Sample questions for Selection Test 2024-25

Instructions to Examinee

Duration	**150 mins**
Max. Marks	**300**

NAME	
Hall Ticket No.	
SCHOOL	

(i)

The duration of test is 150 mins. Total Marks : 300

- **Instructions for Quantitative Aptitude**
  - This section contain **15** questions (numbered **1 to 15).**
  - These questions are based on quantitative analysis.
  - Answer to each question is an integer between 000 to 999 (both values inclusive).
  - To answer the question, shade the appropriate bubble in ORS (optical response sheet).
- **Marking scheme:**
  - +4 if correct answer is marked.
  - 0 in all other cases

- **Instructions for Physics Section A:**
  - This section contain **10** questions (numbered **16 to 25)**.
  - Each question is followed by 4 options (A), (B), (C) and (D)
  - Only one of the option among these is correct.
- To answer the question shade the appropriate bubble in ORS.
- **Marking scheme:**
  - +4 if correct answer is marked.
  - 0 in all other cases

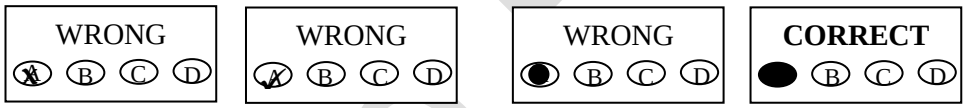
- **Instructions for Physics Section B:**
  - This section contain **5** questions (numbered **26 to 30**)
  - Answer to each question is an integer between 000 to 999 (both values inclusive).
  - To answer the question, shade the appropriate bubble in ORS

- Marking scheme:
  - +4 if correct answer is marked.
  - 0 in all other cases
- **Instructions for Chemistry Section A:**
  - This section contain **10** questions (numbered **31 to 40)**.
  - Each question is followed by 4 options (A), (B), (C) and (D)
  - Only one of the option among these is correct.
  - To answer the question shade the appropriate bubble in ORS.
- **Marking scheme:**
  - +4 if correct answer is marked.
  - 0 in all other cases
- **Instructions for Chemistry Section B:**
  - This section contain **5** questions (numbered **41 to 45**)
  - Answer to each question is an integer between 000 to 999 (both values inclusive).
  - To answer the question, shade the appropriate bubble in ORS
- **Marking scheme:**
  - +4 if correct answer is marked.
  - 0 in all other cases
- **Instructions for Mathematics Section A:**
  - This section contain **10** questions (numbered **46 to 55)**.
  - Each question is followed by 4 options (A), (B), (C) and (D)
  - Only one of the option among these is correct.
  - To answer the question shade the appropriate bubble in ORS.
- **Marking scheme:**
  - +4 if correct answer is marked.
  - 0 in all other cases
- **Instructions for Mathematics Section B:**
  - This section contain **5** questions (numbered **56 to 60**)
  - Answer to each question is an integer between 000 to 999 (both values inclusive).
  - To answer the question, shade the appropriate bubble in ORS
- **Marking scheme:**
  - +4 if correct answer is marked.
  - 0 in all other cases
- **Instructions for Biology Section A:**
  - This section contain **12** questions (numbered **61 to 72)**.
  - Each question is followed by 4 options (A), (B), (C) and (D)
  - Only one of the option among these is correct.
  - To answer the question shade the appropriate bubble in ORS.

- **Marking scheme:**
  - +4 if correct answer is marked.
  - 0 in all other cases
- **Instructions for Biology Section B:**
  - This section contain linked comprehension questions (numbered **73 to 75**)
  - A passage is given which is followed by three questions.
  - Corresponding to each question, there are 4 options (A), (B), (C) and (D)
  - Only one of the option among these is correct.
  - To answer the question shade the appropriate bubble in ORS.
- **Marking scheme:**
  - +4 if correct answer is marked.
  - 0 in all other cases

Instructions for filling the OMR Sheet:

1. Write your **name** and **register number** with black ball point pen in the response sheet and darken the appropriate circle **under** each alphabet/digit.
2. While marking your answers in the OMR sheet, darken the circle/s (in full) as shown in the example below using **Black ball point pen**.



3. Folding of OMR's, stray markings on the OMR's will lead to rejection during evaluation.

Space for rough work is provided in the question paper booklet.

Quantitative Aptitude

Numerical problems

(The answer to each of the following question is an integer ranging from 0 to 999)

1. The difference between simple and compound interests compounded annually on a certain sum of money for 2 years at 4% per annum is Re. 1. The sum (in Rs.) is

   Ans 625

   Let the sum be Rs. x. Then

   $$\text{C.I} = \left[x\left(1+\frac{4}{100}\right)^2 - x \right] = \left(\frac{676}{625}x - x\right) = \frac{51}{625}x$$

   $$\text{S.I} = \left(\frac{x \times 4 \times 2}{100}\right) = \frac{2x}{25} \qquad \therefore \frac{51x}{625} - \frac{2x}{25} = 1 \Rightarrow x = 625$$

2. If 6 men and 8 boys can do a piece of work in 10 days while 26 men and 48 boys can do the same in 2 days, the time taken by 15 men and 20 boys in doing the same work will be

   Ans 4

   Let 1 man's 1 day's work = x and 1 boy's 1 day's work = y

   Then, $6x + 8y = \frac{1}{10}$ and $26x + 48y = \frac{1}{2}$

   Solving these two equations, we get : $x = \frac{1}{100}$ and $y = \frac{1}{200}$

   (15 men + 20 boys) 1 day's work $= \left(\frac{15}{100} + \frac{20}{200}\right) = \frac{1}{4}$

   $\therefore$ 15 men and 20 boys can do the work in 4 days

3. What is the unit digit in $\{(6374)^{1793} \times (625)^{317} \times (341^{491})\}$?

   Ans 0

   Unit digit in $(6374)^{1793}$ = Unit digit in $(4)^{1793}$

   = Unit digit in $[(4^2)^{896} \times 4]$

   = Unit digit in $(6 \times 4) = 4$

   Unit digit in $(625)^{317}$ = Unit digit in $(5)^{317} = 5$

   Unit digit in $(341)^{491}$ = Unit digit in $(1)^{491} = 1$

   Required digit = Unit digit in $(4 \times 5 \times 1) = 0$

4. A student multiplies a number by $\frac{3}{5}$ instead of $\frac{5}{3}$. What is the percentage error in the calculation?

   Ans 64

   Let the number be x

   Then, error $= \frac{5}{3}x - \frac{3}{5}x = \frac{16}{15}x$

   Error% = $\left(\frac{16x}{15} \times \frac{3}{5x} \times 100\right)\% = 64\%$

5. There are four prime numbers written in ascending order. The product of the first three is 385 and that of the last three is 1001. What is the last number?

Ans 13

Let the given prime numbers be a, b, c and d. Then, abc = 385 and bcd = 1001

$\therefore \frac{abc}{bcd} = \frac{385}{1001} \Rightarrow \frac{a}{d} = \frac{5}{13}$. So. a = 5, d = 13

6. The ratio between the speeds of two trains is 7 : 10. If the second train runs 400 kms in 4 hours then the speed of first train is (in km/hr)

Ans 70

If the speeds 7x, 10x

$10x = \frac{400}{4} \Rightarrow x = 10$

7. If $\sqrt{1369} + \sqrt{0.0615 + x} = 37.25$ and $x = \frac{1}{10^y}$, then the value of y is

Ans 3

$37 + \sqrt{0.0615 + x} = 37.25$

$\sqrt{0.0615 + x} = 0.25$

$0.0615 + x = 0.0625$

$x = 0.001 = \frac{1}{10^3}$

8. A, B and C enter into a partnership and their investments in the ratio $\frac{1}{2} : \frac{1}{3} : \frac{1}{4}$. After 2 months, A withdraws half of his capital and after 10 months, a profit of Rs.378 is divided among them. The share of B is

Ans 144

Ratio of their investments = 6 : 4 : 3

Let be 6x, 4x, 3x

A : B : C = (6x × 2 + 3x × 10) : (4x × 12) : (3x × 12) = 7 : 8 : 6

B's share $= \frac{8}{21} \times 378 = 144$.

9. If a + b + c = 13, $a^2 + b^2 + c^2 = 69$. Then the value of ab + bc + ca is

Ans 50

$a^2 + b^2 + c^2 + 2(ab + bc + ca) = 169$

$ab + bc + ca = \frac{169 - 69}{2} = 50$

10. If the sum of two numbers is 42 and their product is 437, then the absolute difference between the numbers is

Ans 4

Let the numbers be x, y

x + y = 42, xy = 437

$|x - y| = \sqrt{(x + y)^2 - 4xy} = \sqrt{16} = 4$

11. The mean proportional between 234 and 104 is

Ans 156

$\text{Mean} = \sqrt{234 \times 104} = 156$

12. 270 candidates appeared for an examination, of which 252 passed. The pass percentage is $x\frac{y}{z}$, then the value of x – y – z is

Ans 89

$\text{Pass}\% = \frac{252}{270} \times 100 = 93\frac{1}{3}\%$

13. If $1^2 + 2^2 + 3^2 + \ldots + 10^2 = 385$, then the value of $\frac{1}{2}(2^2 + 4^2 + 6^2 + \ldots + 20^2)$ is

Ans 770

$\frac{1}{2}2^2(1^2 + 2^2 + \ldots + 10^2) = 2 \times 385 = 770$

14. A can finish the work in 18 days and B can do the same work in 15 days. B alone worked for 10 days and left the job. If A alone has to finish the remaining work the numbers of days it takes is

Ans 6

$\text{B's 10 days work} = \frac{1}{15} \times 10 = \frac{2}{3}$

$\text{Remaining work} = 1 - \frac{2}{3} = \frac{1}{3}$

$\text{A's 1 day work} = \frac{1}{18}$

$\text{A's } \frac{1}{3}\text{days work} = 18 \times \frac{1}{3} = 6 \text{ days}$

15. If $\frac{a}{3} = \frac{b}{4} = \frac{c}{7}$, then the value of $\frac{a+b+c}{c}$ is

Ans 2

$\frac{a}{3} = \frac{b}{4} = \frac{c}{7} = k \Rightarrow a = 3k, b = 4k, c = 7k$

$\frac{a+b+c}{c} = \frac{14k}{7k} = 2$

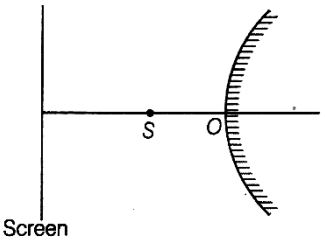
PHYSICS

PART - A

Multiple choice questions with one correct alternative

16. A point source of light is placed 10 cm before a convex mirror of total length is 10 cm and aperture 1 mm. A screen is at 10 cm from the source. Find the length of field of view of image of point source S on the screen.

(A) 1 mm
(B) 0.5 mm
(C) 5 mm
(D) 10 mm



Ans (C)

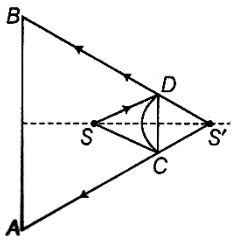
If S′ is image of point source S

$\because$ u = –10 cm, f = 10 cm

$\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$

or $\frac{1}{v}-\frac{1}{10}=\frac{1}{10}$

or $\frac{1}{v}=\frac{1}{10}+\frac{1}{10}=\frac{1}{5}$ $\quad\therefore$ v = 5 cm

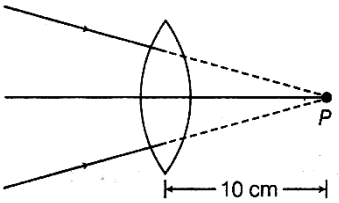


S′CD and S′AB are similar triangles

$\therefore\ \frac{AB}{25\,cm}=\frac{CD}{5\,cm}=\frac{1\,mm}{5\,cm}$

$\therefore\ AB=(1\,mm)\frac{25\,cm}{5\,cm}=5\,mm$

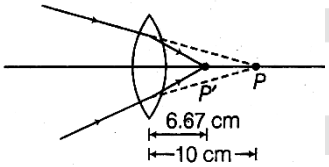
17. A converging beam of light converges at point P. A thin convex lens of focal length 20 cm is placed 10 cm before converging point. Find the position of new converging point from the lens.



(A) 6.67 cm right (B) 6.67 cm left (C) 10 cm left (D) 10 cm right

Ans (A)

Here, u = +10 cm, f = +20 cm



or $\frac{1}{v}-\frac{1}{10}=\frac{1}{20}\Rightarrow\frac{1}{v}=\frac{1}{10}+\frac{1}{20}=\frac{2+1}{20}\ \therefore\ v=\frac{20}{3}cm=6.67\,cm$

18. An object 2.4 m infront of a lens forms a sharp image on a film 12 cm behind the lens. A glass plate 1 cm thick of refractive index 1.50 is interposed between lens and film with its plane faces parallel to film. At what distance from lens should object shifted to be in sharp focus on film?

(A) 7.2 m (B) 2.4 m (C) 3.2 m (D) 5.6 m

Ans (D)

Shift image position due to glass plate, $S=\left(1-\frac{1}{\mu}\right)t=\left(1-\frac{1}{1.5}\right)\times1\,cm=\frac{1}{3}cm$

For the focal length of the lens, $\frac{1}{f}=\frac{1}{v}-\frac{1}{u}=\frac{1}{12}-\frac{1}{-240}$

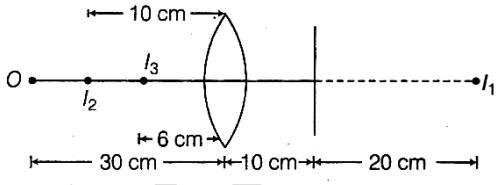
$\frac{1}{f}=\frac{20+1}{240}\Rightarrow f=\frac{240}{21}cm$

Now, get back image on the film, lens has to form image at $\left(12-\frac{1}{3}\right)\text{cm}=\frac{35}{3}\text{cm}$ such that the glass plate will shift the image on the film.

As, $\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$

$\frac{1}{u}=\frac{1}{v}-\frac{1}{f}=\frac{3}{35}-\frac{21}{340}=\frac{48\times3-7\times21}{1680}=-\frac{1}{560} \Rightarrow u = -5.6$ m.

19. A biconvex lens of focal length 15 cm is infront of a plane mirror. The distance between the lens and the mirror is 10 cm. A small object is kept at a distance of 30 cm from the lens. The final image is
(A) virtual and at a distance of 16 cm from the mirror
(B) real and at a distance of 16 cm from the mirror
(C) virtual and at a distance of 20 cm from the mirror
(D) real and at a distance of 20 cm from the mirror
Ans (B)
Object is placed at distance2f from the lens. So first image I_2 will be formed at distance 2f on other side. This image will behave like a virtual object for mirror. The second image I_2 will be formed at distance 20 cm in front of the mirror or, at distance 10 cm to the left hand side of the lens.

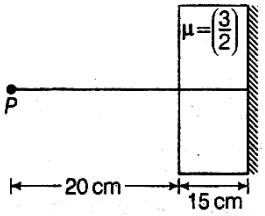


Now, applying lens formula
$\frac{1}{v}-\frac{1}{u}=\frac{1}{f} \quad \therefore \frac{1}{v}-\frac{1}{+10}=\frac{1}{+15}$ or v = 6 cm
Therefore, the final image is at distance 16 cm from the mirror. But this image will be real.
This is because ray of light is travelling from right to left.

20. Two pith balls having charge 3q and 2q are placed at distance of a from each other. For what value of charge transferred from 1st ball to 2nd ball, force between balls becomes maximum?
(A) $\frac{q}{2}$ (B) $\frac{5q}{2}$ (C) 7 q (D) q
Ans (A)

21. A proton (singly ionized hydrogen) and a deutron (singly ionized deuterium), initially at rest are accelerated with same uniform electric field for time *t*.
(A) Both particles will have same momentum (B) Both particles will have same K.E.
(C) Both particles will have same speed (D) Both particles will cover same distance
Ans (A)

22. Find the position of image of point object P from silvered surface.

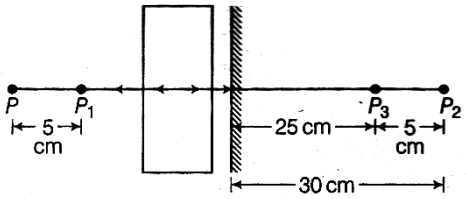


(A) 25 cm behind the silvered surface (B) 30 cm behind the silvered surface

(C) 20 cm behind the silvered surface (D) none of (A), (B) & (C)

Ans (A)

Object shiftness $= t\left(1-\frac{1}{\mu}\right)=15\left(1-\frac{1}{\frac{3}{2}}\right)=5\,\text{cm}$



The image formation due to first refraction through slab is P_1. The image P_1 behaves as object for plane mirror. The image P_1 formed by plane mirror is P_2. The image P_2 behaves as object for second times refraction through the slab. The image due to second times refraction through slab is P_3.

23. A young boy has accommodation of his eye such that the power of his eye-lens can change between 50 D and 60 D. His far point is, infinity. The distance of his retina from the eye-lens and his near point are respectively (in cm)

(A) 2, 10 (B) 2.5, 12 (C) 3, 15 (D) 3.5, 12

Ans (A)

When an eye is fully relaxed, its focal length is largest and the power of the eye-lens is minimum. This power is 50 D according to the given data. The focal length is $(1/50)\text{m} = 2\,\text{cm}$. As the far point is at infinity, the parallel rays coming from infinity are focussed on the retina in the fully relaxed condition. Hence, the distance of the retina from the lens equals the focal length, which is 2 cm.

When the eye is focussed at the near point, the power is maximum, which is 60 D. The focal length in this case is $f = \frac{1}{60}\text{m} = \frac{5}{3}\text{cm}$. The image is formed on the retina. Thus v = 2 cm.

We have, $\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$ or $\frac{1}{u}=\frac{1}{\text{v}}-\frac{1}{f}=\frac{1}{2\,\text{cm}}-\frac{3}{5\,\text{cm}}$

Or, $u = -10$ cm

$\therefore$ The near point is at 10 cm.

24. The muscles of a normal are least strained when the eye is focused on an object

(A) at about 25 cm from the eye (B) far away from the eye

(C) very close to the eye (D) at about 1 m from the eye

Ans (B)

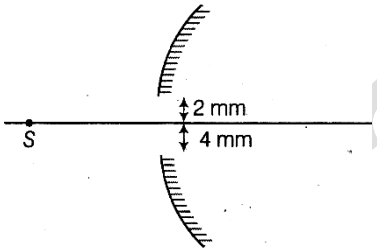
25. How will the image formed by a convex lens be affected if the central portion of the lens is wrapped in black paper as shown in the figure?

(A) No image will be formed.
(B) Full image will be formed but it is less bright.
(C) Full image will be formed but without the central portion
(D) Two images will be formed; one due to each exposed half.
Ans (B)

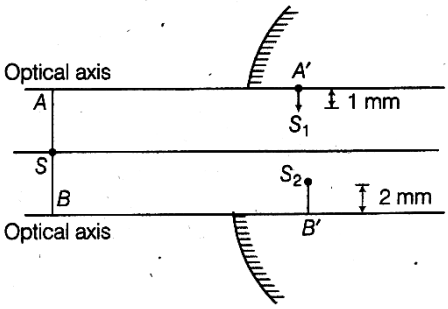
PART B

Numerical problems

26. A convex mirror of focal length 10 cm is cut into two halves and placed before an object at a distance of 10 cm as shown in the figure. The separation between images formed by two halves is _____ mm.



Ans 3
Here, u = –10 cm, f = +10 cm

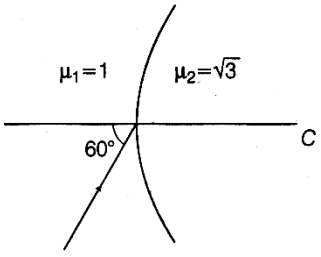


$\because \frac{1}{v}+\frac{1}{u}=\frac{1}{f}$ or $\frac{1}{v}-\frac{1}{10}=\frac{1}{10}$ $\therefore$ v = 5 cm

$\therefore m=-\frac{v}{u}=\frac{1}{2}$

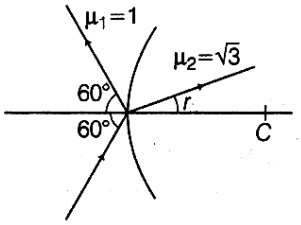
$\therefore S_1S_2 = 6 - 3 = 3$ mm

27. A ray indent on the spherical surface separating two media of refractive indices 1 and $\sqrt{3}$ respectively. C is the center of curvature of the curved surface. Find the angle between reflected and refracted ray (in °) through the spherical surface.



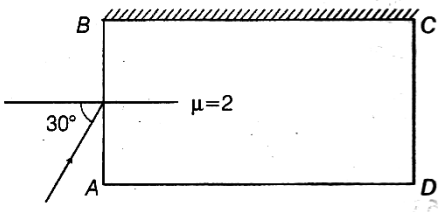
Ans 90

$1\times\sin 60° = \sqrt{3}\sin r$ or $\frac{\sqrt{3}}{2} = \sqrt{3}\sin r$ or $\sin r = \frac{1}{2} \Rightarrow r = 30°$



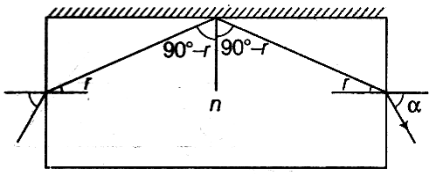
Thus, the angle between refracted and reflected ray is 90°.

28. In the given figure, surface BC of slab (of refractive index 2) is silvered. A ray of light incident on face AB and emerges out from face CD. Find the angle of emergence (in °).



Ans 30

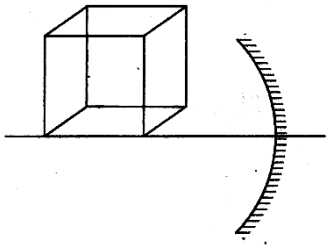
$1 \times \sin 30° = \mu \sin r$



$\therefore \sin r = \frac{\sin 30°}{\mu}$

From figure, $\mu \sin r = 1 \times \sin \alpha \therefore \alpha = 30°$

29. A cube of side length 1 mm is placed at distance 30 cm from the pole of a concave mirror of focal length 20 cm. Its one side is parallel optical axis as shown in the figure.



Find the magnification in the volume of cube.

Ans 16

Here, u = –30 cm, f = –20 cm

$\because \frac{1}{v}+\frac{1}{u}=\frac{1}{f} \Rightarrow \frac{1}{v}-\frac{1}{30}=-\frac{1}{20} \Rightarrow \frac{1}{v}=\frac{1}{30}-\frac{1}{20}=\frac{2-3}{60}$

$\therefore$ v = –60 cm

$\therefore$ Transverse magnification is $m = \frac{-v}{u} = -2$

and longitudinal magnification is $m_1 = \frac{-v^2}{u^2} = -u$

The magnification in sides parallel to optical axis is m_1 and the magnification in sides perpendicular to optical axis is m.

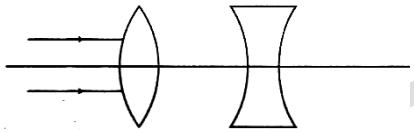
$\therefore \frac{l'}{l} = \frac{-v^2}{u^2} \quad \therefore l' = -4l = -4$ mm and $\frac{b'}{b} = m = -2$

$b' = -2 \times 1 = -2$ mm

$\therefore$ Volume of image = $l' \times b' \times h' = 4 \times (2)\,(2) = 16$ mm^3

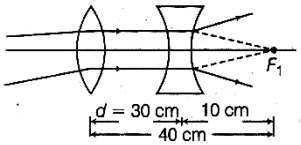
Thus, the magnification in the volume is 16.

30. A parallel beam of light is incident on the system of two lenses of focal length f_1 = 40 cm and f_2 = –10 cm. What should be the distance between the two lenses (in cm), so that rays after refraction from both lenses pass undeviated?



Ans 30

From figure, it is clear that, F_1 should be common focus,



$\therefore$ Separation between lenses = d = 40 – 10 = 30 cm

CHEMISTRY

PART A

Multiple choice questions with one correct alternative

31. In the Rutherford's experiment, helium nuclei (α-particles) were made to impinge on gold foil, and were found to be scattered. Rutherford's experiment on scattering of α-particles showed for the first time that the atom has

(A) electrons (B) protons (C) neutrons (D) nucleus

Ans (D)

32. An exothermic reaction means

(A) product will have less energy (B) reactant will have less energy

(C) reactant will have more energy (D) both (A) and (C)

Ans (D)

33. HCl cannot act as an acid

(A) in water (B) in liquid ammonia (C) in alcohol (D) in benzene

Ans (D)

34. Which of the following is the best scientific method to test presence of water in a liquid?

(A) taste (B) smell

(C) use of litmus paper (D) use of anhydrous copper sulphate

Ans (D)

Anhydrous $CuSO_4$ turns blue in presence of water.

$$\underset{\text{White}}{CuSO_4} + 5H_2O \rightarrow \underset{\text{Blue}}{CuSO_4 \cdot 5H_2O}$$

35. Covalent compounds have low melting points because:
(A) covalent bond is less exothermic
(B) covalent molecules are held by weak van der Waals' forces of attraction
(C) covalent molecules have definite shapes
(D) covalent bond is weaker than ionic bond
Ans (B)

36. The number of oxygen atoms in 0.2 mol of $Na_2CO_3 \cdot 10H_2O$ is
(A) 6.022×10^{24} (B) 1.56×10^{24} (C) 13 (D) 1.2×10^{25}
Ans (B)
1 mole of $Na_2CO_3.10H_2O$ contain $13 \times 6.022 \times 10^{23}$ atoms of oxygen
$\therefore$ 0.2 mol will have $13 \times 0.2 \times 6.022 \times 10^{23}$ atoms = 1.56×10^{24} atoms

37. A 8.4 g of sodium bicarbonate $NaHCO_3$ on reaction with 20.0 g of acetic acid (CH_3COOH) liberated 4.4 g of CO_2 into atmosphere and leaves 24 g of residue. This proves the
(A) law of conservation of mass (B) law of constant proportion
(C) law of multiple proportion (D) law of reciprocal proportion
Ans (A)

38. From equation, $N_2 + 3H_2 \rightarrow 2NH_3$ volume of ammonia gas formed when 8 L of hydrogen reacts with excess of nitrogen is (all volumes are measured at STP)
(A) 4.6 L (B) 5.33 L (C) 8 L (D) 24 L
Ans (B)
$N_2 + 3H_2 \rightarrow 2NH_3$
1 3 2
3 L of hydrogen gives 2 L of NH_3
8 L gives 5.33 L

39. The following table shows the electronic configuration of the elements W, X, Y, Z

Element	W	X	Y	Z
Electronic Configuration	2, 8, 1	2, 8, 7	2, 5	1

What type of bond is formed between Y & Z?
(A) Covalent (B) Ionic (C) Coordinate (D) none of (A), (B) & (C)
Ans (A)

40. An element form an oxide A_2O_3. What will be the formula of chloride of A?
(A) ACl_2 (B) ACl (C) A_2Cl_3 (D) ACl_3
Ans (D)

PART B

Numerical problems

41. Consider the following combustion reaction
$aC_7H_6O_2 + bO_2 \rightarrow cCO_2 + dH_2O$
Find the Sum of all the coefficients
Ans 37
$2C_7H_6O_2 + 15O_2 \rightarrow 14CO_2 + 6H_2O$

42. Number of water molecules appearing in the balanced equation of '$Fe + H_2O \rightarrow Fe_3O_4 + H_2$' is
Ans 4
$3Fe(s) + 4H_2O(g) \rightarrow Fe_3O_4(s) + 4H_2(g)$

43. Two elements P and Q combine to form a compound. If P has 2 and Q has 6 electrons in their outermost shell, the atomicity of the compound is
Ans 2
Valence electrons in P is 2, valence electrons in Q is 6.
$P - 2\bar{e} \rightarrow P^{2+}$ and $Q + 2\bar{e} \rightarrow Q^{2-}$

44. The number of g-atom of oxygen in 6.02×10^{24} CO molecules is
Ans 10
6.02×10^{23} molecules of CO = 1 mole of CO
$\therefore$ 6.02×10^{24} molecules of CO = 10 moles of CO
1 mole of CO contains 1 g atom of oxygen
$\therefore$ 10 moles of CO = 10 g atom of oxygen

45. Calculate the number of atoms in 52 u of He
Ans 13

MATHEMATICS

PART A

Multiple choice questions with one correct alternative

46. Find the value of 'a' for which one root of the quadratic equation $(a^2 - 5a + 3)x^2 + (3a - 1)x + 2 = 0$ is twice as large as the other

(A) $\frac{3}{2}$ (B) $\frac{2}{3}$ (C) $\frac{3}{5}$ (D) $\frac{5}{3}$

Ans (B)
Let the roots be α and 2α, then

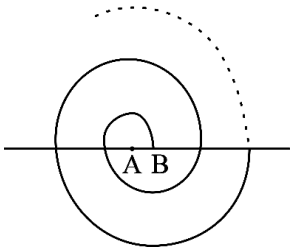
$$\alpha + 2\alpha = \frac{1-3a}{a^2-5a+3} \text{ and } \alpha(2\alpha) = \frac{2}{a^2-5a+3}$$

$$\Rightarrow 2\left[\frac{1}{9}\left(\frac{1-3a}{(a^2-5a+3)}\right)^2\right] = \frac{2}{a^2-5a+3}$$

$$\Rightarrow \frac{(1-3a)^2}{a^2-5a+3} = 9$$

$$\Rightarrow 9a^2 - 6a + 1 = 9a^2 - 45a + 27 \Rightarrow 39a = 26 \Rightarrow a = \frac{2}{3}$$

47. A spiral is made up of successive semicircles with centres alternately at A and B starting with centre at A, of radii 0.5 cm, 1 cm, 1·5 cm, 2 cm … and so on as shown in the figure. What is the total length of such a spiral made up of thirteen consecutive semicircles? (take $\left(\pi = \frac{22}{7}\right)$)



(A) 147 cm (B) 145 cm (C) 143 cm (D) 141 cm

Ans (C)

Length of a semi-circle $= \frac{2\pi r}{2} = \pi r$

Length of semi circle of radii 1 cm = $\pi(1)$

Length of semi –circle of radii 1.5 cm = $\pi(1.5)$

And so on…

π (0·5), π(1·0), π(1·5), π(2·0) … upto 13 term

For the total length of the spiral we need to find sum of the 13 terms

Total length = $0.5\pi + \pi + 1.5\pi + 2\pi$ + … upto 13 terms

$= \pi(0.5 + 1 + 1.5 + 2 + \ldots + \text{upto 13 terms})$

$= \pi\left[\frac{13}{2}\{2(0.5) + (13-1)(0.5)\}\right]$

$= \frac{22}{7} \times 7 \times \frac{13}{2}$

= 143 cm

48. If $\frac{\sin^4\theta}{a} + \frac{\cos^4\theta}{b} = \frac{1}{a+b}$, then value of $\frac{\sin^8\theta}{a^3} + \frac{\cos^8\theta}{b^3}$ is

(A) $\frac{1}{(a+b)^2}$ (B) $\frac{1}{(a+b)^3}$ (C) $\frac{1}{(a+b)^4}$ (D) $\frac{1}{(a+b)^5}$

Ans (B)

Let $\sin^2\theta = x$ then $\sin^4\theta = x^2$ and $\cos^4\theta = (\cos^2\theta)^2 = (1 - \sin^2\theta) = (1 - x)^2$

$\Rightarrow \frac{x^2}{a} + \frac{(1-x)^2}{b} = \frac{1}{a+b} \Rightarrow bx^2 + ax^2 + a - 2ax = \frac{ab}{a+b}$

$\Rightarrow (a + b)\, x^2 - 2ax + a = \frac{ab}{a+b}$

$\Rightarrow (a + b)^2\, x^2 - 2a(a + b)\, x + a^2 + ab = ab$

$\Rightarrow (a + b)^2\, x^2 - 2a\,(a + b)\, x + a^2 = 0$

$\Rightarrow [(a + b)x - a]^2 = 0 \Rightarrow x = \frac{a}{a+b}$

$\Rightarrow \sin^2\theta = \frac{a}{a+b}$ and $\cos^2\theta = \frac{b}{a+b}$

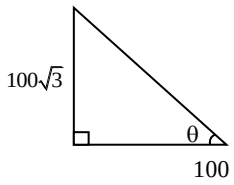
Now, $\dfrac{\left(\dfrac{a}{a+b}\right)^4}{a^3}+\dfrac{\left(\dfrac{b}{a+b}\right)^4}{b^3}=\dfrac{a}{(a+b)^4}+\dfrac{b}{(a+b)^4}=\dfrac{1}{(a+b)^3}$

49. The height of a tower is $100\sqrt{3}$ m . The angle of elevation of its top from a point 100 m away from its foot is

(A) 30° (B) 45° (C) 60° (D) 75°

Ans (C)

$\tan\theta=\dfrac{100\sqrt{3}}{100} \Rightarrow \theta = 60°$



50. The quadratic equation whose one root is $(3+2\sqrt{3})$ is

(A) $x^2 + 6x - 3 = 0$ (B) $x^2 - 6x - 3 = 0$ (C) $x^2 + 6x + 3 = 0$ (D) $x^2 - 6x + 3 = 0$

Ans (B)

One root $= 3+2\sqrt{3}$ and Other root $= 3-2\sqrt{3}$

Quadratic equation is $x^2-(3+2\sqrt{3}+3-2\sqrt{3})x+(3+2\sqrt{3})(3-2\sqrt{3})=0$

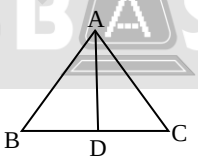
$x^2 - 6x - 3 = 0$

51. If A(–2, 4), B(0, 0), C(4, 2) are vertices of ΔABC. Then the length of median through vertex A is

(A) 5 units (B) 6 units (C) 7 units (D) 9 units

Ans (A)

D = (2, 1) $\Rightarrow$ AD $=\sqrt{(2+2)^2+(1-4)^2}=\sqrt{4^2+3^2}=5$



52. If HCF of 65 and 117 is of the form 65m – 117, then the value of m is

(A) 1 (B) 2 (C) 3 (D) 4

Ans (B)

HCF of 65, 117 = 13

65m – 117 = 13

m = 2

53. $3\cos^2 60° + 2\cot^2 30° - 5\sin^2 45° =$

(A) $\dfrac{13}{6}$ (B) $\dfrac{17}{4}$ (C) 1 (D) 4

Ans (B)

54. Let a, b and c be distinct numbers.

The quadratic equation $\frac{(x-a)(x-b)}{(c-a)(c-b)}+\frac{(x-b)(x-c)}{(a-b)(a-c)}+\frac{(x-c)(x-a)}{(b-c)(b-a)}=1$ has

(A) one root (B) two real and distinct roots

(C) infinite roots (D) no real root

Ans (C)

x = a, x = b, x = c are the solutions.

Hence, the given equation is an identity and has infinite roots.

55. The value of x which satisfies the equation $2017=\sqrt{x+\sqrt{x+\sqrt{x+...}}}$ is

(A) 4,064,255 (B) 4,068,289 (C) 4,066,272 (D) 4,062,240

Ans (C)

$2017=\sqrt{x+2017}$

$\Rightarrow (2017)^2-2017=x$

$\Rightarrow (2017)(2016)=x$

PART B

Numerical problems

56. If $\sqrt{\sqrt{\sqrt{x}}}=\sqrt[4]{\sqrt[4]{\sqrt[4]{3x^4+4}}}$, then the value of x^4 is

Ans 4

$x^{\frac{1}{8}}=(3x^4+4)^{\frac{1}{64}} \Rightarrow x^8 = 3x^4 + 4 \therefore x^4 = 4$

57. The number of terms of an A.P. is even ; the sum of the odd terms is 24, and of the even terms is 30, and the last term exceeds the first by $\frac{21}{2}$, then the number of terms in the series is

Ans 8

Let the series have 2n terms and the series be a, a + d, a + 2d … a + (2n – 1)d

According to the given condition, we have

$[a + (a + 2d) + (a + 4d) + \ldots + \{a + (2n - 2)d\}] = 24$

$\Rightarrow \frac{n}{2}[2a+(n-1)2d]=24$

$\Rightarrow n[a + (n - 1) d] = 24$ … (1)

Also, $[(a + d) + (a + 3d) + \ldots + (a + (2n - 1) d] = 30$

$\Rightarrow \frac{n}{2}[2(a+d)+(n-1)2d]=30$

$\Rightarrow n[(a + d) + (n - 1)d] = 30$ … (2)

Also the last term exceeds the first by $\frac{21}{2}$

$\therefore a+(2n-1)d-a=\frac{21}{2}$

$\Rightarrow (2n-1)d=\frac{21}{2}$ … (3)

Now, subtracting (1) from (2)

nd = 6 … (4)

Dividing (3) by (4), we get $\frac{2n-1}{n}=\frac{21}{12} \Rightarrow n = 4$

So, total number of terms = 2n = 8

58. The polynomials $P(x) = Kx^3 + 3x^2 - 3$ and $Q(x) = 2x^3 - 5x + K$, when divided by $(x - 4)$ leave the same remainder, then the value of K is

Ans 1

$P(4) = Q(4)$

$\Rightarrow 64K + 48 - 3 = 128 - 20 + K$

$\Rightarrow 64K + 45 = K + 108$

$\Rightarrow 63K = 63 \Rightarrow K = 1$

59. If $\tan\theta + \cot\theta = 6$, then the value of $\tan^2\theta + \cot^2\theta$ is

Ans 34

$\tan^2\theta + \cot^2\theta + 2 = 36$

60. The positive value of k for which the equality $x^2 + kx + 64 = 0$ and $x^2 - 8x + k = 0$ which have real roots is

Ans 16

Let D_1 and D_2 be discriminants

$D_1 \geq 0, D_2 \geq 0$

$k^2 - 4 \times 64 \geq 0, 64 - 4k \geq 0$

$k \geq 16, k \leq 16 \therefore k = 16$

BIOLOGY

PART A

Multiple choice questions with one correct alternative

61. In the garden pea plant, allele **T** is dominant over allele **t**. Which of the following crosses will produce tall and dwarf offspring plants in equal ratio?

(A) TT × tt (B) Tt × tt (C) TT × Tt (D) tt × tt

Ans (B)

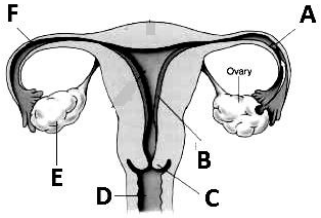
62. Sclerenchyma cells are dead at maturity. Sieve tubes and human erythrocytes are living cells but do not possess nuclei. Which of these cells will not be able to divide?

(A) Both the plant cells (B) All the above cells

(C) Human RBC (D) The dead cells from the above list

Ans (B)

63. Which of these choices shows the correct interpretation of the parts of the human female reproductive system?



(A) F-undergoes tubectomy

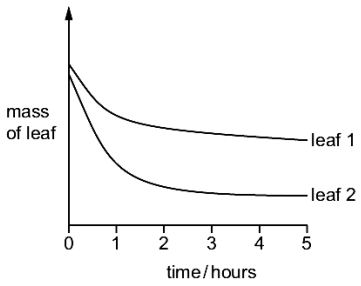
(B) B-gets regenerated by thyroxine

(C) D-is blocked by Copper T

(D) E-produces the female gametes

Ans (B)

64. The image shows the results of an experiment done on two leaves with the same surface area from two different species. The leaves were weighed and left in daylight for a few hours. They were weighed again to find the amount of water lost through transpiration. Based on the image, pick the most appropriate answer



(A) Leaf 1 has lesser cuticle than 2
(B) Leaf 1 has more stomata than 2
(C) Leaf 2 is of a shorter plant
(D) Leaf 2 has more stomata and lesser cuticle than 1
Ans (D)

65. **Statement 1:** Cones of the human retina are responsible for daylight vision.
Statement 2: Cones of the human retina are responsible for colour vision.
(A) Only Statement 1 is true
(B) Both statements are true
(C) Only statement 2 is true
(D) Both statements are false
Ans (B)

66. Which equation is correct to prove that O_2 comes from water during photosynthesis?
(A) $6O_2^{18} + 12H_2O \longrightarrow 6O_2^{18} + C_6H_{12}O_6 + 6H_2O$
(B) $6CO_2 + 12H_2O^{18} \longrightarrow 6O_2 + C_6H_{12}O_6 + 6H_2O^{18}$
(C) $6O_2^{18} + 12H_2O \longrightarrow 6O_2^{18} + C_6H_{12}O_6$
(D) $6CO_2 + 12H_2O^{18} \longrightarrow 6O_2^{18} + C_6H_{12}O_6 + 6H_2O$
Ans (D)

67. **Assertion:** CFCs cause damage to the ozone layer.
Reason: Ozone layer protects the earth's surface from UV radiations.
(A) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(B) Both Assertion and Reason are correct and Reason is not the correct explanation of Assertion.
(C) Assertion is true and Reason is false.
(D) Assertion is false and Reason is true
Ans (B)

68. Identify the correct statements with regard to Golgi complex from the following
(i) The organelles involved in storage and modification of products
(ii) The synthesis of proteins
(iii) Formation of complex sugars from simple sugars
(iv) Packaging of products
(v) The membranes are connected with membranes of Mitochondria
(A) (i) and (ii) are correct
(B) (ii) and (iii) are correct
(C) (i), (iii) and (iv) are correct
(D) (i) and (v) are correct
Ans (C)

69. **Statement -I:** The process of pairing of any two chromosomes is called synapsis.
Statement -II: Synapsis is seen in meiosis after pachytene.
(A) Statement-I and Statement-II are true and Statement-II is the correct explanation of Statement-I.
(B) Statement-I and Statement-II are true, but Statement-II is not the correct explanation of Statement –I
(C) Statement-I is true, but Statement-II is false
(D) Both Statement-I and II are false
Ans (D)

70. In a self pollinated plant, what would be the minimum number of meiotic divisions to form 200 seeds.
(A) 200 (B) 250 (C) 100 (D) 50
Ans (B)

71. The number of chromosomes in the shoot tip cells of a maize plant is 20, the number of chromosomes in the pollen and zygote of the same plant respectively is
(A) 40, 20 (B) 20, 40 (C) 20, 10 (D) 10, 20
Ans (D)

72. Which of the following are simple, living tissues seen in plants?
I. Parenchyma
II. Collenchyma
III. Sclerenchyma
IV. Xylem
V. Cartilage
VI. Phloem
(A) I and II (B) II and III (C) I, II and III (D) I, II, III and VI
Ans (A)

PART B

Read the passage given below and answer questions 73 to 75 by choosing the correct alternative

Ants are insects whose social life is highly structured, comparable only to that of honey bees or termites. Ants are called social insects because they live in colonies and establish complex communities. They are normally constituted of three castes: the queen, the drones and the workers. Each caste has its own distinct morphology and carries out particular activities within the society. Colony living offers various advantages, one of the most essential being improved safety for the entire group. Generally, each ant colony has only one queen. She spends her life laying eggs. There are also female worker ants that do not breed but instead carry out a range of different tasks: searching for food, caring for the queen and her offspring, building galleries, maintaining the nest and protecting the anthill. The main role that drones perform is to fertilise queens, and they are only present inside the colony for limited periods of time.

73. Which of the following roles are not performed by worker ants?
(A) Finding and obtaining food
(B) Taking care of the queen and the young larvae
(C) Protecting the anthill
(D) Laying eggs in specific chambers of the anthill

Ans (D)

74. One of the following statements is incorrect about social ants. Identify the same.
(A) The morphology and functions of the three castes of social ants is different.
(B) Drones have the longest life of all ants and protect the colony from ant-eating animals
(C) Worker ants are females.
(D) Generally, an ant colony has a single queen.
Ans (B)

75. To insects like honeybees and ants, which of these is an advantage of living in groups called colonies in comparison to living alone?
(A) Colony life gives higher safety to the members
(B) All functions can be done by all members of the colony
(C) The members do not have to search for food and instead can feed on one other
(D) The colony looks big and impressive in a forest or grassland.
Ans (A)

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