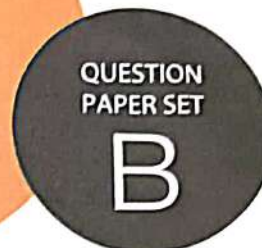




SOF NATIONAL SCIENCE
OLYMPIAD 2022-23



DO NOT OPEN THIS BOOKLET UNTIL ASKED TO DO SO

Total Questions: 50 | Time: 1 hr.

Guidelines for the Candidate

- You will get additional ten minutes to fill up information about yourself on the OMR Sheet, before the start of the exam.
- 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.
- The Question Paper comprises three sections :
Section - 1 : **Physics & Chemistry** (25 Questions)
Section - 2 : **Achievers Section** (5 Questions)
Section - 3 : **Mathematics** (20 Questions) or **Biology** (20 Questions)
- Section-1 and 2 are compulsory for all.** In Section-3 opt for Mathematics OR Biology and mark the same on the OMR Sheet. Each question in Achievers Section carries 3 marks, whereas all other questions carry one mark each.
- All questions are compulsory. There is no negative marking. Use of calculator is not permitted.
- There is only ONE correct answer. Choose only ONE option for an answer.
- 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.
- Rough work should be done in the blank space provided in the booklet.
- Return the OMR Sheet to the invigilator at the end of the exam.
- Please fill in your personal details in the space provided on this page before attempting the paper.

16. ● (B) (C) (D)

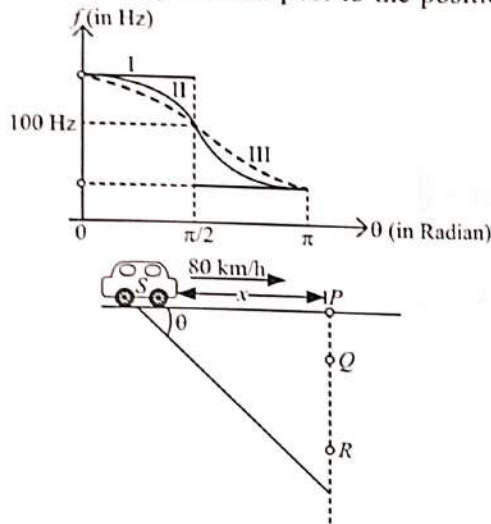


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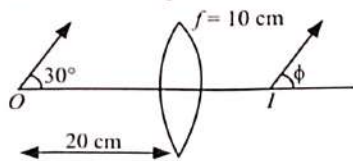
SECTION-1
PHYSICS

1. A car is moving with a speed of 80 km/h on a straight road. It whistles horn with a frequency of 100 Hz. There are three persons P , Q and R . P on track, Q at a perpendicular distance of y from the track and R at a perpendicular distance of $2y$ from the track as shown in the given figure. The variation of the observed frequency with respect to the position x is



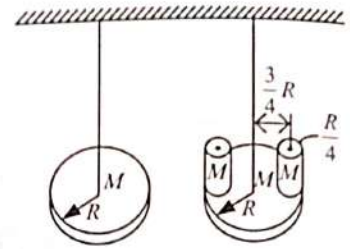
- A. $P - I, Q - II, R - III$
 B. $P - II, Q - I, R - III$
 C. $P - III, Q - II, R - I$
 D. $P - I, Q - III, R - II$

2. Let an object O starts moving in front of a convex lens of focal length $+10$ cm, at an angle of 30° with the principal axis as shown in the given figure. If ϕ denotes the angle with the principal axis at which the image I starts moving, then



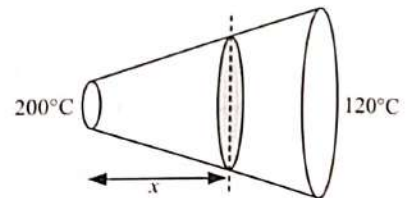
- A. $\phi = \frac{3\pi}{4}$ B. $\phi = \frac{\pi}{2}$
 C. $\phi = \frac{\pi}{6}$ D. $\phi = -\frac{\pi}{6}$

3. Find the ratio of square of time periods, of two torsional pendulums as shown in the given figure. The two differs only by the addition of cylindrical masses. The radius of each additional mass is $\frac{1}{4}$ the radius of the disc. Each cylinder and disc have equal mass.

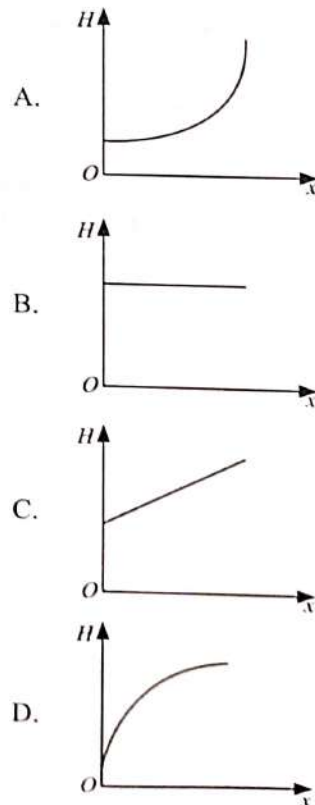


- A. $\frac{4}{9}$ B. $\frac{8}{27}$
 C. $\frac{3}{8}$ D. $\frac{9}{8}$

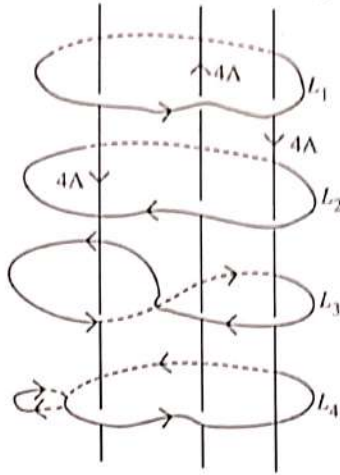
4. Consider a metallic conductor of non-uniform cross-section as shown in the given figure.



Material of the conductor is isotropic and its curved surface is thermally isolated from surroundings. Its ends are maintained at temperatures 200°C and 120°C . If in steady state, heat flow rate is equal to H , then which of the following graphs correctly depicts the variation of H with distance x from the left end?



5. Three current carrying wires carrying same current in different directions are as shown in the given figure.



Now, consider following statements.

- I. Along L_1 $\vec{B} \cdot d\vec{l}$ is $4\mu_0$.
- II. Along L_2 $\vec{B} \cdot d\vec{l}$ is $4\mu_0$.
- III. Along L_3 $\vec{B} \cdot d\vec{l}$ is $-4\mu_0$.
- IV. Along L_4 $|\vec{B} \cdot d\vec{l}|$ is $4\mu_0$.

Which of the given statements is/are correct?

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

6. A hypothetical atom is having different energy levels as shown in the given figure.

$n = \infty$	0 eV
$n = 5$	-0.80 eV
$n = 4$	-1.45 eV
$n = 3$	-3.08 eV
$n = 2$	-5.30 eV
$n = 1$	-15.6 eV

Now, consider the following statements

- I. Ionization potential of the atom is 15.6 eV.
- II. The shortest wavelength limit of the series terminating at $n = 2$ is 2339 Å.

- A. Both I and II are correct
- B. Both I and II are incorrect
- C. Only I is correct
- D. Only II is correct

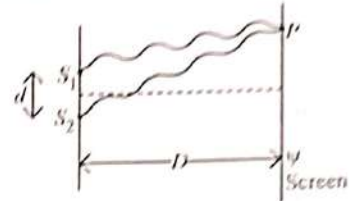
7. Read the given statements and select the correct option.

Statement 1 : A charged particle can never move along a magnetic field line in absence of any other force.

Statement 2 : Force on a charged particle of charge q moving with velocity \vec{v} due to magnetic field \vec{B} is given by $\vec{F} = q(\vec{v} \times \vec{B})$.

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

8. An experimental setup of Young's double slit experiment is shown below.

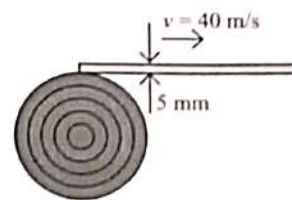


Now, a thin transparent sheet of refractive index μ is introduced in front of the source S_1 . Match the column I with column II and select the correct option from the given codes

Column I	Column II
P. Intensity of maxima will	(i) Increase
Q. Intensity of minima will	(ii) Decrease
R. Fringe width will	(iii) Remains same
S. Fringe pattern will	(iv) Shift upward
	(v) Shift downward

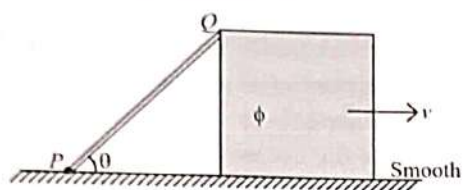
	P	Q	R	S
A.	(i)	(ii)	(iii)	(iv)
B.	(ii)	(i)	(iii)	(iv)
C.	(iii)	(i)	(ii)	(iv)
D.	(ii)	(i)	(iii)	(v)

9. In a continuous printing process, paper is drawn into the press at a constant speed of 40 m/s. If 20 cm be the radius of paper on the roll at any given time and 5 mm be the thickness of the paper, then angular acceleration of the roll is



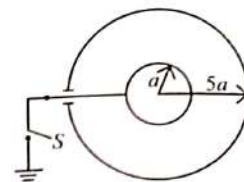
- A. 250 rev/s²
- B. 25 rev/s²
- C. 50 rev/s²
- D. 500 rev/s²

10. A rod PQ and a block ϕ are connected as shown in the given figure. End P of the rod is fixed through a frictionless axle on the ground.

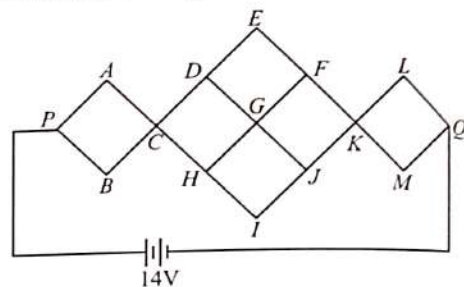


Now, select the correct option.

- A. When $\theta = 60^\circ$ and $v = 1$ m/s, speed of end Q is 2 m/s.
 B. When $\theta = 45^\circ$ and $v = 2$ m/s, speed of end Q is $\sqrt{2}$ m/s.
 C. When $\theta = 30^\circ$ and $v = \sqrt{3}$ m/s, speed of end Q is 2 m/s.
 D. When $\theta = 60^\circ$ and $v = \sqrt{3}$ m/s, speed of end Q is 2 m/s.
11. Two conducting thin concentric shells of radii a and $5a$ are shown in the given figure. The outer shell carries a charge of $100 \mu\text{C}$ and the inner shell is neutral. The amount of charge which flows, from inner shell to the earth after the switch S is closed, is equal to



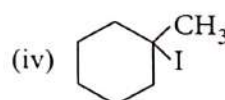
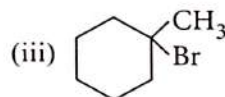
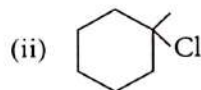
- A. $20 \mu\text{C}$
 B. $-40 \mu\text{C}$
 C. $500 \mu\text{C}$
 D. $-500 \mu\text{C}$
12. A resistor grid is connected with a battery as shown in the given figure. Resistance of each straight section is 1Ω . Current through the circuit is.



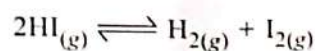
- A. 1 A
 B. 2 A
 C. 3 A
 D. 4 A

CHEMISTRY

13. The IE of early actinoids are lower than those of early lanthanoids, because
- A. $5f$ -orbitals penetrate less into the inner core of electrons
 B. $5f$ -electrons are more effectively shielded from the nuclear charge than $4f$ -electrons of the corresponding lanthanoids.
 C. Both A and B
 D. Neither A nor B.
14. Al_2O_3 is reduced by electrolysis at low potentials and high currents. If 4.0×10^4 ampere of current is passed through molten Al_2O_3 for 6 hours, what mass of aluminium is produced? (Assume 100% current efficiency and At. mass of $\text{Al} = 27 \text{ g mol}^{-1}$)
- A. $1.3 \times 10^4 \text{ g}$
 B. $2.4 \times 10^4 \text{ g}$
 C. $8.1 \times 10^4 \text{ g}$
 D. $9.0 \times 10^4 \text{ g}$



- A. (i) < (ii) < (iii) < (iv)
 B. (iv) < (iii) < (ii) < (i)
 C. (iii) < (i) < (ii) < (iv)
 D. (ii) < (iv) < (iii) < (i)
16. A sample of $\text{HI}_{(g)}$ is placed in a flask at a pressure of 0.4 atm. At equilibrium, partial pressure of $\text{HI}_{(g)}$ is 0.08 atm. What is K_p for the given equilibrium?



- A. 0.04
 B. 0.4
 C. 40
 D. 4

15. Predict the order of reactivity of the following compounds in $\text{S}_{\text{N}}1$ reactions.

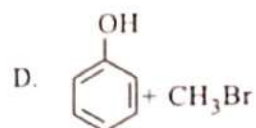
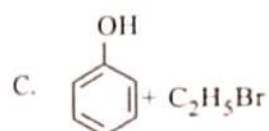
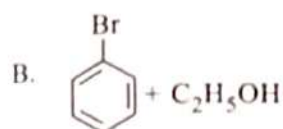
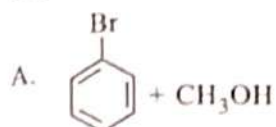


17. Match column I with column II and select the correct option from the given codes.

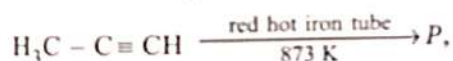
Column I		Column II	
(P)	$[\text{Co}(\text{CN})_6]^{3-}$	(i)	5.92 BM
(Q)	$[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$	(ii)	0 BM
(R)	$[\text{Mn}(\text{CN})_6]^{4-}$	(iii)	4.90 BM
(S)	$[\text{Co}(\text{H}_2\text{O})_6]^{3+}$	(iv)	1.73 BM

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

18. The reaction of anisole with HBr produces



19. In the following reaction,



the total number of carbon atoms present in the product P, is

- A. 21 B. 9
 C. 24 D. 18

20. Which of the following bonds will be most polar?

- A. N – Br
 B. O – F
 C. N – F
 D. O – O

21. The correct order of extent of hydration of the given salts is

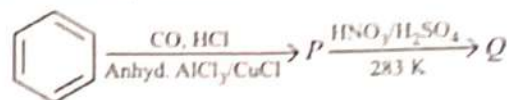
- A. $\text{LiCl} < \text{NaCl} < \text{KCl}$
 B. $\text{KCl} < \text{NaCl} < \text{LiCl}$
 C. $\text{NaCl} < \text{KCl} < \text{LiCl}$
 D. $\text{LiCl} < \text{KCl} < \text{NaCl}$

22. A 4.50 molal solution of $\text{KOH}_{(aq)}$ has a density 1.88 g cm^{-3} . The molarity of the solution is

[Atomic masses : K : 39.0 u; O : 16.0 u; H : 1.0 u]

- A. 8.68 M
 B. 6.75 M
 C. 9.23 M
 D. 7.72 M

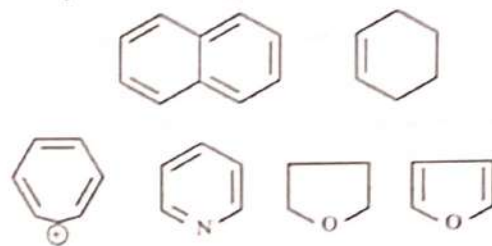
23. In the following reaction,



P and Q are respectively

- A. Benzoic acid and *p*-nitrobenzoic acid
 B. Toluene and benzoic acid
 C. Benzaldehyde and *m*-nitrobenzaldehyde
 D. Benzyl alcohol and *o*-nitrobenzenol

24. Study the following structures carefully.



The total number of aromatic compounds is

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

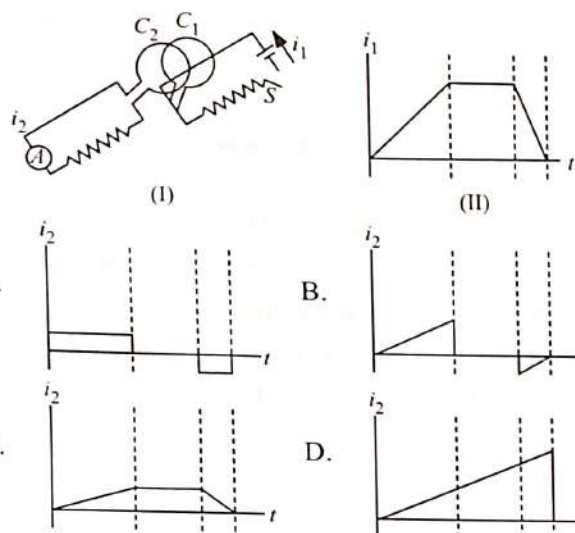
25. Read the given statements carefully and select the incorrect ones.

- I. Complete hydrolysis of DNA (or RNA) produces a pentose sugar, sulphuric acid and sulphur containing heterocyclic compounds.
 II. RNA contains four bases, *i.e.*, adenine, guanine, cytosine and thymine.
 III. Keratin and myosin are examples of fibrous proteins.
 IV. Thiamine and riboflavin are fat soluble vitamins while vitamins E and K are water soluble.
 A. I, III and IV only
 B. III and IV only
 C. I and II only
 D. I, II and IV only

SECTION-2

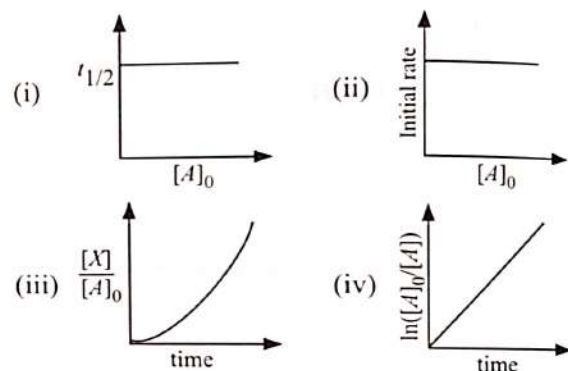
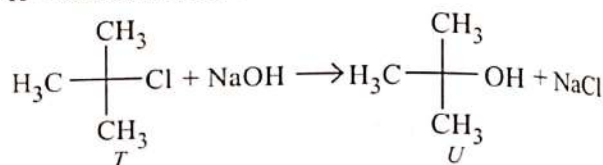
ACHIEVERS SECTION

26. Two coils C_1 and C_2 are placed close to each other as shown in figure (I). When the switch S is closed, current in coil C_1 varies as shown in figure (II). Which of the following graphs correctly represents the variation of current i_2 in coil C_2 , as a function of time?



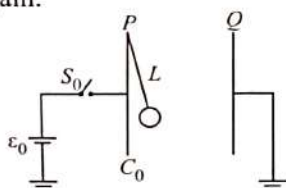
- A. $\frac{C_1 \epsilon_0}{C_0 + C_1}$
 B. $\frac{C_0 \epsilon_0}{C_0 + C_1}$
 C. $\frac{2C_1 \epsilon_0}{C_0 - C_1}$
 D. $\frac{2C_0 \epsilon_0}{C_0 - C_1}$
29. Which of the following plots are incorrect for the given reaction?

Where
 A_0 - initial concentration of T
 A - concentration of T at time t
 X - concentration of U at time t



Direction (Q.No. 27 and 28) : Read the given passage and answer the following questions.

Consider an experimental setup in which a parallel plate capacitor PQ has vertical plates with separation, $d = 25$ mm and capacitance C_0 . From the plate P , a small conducting ball hangs on a non-conducting silk thread of length $L = 50$ mm. Mass of the ball is m and capacitance is C_1 . It initially touches the plate P , as shown in the given figure. The plate Q is grounded while plate P is connected to a battery of emf ϵ_0 for a short time by closing the switch S_0 and then opening it again.

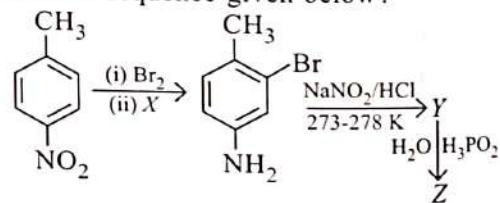


Motion of the conducting ball was observed. It has been found that due to the charge deposited on the plates and the ball, the ball swings across, touches the plate Q , swings back, touches plate P and finally swings out again such that it almost touches plate Q . Take $g = 10$ m/s².

27. The angle made by the ball and string with the vertical, when the ball is in its final position is
- A. 30° B. 45°
 C. 60° D. 0°
28. The ball initially touches plate Q , it loses charge to Q , swings back and touches plate P and then finally again swings out and almost touches plate Q . The new potential V of the ball is given by

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

30. Which of the following statements are correct regarding the reactions sequence given below?



- I. X can be Sn/HCl .
 II. Diazotisation takes place in presence of NaNO_2/HCl at $273-278$ K.
 III. H_3PO_2 acts as an oxidising agent and it oxidises Y to form Z .
 IV. Z is an alkyl halide.
- A. I and II only
 B. III and IV only
 C. I, II and IV only
 D. II, III and IV only

SECTION-3
MATHEMATICS

31. Let $A = \{1, 2, 3, 4\}$ and R be a relation on A given by $R = \{(1, 1), (2, 2), (3, 3), (4, 4), (1, 2), (2, 1), (3, 1)\}$. Then, R is
- Transitive only
 - Symmetric only
 - An equivalence relation
 - None of these
32. If A and B are the points $(-3, 4, -8)$ and $(5, -6, 4)$ respectively, then find the ratio in which yz -plane divides \overline{AB} .
- 5 : 2
 - 7 : 5
 - 3 : 5
 - 5 : 3
33. The numbers a, b, c are in A.P. and $a + b + c = 60$. The numbers $(a - 2), b, (c + 3)$ are in G.P. Then which of the following is not the possible values of $a^2 + b^2 + c^2$?
- 1208
 - 1218
 - 1298
 - None of these
34. If $A^{-1} = \begin{bmatrix} 5 & -2 \\ -7 & 4 \end{bmatrix}$ and $B^{-1} = \frac{1}{2} \begin{bmatrix} 9 & -7 \\ -8 & 6 \end{bmatrix}$, then find $(AB)^{-1}$.
- $\begin{bmatrix} 47 & -23 \\ -41 & 20 \end{bmatrix}$
 - $\begin{bmatrix} 40 & 20 \\ 45 & 21 \end{bmatrix}$
 - $\begin{bmatrix} 47 & 23 \\ -21 & 45 \end{bmatrix}$
 - None of these
35. Simplify $\int x e^{x^2} dx$
- $-\frac{e^{x^2}}{2} + C$
 - $\frac{e^{x^2}}{2} + C$
 - $\frac{e^x}{2} + C$
 - $-\frac{e^x}{2} + C$
36. Find the angle (in radian) through which a pendulum swings and its length is 75 cm and tip describes an arc of length 21 cm.
- $7/25$
 - $6/25$
 - $8/25$
 - $3/25$
37. Find the area enclosed between the curve $x^2 + y^2 = 16$ and the coordinate axes in the first quadrant.
- (4π) sq. units
 - (3π) sq. units
 - (2π) sq. units
 - (π) sq. units
38. The complex number, $z = \frac{(-\sqrt{3} + 3i)(1 - i)}{(3 + \sqrt{3}i)(1)(\sqrt{3} + \sqrt{3}i)}$
- lies on real axis
 - lies on imaginary axis
 - lies in first quadrant
 - lies in second quadrant
39. Read the given statements carefully and select the correct option.
- Statement-I** : Let A and B are two symmetric matrices of order 3, then $A(BA)$ and $(AB)A$ are symmetric matrices.
- Statement-II** : AB is symmetric matrix, if matrix multiplication of A and B is commutative.
- Both Statement-I and Statement-II are true.
 - Both Statement-I and Statement-II are false.
 - Statement-I is true but Statement-II is false.
 - Statement-I is false but Statement-II is true.
40. If the median of the data 6, 7, $x - 2$, x , 18, 21 written in ascending order is 16, then the variance of that data is
- $30\frac{1}{5}$
 - $31\frac{1}{3}$
 - $32\frac{1}{2}$
 - $33\frac{1}{3}$
41. The function $f(x) = x + \cos x$ is
- always increasing
 - always decreasing
 - increasing for certain range of x
 - None of these
42. A flashlight has 8 batteries out of which 3 are dead. If two batteries are selected without replacement and tested, then the probability that both are dead is
- $\frac{33}{56}$
 - $\frac{9}{64}$
 - $\frac{1}{14}$
 - $\frac{3}{28}$

43. Find the value of $\tan^{-1}\left[2\sin\left(2\cos^{-1}\frac{\sqrt{3}}{2}\right)\right]$.

- A. $\frac{\pi}{2}$ B. $\frac{\pi}{6}$
C. $\frac{\pi}{3}$ D. $\frac{\pi}{4}$

44. Let $f(x) = \begin{cases} x^3 + x^2 - 16x + 20, & x \neq 2 \\ k, & x = 2 \end{cases}$

If $f(x)$ is continuous for all x , then $k =$
A. 3
B. 5
C. 7
D. 9

45. Find the value of $\begin{vmatrix} a-b & b-c & c-a \\ b-c & c-a & a-b \\ c-a & a-b & b-c \end{vmatrix}$.

- A. 0
B. 1
C. 2
D. 3

46. If A and B are two sets such that $n(A) = 3, n(B) = 4$ and $n(A \cap B) = 2$, then find $n\{(A \times B) \cap (B \times A)\}$.

- A. 4
B. 3
C. 2
D. 1

47. If $\frac{dy}{dx} = y \sin 2x$ and $y(0) = 1$, then the particular solution of the given differential equation is,

- A. $y = e^{\sin^2 x}$
B. $y = \sin^2 x$
C. $y = \cos^2 x$
D. $y = e^{\cos^2 x}$

48. Solve the following linear inequation.

$$\frac{2x-3}{4} + 1 < x + \frac{4}{3}; x \in R$$

- A. $\left(-\infty, -\frac{5}{6}\right)$ B. $\left(-\frac{5}{6}, \infty\right)$
C. $\left(\frac{5}{3}, \infty\right)$ D. $\left(-\frac{13}{6}, \infty\right)$

49. Let $y = t^{10} + 1$ and $x = t^8 + 1$, then $\frac{d^2y}{dx^2}$ is equal to

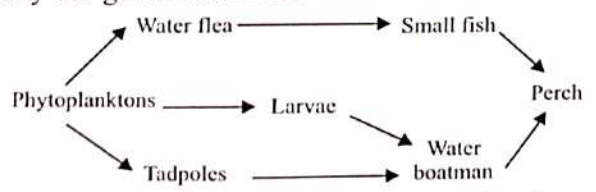
- A. $\frac{5}{2}t$
B. $20t^8$
C. $\frac{5}{16t^6}$
D. None of these

50. Consider the linear programming problem:
Max. $Z = 4x + y$

Subject to $x + y \leq 50$; $x + y \geq 100$; $x, y \geq 0$
The maximum value of Z is
A. 0 B. 50
C. 100 D. Does not exist

OR
BIOLOGY

31. Study the given food web.



Select the incorrect statement regarding it.

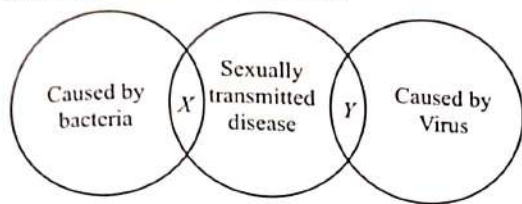
- A. Small fish and water boatman act as both predator and prey.
B. Phytoplanktons belong to the level of primary consumer.
C. Small fish is a secondary consumer and perch is a tertiary consumer.
D. All of these

32. Refer to the given figure of a type of connective tissue and select the incorrect statement regarding it.



- A. It contains clear, large amount of translucent matrix with less fibres.
B. It is hard and non-elastic and therefore forms vertebrae of shark.
C. It forms articular surfaces at the joints of long bones.
D. It forms skeleton of cartilaginous fishes.

33. Refer to the given Venn diagram and select the option that correctly identifies X and Y .



X

Y

- | | |
|-------------------|-------------|
| A. Genital herpes | Chancroid |
| B. Gonorrhoea | Hepatitis-B |
| C. Trichomoniasis | Scabies |
| D. Chlamydia | Syphilis |

34. In corn, purple kernels are dominant to yellow. A random sample of 100 kernels is taken from a population in Hardy-Weinberg equilibrium. It is found that 16 kernels are yellow and 84 are purple. What is the percentage of yellow allele in the population?

- A. 0.36
B. 0.16
C. 0.4
D. 0.016

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

Statement 1 : Centrioles are capable of replication.

Statement 2 : In animal cells, centriole replication is independent of cell division.

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

36. Select the option that correctly fills up the given blanks.

- (i) Biogas is a mixture of gases which is produced by _____ breakdown of biomass.
(ii) Methanogens are commonly found in the _____ during sewage treatment.
(iii) _____ species are free-living fungi and effective biocontrol agents of several plant pathogens.
- A. (i) Anaerobic, (ii) Anaerobic sludge, (iii) *Trichoderma*
B. (i) Aerobic, (ii) Primary sludge, (iii) *Trichoderma*
C. (i) Anaerobic, (ii) Anaerobic sludge, (iii) *Azotobacter*
D. (i) Aerobic, (ii) Primary sludge, (iii) *Glomus*

37. Given are the names of different types of germ cells in a human male.

- | |
|------------------------------|
| (i) Spermatid |
| (ii) Primary spermatocyte |
| (iii) Secondary spermatocyte |
| (iv) Spermatogonium |
| (v) Spermatozoa |

Select the option that correctly segregates them as haploid and diploid cells.

- | | Haploid cells | Diploid cells |
|----|-----------------|-------------------|
| A. | (i), (iii), (v) | (ii), (iv) |
| B. | (i), (v) | (ii), (iii), (iv) |
| C. | (ii), (iii) | (i), (iv), (v) |
| D. | (ii), (iv) | (i), (iii), (v) |

38. X are substances which are incapable of inducing antibody formation by themselves but can be made capable of inducing antibodies on combining with larger molecules which serve as carriers. X are

- A. Complete antigens
B. Antibodies
C. Epitopes
D. Haptens.

39. Cellular level of body organisation, inner layer consisting of highly specialised flagellated choanocytes and body consisting of a system of pores and canals are the characteristics of Phylum

- A. Porifera
B. Coelenterata
C. Annelida
D. Arthropoda.

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

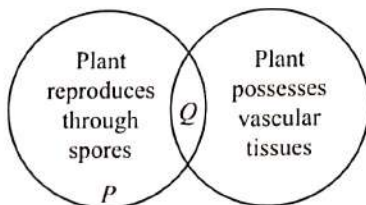
- | Column I | Column II |
|------------------------------------|---|
| P. PCT | (i) Minimum reabsorption |
| Q. DCT | (ii) Filtration of blood |
| R. Ascending limb of loop of Henle | (iii) Reabsorption of 70-80% electrolytes |
| S. Counter current mechanism | (iv) Conditional reabsorption of Na^+ |
| T. Glomerulus | (v) Maintenance of concentration gradient in medullary interstitium |
- A. P-(iii), Q-(iv), R-(i), S-(v), T-(ii)
B. P-(iii), Q-(v), R-(iv), S-(ii), T-(i)
C. P-(i), Q-(iii), R-(ii), S-(v), T-(iv)
D. P-(iii), Q-(i), R-(iv), S-(v), T-(ii)

41. To understand the concept of cleistogamous flower, Mohan has chosen two plants which can produce assured seed set even without pollinating agents. Select the option that correctly identifies the plants with the reason for producing the assured seed set.
- Plants: *Allium cepa*, Tobacco; By promoting cross-pollination
 - Plants: *Mirabilis*, *Oxalis*; Both plants have exposed anthers and stigma
 - Plants: *Commelina*, *Oxalis*; The flowers of both plants are bisexual and closed
 - Plants: *Viola*, Tobacco; In both the plants pollens are transferred from the anther to the stigma of other flowers on the same plant.

42. In genetic engineering, a DNA segment (gene) of interest is transferred to the host cell through a vector. Which among the following agents (i-iv) given in the box can be used as a vector(s)?

(i) <i>Amoeba</i>	(ii) Plasmid
(iii) <i>Plasmodium</i>	(iv) Bacteriophage

- (i), (ii) and (iv) only
 - (ii) only
 - (i) and (iii) only
 - (ii) and (iv) only
43. If a pea plant produces 2560 seeds during a dihybrid cross between homozygous round-yellow and wrinkled-green plant, then how many seeds are wrinkled-yellow, round-yellow and wrinkled-green, respectively?
- 640, 480, 1280
 - 480, 1440, 160
 - 640, 1280, 320
 - 160, 1440, 480
44. Refer to the given Venn diagram and select the correct option regarding *P* and *Q*.



- P* could be an alga or a bryophyte whereas *Q* could be a pteridophyte.
- True roots, stems and leaves are present in *P* but absent in *Q*.
- Antheridium in *Q* is sessile whereas that in *P* (if present) is stalked.
- P* is exclusively xerophytic whereas *Q* is amphibious by nature.

45. Bt proteins are produced by the soil bacterium, *Bacillus thuringiensis*. These proteins are delta-endotoxins that possess toxic properties and can be used as biopesticides, as well as a source of genes for the construction of transgenic plants resistant to insects. These toxins do not kill the bacteria that produce them because
- These recognise only insect-specific targets
 - They do not have proteases enzymes to break their cell membrane
 - The endotoxin that accumulates in the bacterium is an inactive precursor
 - They do not have the alkaline environment for the activation of Bt protein.

46. 3' AAATGCGCGATA 5' is the sequence of nucleotides on a gene; after transcription the mRNA formed against it and the sequence of bases in the corresponding anticodons will be

- 5' UUUACGCGCUAU 3' and 3' AAAUGCGCGAUA 5'
- 5' UAUCGCGCAUUU 3' and 3' AUAGCGCGUAAA 5'
- 5' UUUACCTUGUAU 3' and 3' AAAUGGUACAUA 5'
- 5' UAUGUTCCAUUU 3' and 3' AUACAUGGUAAA 5'.

47. Identify the family which shows the given diagnostic features.

Pentamerous flowers, epipetalous-bicarpellary, syncarpous, superior ovary, bilocular, placenta swollen with many ovules

- Solanaceae
- Fabaceae
- Liliaceae
- Poaceae

48. Which of the following statements are correct about crossing over/genetic recombination?
- It occurs in tetrad stage. It occurs in pachytene stage of prophase I of meiosis I.
 - It occurs between non-sister chromatids of homologous chromosomes.
 - It is a recombinase enzyme mediated process.
 - It is also the reciprocal transfer of genes between the non homologous chromosomes.
- (iii) and (iv) only
 - (i), (ii) and (iii) only
 - (ii), (iii) and (iv) only
 - (i), (ii), (iii) and (iv)

49. How many among the following are the free living nitrogen fixing organisms?

Nostoc, Anabaena, Rhizobium, Frankia, Azotobacter, Rhodospirillum, Beijerinckia, Bacillus, Nitrobacter and Thiobacillus

- A. 5
- B. 8
- C. 7
- D. 6

50. Select the incorrect statement regarding mutualism.

- A. Lichen represents an intimate mutualistic relationship between fungus and alga or cyanobacterium.
- B. Mycorrhizae are beneficial associations between fungi and roots of higher plants.
- C. Plants reward animal pollinators with nectar for aiding pollination.
- D. An orchid growing as an epiphyte on a mango branch is a classic example of mutualism.

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