner as the process proceeds.

48. Read the given passage and fill in the blanks by selecting an appropriate option.

Atomic numbers of elements *P*, *Q*, *R* and *S* are 3, 10, 12 and 20 respectively. Elements (i) belong to the same period while elements (ii) belong to the same group. For cation formation, (iii) loses electron from *L*-shell while (iv) loses electrons from *N*-shell.

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

49. Refer to the given diagram of a part of human male reproductive system and select the incorrect option regarding structures *L*, *M*, *N* and *O*.



- A. During vasectomy, a small portion of *N* is cut to prevent transport of sperms.
 B. *N* and *O* are paired structures which secrete a fluid that neutralises acids from urine.
 C. *L* carries the sperms to *M* where they are stored temporarily.
 D. All of these


50. Read the given statements each with one or two blanks. Select the option that correctly fills the blanks in any two of the statements.

- (a) (i) is the process of aerobic burning whereas (ii) is anaerobic burning of combustible constituent of solid waste at high temperature.
- (b) (i) secretes milky fluid which helps in the mobility of sperms.
- (c) Tendrils of *Passiflora* and thorns of *Bougainvillea* are (i) organs while wings of birds and insects are (ii) organs.

- (d) (i) controls the coordination of body movements and posture whereas (ii) controls rate of heartbeat.
- A. (b) - (i) - Cowper's gland; (c) - (i) - Analogous, (ii) - Homologous
- B. (c) - (i) - Homologous, (ii) - Analogous; (d) - (i) - Medulla oblongata, (ii) - Cerebellum
- C. (b) - (i) - Prostate gland; (c) - (i) - Homologous, (ii) - Analogous
- D. (a) - (i) - Incineration, (ii) - Pyrolysis; (d) - (i) - Hypothalamus, (ii) - Medulla oblongata

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