

MATHEMATICS

- If $f: \mathbb{R} \rightarrow \mathbb{R}$ and $g: \mathbb{R} \rightarrow \mathbb{R}$ are defined by $f(x) = |x|$ and $g(x) = [x - 3]$ for $x \in \mathbb{R}$, then $g \circ f: -\frac{8}{5} < x < \frac{8}{5}$ is equal to
 (a) $\{0, 1\}$ (b) $\{1, 2\}$
 (c) $\{-3, -2\}$ (d) $\{2, 3\}$
- For any integer $n \geq 1$, the sum $\sum_{k=1}^n k(k+2)$ is equal to
 (a) $\frac{n(n+1)(n+2)}{6}$ (b) $\frac{n(n+1)(2n+1)}{6}$
 (c) $\frac{n(n+1)(2n+7)}{6}$ (d) $\frac{n(n+1)(2n+9)}{6}$
- 9 balls are to be placed in 9 boxes and 5 of the balls cannot fit into 3 small boxes. The number of ways of arranging one ball in each of the boxes is
 (a) 18720 (b) 18270
 (c) 17280 (d) 12780
- If ${}^n P_r = 30240$ and ${}^n C_r = 252$, then the ordered pair (n, r) is equal to
 (a) (12, 6) (b) (10, 5)
 (c) (9, 4) (d) (16, 7)
- If $(1 + x + x^2 + x^3)^5 = \sum_{k=0}^{15} a_k x^k$ then $\sum_{k=0}^7 a_{2k}$ is equal to
 (a) 128 (b) 256
 (c) 512 (d) 1024
- If $a + P = -2$ and $a^3 + \beta^3 = -56$, then the quadratic equation whose roots are a and β is
 (a) $x^2 + 2x - 16 = 0$ (b) $x^2 + 2x + 15 = 0$
 (c) $x^2 + 2x - 12 = 0$ (d) $x^2 + 2x - 8 = 0$
- The cubic equation whose roots are thrice to each of the roots of $x^3 + 2x^2 - 4x + 1 = 0$ is
 (a) $x^3 - 6x^2 + 36x + 27 = 0$
 (b) $x^3 + 6x^2 + 36x + 27 = 0$
 (c) $x^3 - 6x^2 - 36x + 27 = 0$
 (d) $x^3 + 6x^2 - 36x + 27 = 0$
- If $A = \frac{1}{4} \begin{pmatrix} -2 & 0 \\ 0 & 1 \end{pmatrix}$ and $f(t) = t^2 - 3t + 7$, then $f(A) + \frac{3}{-12} \begin{pmatrix} 6 & 0 \\ 0 & 0 \end{pmatrix}$ is equal to
 (a) $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ (b) $\begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$
 (c) $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ (d) $\begin{pmatrix} 1 & 1 \\ 0 & 0 \end{pmatrix}$
- | | | |
|-------------|-------------|-------------|
| $a - b - c$ | $2a$ | $2a$ |
| $2b$ | $b - c - a$ | $2b$ |
| $2c$ | $2c$ | $c - a - b$ |

is equal to

 (a) 0 (b) $a + b + c$
 (c) $(a + b + c)^2$ (d) $(a + b + c)^3$
- If ω is a complex cube root of unity, then $\sin \omega^{10} + \omega^{23} \pi - \frac{\pi}{4}$ is equal to
 (a) $\frac{1}{2}$ (b) $\frac{1}{2}$
 (c) 1 (d) $\frac{3}{2}$

11. $3\operatorname{cosec} 20^\circ - \sec 20^\circ$ is equal to

- (a) 2
(b) $2\sin 20^\circ - \operatorname{cosec} 40^\circ$
(c) 4
(d) $4\sin 20^\circ, \operatorname{cosec} 40^\circ$

12. If $\tan \theta + \tan\left(\theta + \frac{\pi}{3}\right) + \tan\left(\theta + \frac{2\pi}{3}\right) = 3$, then which of the following is equal to 1 ?

- (a) $\tan 2\theta$ (b) $\tan 3\theta$
(c) $\tan^2 \theta$ (d) $\tan^3 \theta$

13. $\{x \in \mathbb{R} : \cos 2x + 2\cos^2 x = 2\}$ is equal to

- (a) $2n\pi + \frac{\pi}{3} : n \in \mathbb{Z}$ (b) $n\pi \pm \frac{\pi}{6} : n \in \mathbb{Z}$
(c) $n\pi + \frac{\pi}{3} : n \in \mathbb{Z}$ (d) $2n\pi - \frac{\pi}{3} : n \in \mathbb{Z}$

14. If $\sin^{-1} \frac{3}{x} + \sin^{-1} \frac{4}{x} = \frac{\pi}{2}$, then x is equal to

- (a) 3 (b) 5
(c) 7 (d) 11

15. In $\triangle ABC$, if $\frac{1}{b+c} + \frac{1}{c+a} = \frac{3}{a+b+c}$, then C is equal to

- (a) 90° (b) 60°
(c) 45° (d) 30°

16. In a triangle, if $r_1 = 2r_2 = 3r_3$, then $\frac{a}{b} + \frac{b}{c} + \frac{c}{a}$ is equal to

- (a) $\frac{75}{60}$ (b) $\frac{155}{60}$
(c) $\frac{176}{60}$ (d) $\frac{191}{60}$

17. From the top of a hill h metres high the angles of depressions of the top and the bottom of a pillar are α and β respectively. The height (in metres) of the pillar is

- (a) $\frac{h \tan \beta - \tan \alpha}{\tan \beta}$ (b) $\frac{h \tan \beta - \tan \alpha}{\tan \alpha}$
(c) $\frac{h \tan \beta + \tan \alpha}{\tan \beta}$ (d) $\frac{h \tan \beta + \tan \alpha}{\tan \alpha}$

18. The position vectors of P and Q are respectively a and b, If R is a point on PQ such that $PR = 5PQ$, then the position vector of R is

- (a) $5b - 4a$ (b) $5b + 4a$
(c) $4b - 5a$ (d) $4b + 5a$

19. If the position vectors of A, B and C are respectively $2\mathbf{i} - \mathbf{j} + \mathbf{k}$, $\mathbf{i} - 3\mathbf{j} - 5\mathbf{k}$ and $3\mathbf{i} - 4\mathbf{j} - 4\mathbf{k}$, then $\cos^2 A$ is equal to

- (a) 0 (b) $\frac{6}{41}$
(c) $\frac{35}{41}$ (d) 1

20. Let a be a unit vector, $\mathbf{b} = 2\mathbf{i} + \mathbf{j} - \mathbf{k}$ and $\mathbf{c} = \mathbf{i} + 3\mathbf{k}$. Then, maximum value of $[\mathbf{abc}]$ is

- (a) -1 (b) $\sqrt{10} + \sqrt{6}$
(c) $\sqrt{10} - \sqrt{6}$ (d) $\sqrt{59}$

21. If A and B are independent events of a random experiment such that $P(A \cap B) = \frac{1}{6}$ and $P(A \cap B) = \frac{1}{3}$, then $P(A)$ is equal to (Here, E is the complement of the event E)

- (a) $\frac{1}{4}$ (b) $\frac{1}{3}$
(c) $\frac{5}{7}$ (d) $\frac{2}{3}$

22. For $k = 1, 2, 3$ the box B_k contains k red balls and $(k + 1)$ white balls, Let $P(B_1) = \frac{1}{2}$, $P(B_2) = 1$ and $P(B_3) = \frac{1}{6}$. A box is selected at random and a ball is drawn from it. If a red ball is drawn, then the

probability that it has come from box B_2 , is

- (a) $\frac{35}{78}$ (b) $\frac{14}{39}$
(c) $\frac{10}{13}$ (d) $\frac{12}{13}$

23. If the sum of the distances of a point P from two perpendicular lines in a plane is 1, then the locus of P is a

- (a) rhombus (b) circle
(c) straight line (d) pair of straight lines-

24. The transformed equation of $3x^2 + 3y^2 + 2xy = 2$, when the coordinate axes are rotated through an angle of 45° , is

- (a) $x^2 + 2y^2 = 1$ (b) $2x^2 + y^2 = 1$
(c) $x^2 + y^2 = 1$ (d) $x^2 + 3y^2 = 1$

25. If l, m, n are in arithmetic progression, then the straight line $lx + my + n = 0$ will pass through the point

- (a) $(-1, 2)$ (b) $(1, -2)$
(c) $(1, 2)$ (d) $(2, 1)$

26. A pair of perpendicular straight lines passes through the origin and also through the point of intersection of the curve $x^2 + y^2 = 4$ with $x + y = a$. The set containing the value of ' a ' is

- (a) $\{-2, 2\}$ (b) $\{-3, 3\}$
(c) $\{-4, 4\}$ (d) $\{-5, 5\}$

27. In $\triangle ABC$ the mid points of the sides AB, BC and CA are respectively $(1, 0, 0), (0, m, 0)$ and $(0, 0, n)$. Then,

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$\frac{AB^2 + BC^2 + CA^2}{l^2 + m^2 + n^2}$ is equal to

- (a) 2 (b) 4
(c) 8 (d) 16

28. If the lines $2x - 3y = 5$ and $3x - 4y = 7$ are two diameters of a circle of radius 7, then the equation of the circle is

- (a) $x^2 + y^2 + 2x - 4y - 47 = 0$
(b) $x^2 + y^2 = 49$
(c) $x^2 + y^2 - 2x + 2y - 47 = 0$
(d) $x^2 + y^2 = 17$

29. The inverse of the point $(1, 2)$ with respect to the circle $x^2 + y^2 - 4x - 6y + 9 = 0$, is

- (a) $1, \frac{1}{2}$ (b) $(2, 1)$
(c) $(0, 1)$ (d) $(1/0)$

30. If $2x + 3y + 12 = 0$ and $x - y + 4\lambda = 0$ are conjugate with respect to the parabola $y^2 = 8x$, then λ is equal to

- (a) 2 (b) -2
(c) 3 (d) -3

31. The distance between the foci of the hyperbola $x^2 - 3y^2 - 4x - 6y - 11 = 0$ is

- (a) 4 (b) 6
(c) 8 (d) 10

32. The radius of the circle with the polar equation $r^2 - 8r(\sqrt{3}\cos\theta + \sin\theta) + 15 = 0$ is

- (a) 8 (b) 7
(c) 6 (d) 5

33. If $f: \mathbb{R} \rightarrow \mathbb{R}$ is defined by $f(x) = [x - 3] + |x - 4|$ for $x \in \mathbb{R}$, then $\lim_{x \rightarrow 3} fx$ is equal to

- (a) -2 (b) -1
(c) 0 (d) 1

34. If $f: \mathbb{R} \rightarrow \mathbb{R}$ is defined by

$$\frac{\cos 3x - \cos x}{x^2}$$

- λ for $x \neq 0$ and if f is continuous at $x = 0$, then λ is equal to
for $x = 0$
- (a) -2 (b) -4
(c) -6 (d) -8

35. If $f(2) = 4$ and $f'(2) = 1$, then $\lim_{x \rightarrow 2} \frac{xf^2 - 2fx}{x-2}$ is equal to

- (a) -2 (b) 1
(c) 2 (d) 3

36. If $x = a \cos \theta + \log \tan \frac{\theta}{2}$ and $y = a \sin \theta$, then $\frac{dy}{dx}$ is equal to

- (a) $\cot \theta$ (b) $\tan \theta$
(c) $\sin \theta$ (d) $\cos \theta$

37. The equation of the normal to the curve $y^4 = ax^3$ at (a, a) is

- (a) $x + 2y = 3a$ (b) $3x - 4y + a = 0$
(c) $4x + 3y = 7a$ (d) $4x - 3y = 0$

38. The length of the sub tangent at $(2, 2)$ to the curve $x^5 = 2y^4$ is

- (a) $\frac{5}{2}$ (b) $\frac{8}{5}$
(c) $\frac{2}{5}$ (d) $\frac{5}{8}$

39. If $e^x \frac{1 - \sin x}{1 - \cos x} dx = fx + \text{constant}$, then $f(x)$ is equal to

- (a) $e^x \cot \frac{x}{2} + c$ (b) $e^{-x} \cot \frac{x}{2} + c$
(c) $-e^x \cot \frac{x}{2} + c$ (d) $-e^{-x} \cot \frac{x}{2} + c$

40. If $e^x 1 + x \cdot \sec^2 x e^x dx = f(x) + \text{constant}$, then $f(x)$ is equal to

- (a) $\cos(xe^x)$ (b) $\sin(xe^x)$
(c) $2 \tan^{-1}(x)$ (d) $\tan(xe^x)$

41. $\int_{-\pi/2}^{\pi/2} \sin x dx$ is equal to

- (a) 0 (b) 1
(c) 2 (d) π

42. The area (in sq unit) of the region bounded by the curves $2x = y^2 - 1$ and $x = 0$ is

- (a) $\frac{1}{3}$ (b) $\frac{2}{3}$
(c) 1 (d) 2

43. The solution of the differential equation $\frac{dy}{dx} = \frac{xy+y}{xy+x}$ is

- (a) $x + y - \log \frac{cy}{x}$ (b) $x + y = \log(cxy)$
(c) $x - y - \log \frac{cx}{y}$ (d) $y - x = \log \frac{cx}{y}$

44. The solution of the differential equation

$$\frac{dy}{dx} - y \tan x = e^x \sec x$$

- (a) $y = e^x \cos x + c$ (b) $y \cos x = e^x + c$
(c) $y = e^x \sin x + c$ (d) $y \sin x = e^x + c$

45. The solution of the differential equation $xy^2 dy - (x^3 + y^3) dx = 0$ is

- (a) $y^3 = 3x^3 + c$
(b) $y^3 = 3x^3 \log(cx)$

- (c) $y^3 = 3x^3 + \log(cx)$
 (d) $y^3 + 3x^3 = \log(cx)$

PHYSICS

- 46. The energy (E), angular momentum (L) and universal gravitational constant (G) are chosen as fundamental quantities. The dimensions of universal gravitational constant in the dimensional formula of Planck's constant (h) is**
 (a) Zero (b) -1
 (c) $\frac{5}{3}$ (d) 1
- 47. The component of vector $A = a_x l + a_y j + a_z k$ along the direction of $l - j$ is**
 (a) $a_x - a_y + a_z$ (b) $a_x - a_y$
 (c) $(a_x - a_y)/\sqrt{2}$ (d) $(a_x + a_y + a_z)$
- 48. A body thrown, vertically up to reach its maximum height in t second. The total time from the time of projection to reach a point at half of its maximum height while returning (in second) is**
 (a) $2t$ (b) $1 + \frac{1}{2}t$
 (c) $\frac{3t}{2}$ (d) $\frac{t}{2}$
- 49. If a body is projected with an angle e to the horizontal, then**
 (a) its velocity is always perpendicular to its acceleration
 (b) its velocity becomes zero at its maximum height
 (c) its velocity makes zero angle with the horizontal at its maximum height
 (d) the body just before hitting the ground, the direction of velocity coincides with the acceleration
- 50. A river of salty water is flowing with a velocity 2 m/s, If the density of the water is 1.2 g/cc, then the kinetic energy of each cubic metre of water is**
 (a) 2.4 J (b) 24 J
 (c) 2.4 kJ (d) 4.8 kJ
- 51. A ball is dropped from a height h on a floor of coefficient of restitution e . The total distance covered by the ball just before second hit is**
 (a) $h(1 - 2e^2)$ (b) $h(1 + 2e^2)$
 (c) $h(1 + e^2)$ (d) he^2
- 52. Two particles A and B initially at rest, move towards each other, under mutual force of attraction. At an instance when the speed of A is v and speed of B is $2v$, the speed of centre of mass (CM) is**
 (a) Zero (b) V
 (c) $2.5 V$ (d) $4v$
- 53. Starting from rest, the time taken by a body sliding down on a rough inclined plane at 45° with the horizontal is, twice the time taken to travel on a smooth plane of same inclination and same distance. Then the coefficient of kinetic friction is**
 (a) 0.25 (b) 0.33
 (c) 0.50 (d) 0.75
- 54. A steel wire can withstand a load up to 2940 N. A load of 150 kg is suspended from a rigid support. The maximum angle through which the wire can be displaced from the mean position, so that the wire does not break when the load passes through the position of equilibrium, is**
 (a) 30° (b) 60°
 (c) 80° (d) 85°
- 55. The moment of inertia of a thin circular disc about an axis passing through its centre and perpendicular to its plane is 1. Then, the moment of inertia of the disc about an axis parallel to its diameter and touching the edge of the rim is**

- (a) I (b) 2 I
(c) $\frac{3}{2}I$ (d) $\frac{5}{2}I$

56. The orbit of geo-stationary satellite is circular, the time period of satellite depends on -

- (i) mass of the satellite
(ii) mass of the earth
(iii) radius of the orbit
(iv) height of the satellite from the surface of earth Which of the following is correct?

- (a) (i) only (b) (i) and (ii)
(c) (i), (ii) and (iii) (d) (ii), (iii) and (iv)

57. A particle is executing simple harmonic motion with an amplitude A and time period T. The displacement of the particles after 2 T period from its initial position is

- (a) A (b) 4 A
(c) 8 A (d) Zero

58. A load of 1 kg weight is attached to one end of a steel wire of area of cross-section 3 mm^2 and Young's modulus 10^{11} N/m^2 . The other end is suspended vertically from a hook on a wall, then the load is pulled horizontally and released. When the load passes through its lowest position the fractional change in length is ($g = 10 \text{ m/s}^2$)

- (a) 0.3×10^{-4} (b) 0.3×10^{-3}
(c) 0.3×10^3 (d) 0.3×10^4

59. The surface tension of soap solution is 0.03 N/m . The work done in blowing to form a soap bubble of surface area 40 cm^2 , (in J), is

- (a) 1.2×10^{-4} (b) 2.4×10^{-4}
(c) 12×10^{-4} (d) 24×10^{-4}

60. Two rain drops reach the earth with different terminal velocities having ratio 9: 4. Then the ratio of their volumes is

- (a) 3: 2 (b) 4: 9
(c) 9: 4 (d) 27: 8

61. One litre of oxygen at a pressure of 1 atm and two litres of nitrogen at a pressure of 0.5 atm, are introduced into a vessel of volume 1 L. If there is no change in temperature, the final pressure of the mixture of gas (in atm) is

- (a) 1.5 (b) 2.5
(c) 2 (d) 4

62. There is some change W length when a 33000 N tensile force is applied on a steel rod of area of cross-section 10^{-3} m^2 . The change of temperature required/to produce the same elongation, if the steel rod is heated, is (The modulus of elasticity is $3 \times 10^{11} \text{ N/m}^2$ and the coefficient of linear expansion of steel is $1.1 \times 10^{-5} / ^\circ\text{C}$)

- (a) 20°C (b) 15°C
(c) 10°C (d) 0°C

63. In the adiabatic compression, the decrease in volume is associated with

- (a) increase in temperature and decrease in pressure
(b) decrease in temperature and increase in pressure
(c) decrease in temperature and decrease in pressure
(d) increase in temperature and increase in pressure

64. Which of the following is true in the case of an adiabatic processes

where $\gamma = C_p/C_v$?

- (a) $p^{1-\gamma}T^{1-\gamma} = \text{constant}$
(b) $p^\gamma T^{1-\gamma} = \text{constant}$

- (c) $pT^{\gamma} = \text{constant}$
 (d) $p^{\gamma} T^{\gamma} = \text{constant}$

65. Two slabs *A* and *B* of equal surface area are placed one over the other such that their surfaces are completely in contact. The thickness of slab *A* is twice that of *B*. The coefficient of thermal conductivity of slab *A* is twice that of *B*. The first surface of slab *A* is maintained at 100°C , while the second surface of slab *B* is maintained at 25°C . The temperature at the contact of their surfaces is
 (a) 62.5°C (b) 45°C
 (c) 55°C (d) 85°C
66. When a sound wave of wavelength λ is propagating in a medium, the 'maximum velocity of the particle is equal to the wave velocity'. The amplitude of wave is
 (a) λ (b) $\frac{\lambda}{2}$
 (c) $\frac{\lambda}{2\pi}$ (d) $\frac{\lambda}{4\pi}$
67. A car is moving with a speed of 72 km/h towards a hill. Car blows horn at a distance of 1800 m from the hill. If echo is heard after 10 s , the speed of sound (in m/s) is
 (a) 300 (b) 320
 (c) 340 (d) 360
68. The refractive index of a material of a planoconcave lens is $5/3$, the radius of curvature is 0.3 m . The focal length of the lens in air is
 (a) -0.45 m (b) -0.6 m
 (c) -0.75 m (d) -1.0 m
69. Statement (S): Using Huygen's eye-piece measurements can be taken but are not correct.

Reason (R): The cross wires, scale and final image are not magnified proportionately because the image of the object is magnified by two lenses, whereas the cross-wire scale is magnified by one lens only.

Identify the correct one of the following

- (a) Both (S) and (R) are true, (R) explains (S).
 (b) Both (S) and (R) are true, but (R) cannot explain (S).
 (c) Only (S) is correct, but (R) is wrong.
 (d) Both (S) and (R) are wrong.
70. An achromatic combination of lenses produces -
 (a) images in black and white
 (b) coloured images,
 (c) images unaffected by variation of refractive index with wavelength
 (d) highly enlarged images are formed
71. In Fraunhofer diffraction experiment, L is the distance between screen and the obstacle, b is the size of obstacle and λ is wavelength of incident light. The general condition for the applicability of Fraunhofer diffraction is
 (a) $\frac{b^2}{L\lambda} \gg 1$ (b) $\frac{b^2}{L\lambda} = 1$
 (c) $\frac{b^2}{L\lambda} \ll 1$ (d) $\frac{b^2}{L\lambda} \neq 1$
72. With a standard rectangular bar magnet the time period of a vibration magnetometer is 4 s . The bar magnet is cut parallel to its length into four equal pieces. The time period of vibration magnetometer when one piece is used (in second) (bar magnet breadth is, small) is
 (a) 16 (b) 8
 (c) 4 (d) 2
73. The magnetised wire of moment M and length l is bent in the form of semicircle of radius r . Then its magnetic moment is

- (a) $\frac{2M}{\pi}$ (b) $2M$
 (c) $\frac{M}{\pi}$ (d) zero

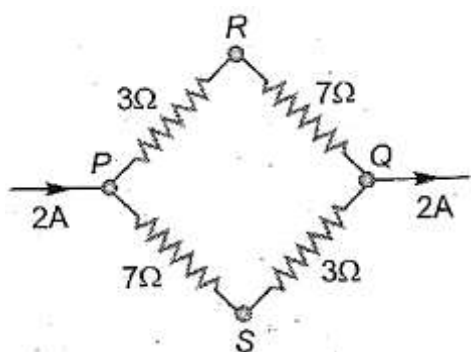
74. A charge of $1\pi\text{C}$ is divided into two parts such that their charges are in the ratio of 2: 3. These two charges are kept at a distance 1 m apart in vacuum. Then, the electric force between them (in N) is

- (a) 0.216 (b) 0.00216
 (c) 0.0216 (d) 2.16

75. Two charges $+q$ and $-q$ are kept apart. Then at any point on the right bisector of line joining the two charges

- (a) The electric field strength is zero
 (b) The electric potential is zero
 (c) Both electric potential and electric field strength are zero
 (d) Both electric potential and electric field strength are nonzero

76. A current of 2 A flows in an electric circuit as shown in figure. The potential difference ($V_R - V_S$), in volts (V_R and V_S) are potentials at R and S respectively) is



- (a) -4 (b) +2
 (c) +4 (d) -2

77. When a battery connected across a resistor of 16Ω , the voltage across the resistor is 12 V. When the same battery is connected across a resistor of 10Ω , voltage across it is 11 V. The internal resistance of the battery (in ohm) is

- (a) $\frac{10}{7}$ (b) $\frac{20}{7}$
 (c) $\frac{25}{7}$ (d) $\frac{30}{7}$

78. One junction of a certain thermoelectric couple is at a fixed temperature T_1 , and the other junction is at temperature T . The thermo-electromotive force for this is expressed by $E = k (T - T_1) T_0 - \frac{1}{2} T^2 + T_2$. At temperature $T = \frac{1}{2} T_0$ the thermoelectric power is

- (a) $19G$ (b) $\frac{G}{19}$
 (c) $20G$ (d) $\frac{G}{20}$

79. In a galvanometer 5% of the total current in the circuit passes through it. If the resistance of the galvanometer is G , the shunt resistance 5 connected to the galvanometer is

- (a) $19G$ (b) $\frac{G}{19}$
 (c) $20G$ (d) $\frac{G}{20}$

80. Two concentric coils of 10 turns each are placed in the same plane. Their radii are 20 cm and 40 cm and carry 0.2 A and 0.3

A. current respectively in opposite directions. The magnetic induction (in tesla) at the centre is

- (a) $\frac{3}{4}\mu_0$ (b) $\frac{5}{4}\mu_0$
(c) $\frac{7}{4}\mu_0$ (d) $\frac{9}{4}\mu_0$

81. The number of turns in primary- and secondary coils of a transformer is 50 and 200 respectively. If the current in the primary coil is 4 A, then the current in the secondary coil is

- (a) 1 A (b) 2 A
(c) 4 A (d) 5 A

82. X-rays of wavelength 0.140 nm are scattered' from a block of carbon. What will be the wave lengths of X-rays scattered at 90° ?

- (a) 0.140 nm (b) 0.142 nm
(c) 0.144 nm (d) 0.146 nm

83. An X-ray tube produces a continuous spectrum of radiation with its shortest wavelength of $45 \times 10^{-2} \text{ \AA}$. The maximum energy of a photon in the radiation in eV is ($h = 6.62 \times 10^{-34} \text{ J-s}$, $c = 3 \times 10^8 \text{ m/s}$)

- (a) 27,500 (b) 22,500
(c) 17,500 (d) 12,500

84. F_{pp} , F_{nn} and F_{np} are the nuclear forces between proton-proton, neutron-neutron and neutron-proton respectively. Then relation between them is

- (a) $F_{pp} = F_{nn} \neq F_{np}$ (b) $F_{pp} \neq F_{nn} = F_{np}$
(c) $F_{pp} = F_{nn} = F_{np}$ (d) $F_{pp} \neq F_{nn} \neq F_{np}$

85. Which of the following statements is not correct when a junction diode is in forward bias?

- (a) The width of depletion region decreases.
(b) Free electrons on n-side will move towards' the junction.
(c) Holes on p-side move towards the junction.
(d) Electron on n-side and holes on, p-side will move away from junction.

CHEMISTRY

86. An electronic transition in hydrogen atom results - in the formation of H_α line of hydrogen in Lyman series, the energies associated with the electron in each of the orbits involved in the transition (in kcal mol^{-1}) are

- (a) $-313.6, -34.84$ (b) $-313.6, -78.4$
(c) $-78.4, -34.84$ (d) $-78.4, -19.6$

87. The velocities of two particles A and B are 0.05 and 0.02 ms^{-1} respectively. The mass of B is five times the mass of A. The ratio of their de- Broglie's wavelength is

- (a) 2:1 (b) $-1:4$
(c) 1:1 (d) 4:1

88. If the mass defect of ${}_5\text{B}^{11}$ is 0.081u , its average binding energy (in MeV) is

- (a) 8.60 (b) 6.85
(c) 5.60 (d) 5.86

89. The atomic numbers of elements A, B, C and D are $Z - 1$, Z , $Z + 1$ and $Z + 2$, respectively. If 'B' is a noble gas, choose the correct answers from the following statements

- (1) 'A' has higher electron affinity
(2) 'C' exists in +2 oxidation state
(3) 'D' is an alkaline earth metal
(a) (1) and (2) (b) (2) and (3)
(c) (1) and (3) (d) (1), (2) and (3)

90. The bond length of HCl molecule is $1.275 \text{ \AA}$ and its dipole moment is 1.03 D . The ionic character of the molecule (in percent) (charge of the electron = $4.8 \times 10^{-10} \text{ esu}$) is

- (a) 100 (b) 67.3
(c) 33.66 (d) 16.83

91. Which one of the following is a correct set?

- (a) H_2O , sp^3 , angular
(b) BCl_3 , sp^3 , angular
(c) NH_4^+ , dsp^2 , square planar
(d) CH_4 , dsp^2 , tetrahedral

92. Match the following

	List-I		List-II (At STP)
(A)	10 g CaCO_3 $\xrightarrow[\text{decomposition}]{\Delta}$	(i)	0.224 L CO_2
(B)	1.06 g Na_2CO_3 $\xrightarrow{\text{Excess HCl}}$	(ii)	4.48 L CO_2
(C)	2.4 g C $\xrightarrow[\text{combustion}]{\text{Excess O}_2}$	(iii)	0.448 L CO_2
(D)	0.56 g CO $\xrightarrow[\text{combustion}]{\text{Excess O}_2}$	(iv)	2.24 L CO_2
		(v)	22.4 L CO_2

The correct match is

A B C D

- (a) iv i ii iii
(b) v i ii iii
(c) iv i iii ii
(d) i iv ii iii

93. What is the temperature at which the kinetic energy of 0.3 moles of helium is equal to the kinetic energy of 0.4 moles of argon -at 400 K?

- (a) 400 K (b) 873 K
(c) 533 K (d) 300 K

94. When 25 g of a non-volatile solute is dissolved in 100. g of water, the vapour pressure is lowered by $2.25 \times 10^{-1} \text{ mm}$. If the vapour pressure of water at 20°C is 17.5 mm, what is the molecular weight of the solute?

- (a) 206 (b) 302
(c) 350 (d) 276

95. 50 mL of H_2O is added to 50 mL of $1 \times 10^{-3} \text{ M}$ barium hydroxide solution. What is the pH of the resulting solution?

- (a) 3.0 (b) 3.3
(c) 11.0 (d) 11.7

96. Assertion (A): The aqueous solution of $\text{CH}_3\text{COONa}^2$ alkaline in nature.

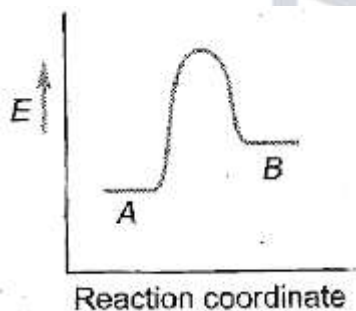
Reason (R): Acetate ion undergoes anionic hydrolysis

The correct answer is

- (a) both (A) and (R) are true and (R) is the correct explanation of (A).
(b) both (A) and (R) are true but (R) is not the correct explanation of (A).

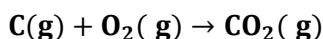
- (c) (A) is true but (R) is not true.
(d) (A) is not true but (R) is true.

97. When same quantity of electricity is passed through aqueous AgNO_3 and H_2SO_4 solutions connected in series, 5.04×10^{-2} g of H_2 is liberated. What is the mass of silver (in grams) deposited? (Eq. wts. of hydrogen = 1.008, silver = 108)
(a) 54 (b) 0.54
(c) 5.4 (d) 10.8
98. When electric current is passed through acidified water for 1930 s, 1120 mL of H_2 gas is collected (at STP) at the cathode. What is the current passed in amperes?
(a) 0.05 (b) 0.50
(c) 5.0 (d) 50
99. For a crystal, the angle of diffraction (2θ) is 90° and the second order line has a d value of $2.28\text{\AA}$. The wavelength (in $\text{\AA}$) of Xrays used for Bragg's diffraction is
(a) 1.612 (b) 2.00
(c) 2.28 (d) 4.00
100. In a 500 mL flask, the degree of dissociation of PCl_5 at equilibrium is 40% and the initial amount is 5 moles. The value of equilibrium constant in molL^{-1} for the decomposition of PCl_5 is
(a) 2.33 (b) 2.66
(c) 5.32 (d) 4.66
101. For a reversible reaction $\text{A} \rightleftharpoons \text{B}$, which one of the following statements is wrong from the given energy profile diagram?

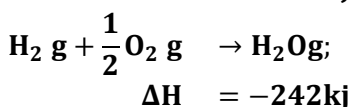
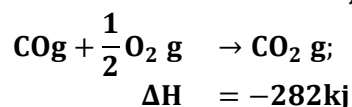
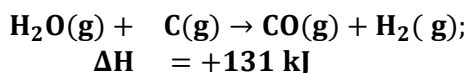


- (a) Activation energy of forward reaction is greater than backward reaction
(b) The forward reaction is endothermic
(c) The threshold energy is less than that of activation energy
(d) The energy of activation of forward reaction is equal to the sum of heat of reaction and the energy of activation of backward reaction

102. Calculate ΔH in kJ for the following reaction

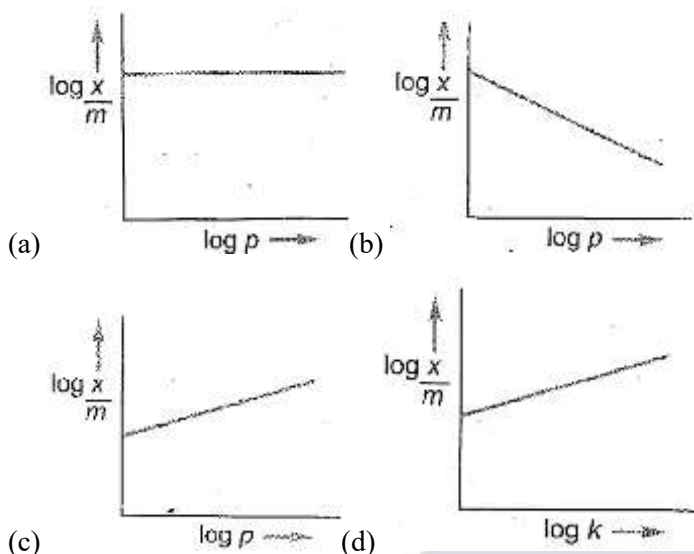


Given that,



- (a) -393 (b) + 393
(c) +655 (d) - 655

103. Which one of the following graphs represents "Freundlich adsorption isotherm?"



104. Which one of the following reactions represents the oxidising property of H_2O_2 ?

- (a) $2\text{KMnO}_4 + 3\text{H}_2\text{O}_4 + 5\text{H}_2\text{O}_2 \rightarrow \text{K}_2\text{SO}_4 + 2\text{MnSO}_4 + 8\text{H}_2\text{O} + 5\text{O}_2$
(b) $2\text{K}_3[\text{Fe}(\text{CN})_6] + 2\text{KOH} + \text{H}_2\text{O}_2 \rightarrow 2\text{K}_4[\text{Fe}(\text{CN})_6] + 2\text{H}_2\text{O} + \text{O}_2$
(c) $\text{PbO}_2 + \text{H}_2\text{O}_2 \rightarrow \text{PbO} + \text{H}_2\text{O} + \text{O}_2$
(d) $2\text{KI} + \text{H}_2\text{SO}_4 + \text{H}_2\text{O}_2 \rightarrow \text{K}_2\text{SO}_4 + 12\text{I} + 2\text{H}_2\text{O}$

105. Which of the following statements are correct for alkali metal compounds?

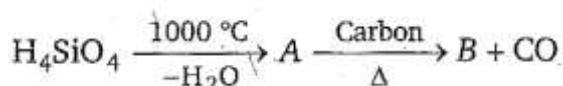
- (i) Superoxides are paramagnetic in nature.
(ii) The basic strengths of hydroxides increases down the group.
(iii) The conductivity of chlorides in their aqueous solutions decreases down the group.
(iv) The basic nature of carbonates in aqueous solutions is due to cationic hydrolysis.

- (a) (i), (ii) and (iii) only (b) (i) and (ii) only
(c) (ii), (iii) and (iv) only (d) (iii) and (iv) only

106. Boron halides behave as Lewis acids because of "their nature.

- (a) proton donor (b) covalent
(c) electron deficient (d) ionising

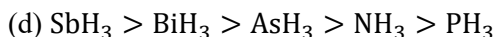
107. Identify B in the following reaction



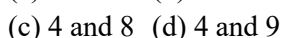
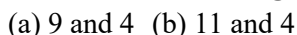
- (a) corundum (b) quartz
(c) silica (d) carborundum

108. The correct order of reducing abilities of hydrides of V group elements is

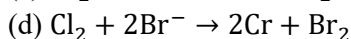
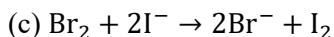
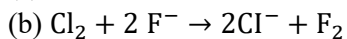
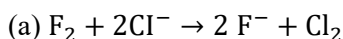
- (a) $\text{NH}_3 < \text{PH}_3 < \text{AsH}_3 < \text{SbH}_3 < \text{BiH}_3$
(b) $\text{NH}_3 > \text{PH}_3 > \text{AsH}_3 > \text{SbH}_3 > \text{BiH}_3$



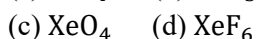
109. The number of sigma and pi bonds in peroxodisulphuric acid are, respectively



110. Which one of the following reactions does not occur?



111. The compound in which the number of $d\pi - p\pi$ bonds are equal to those present in ClO_4^-



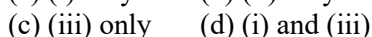
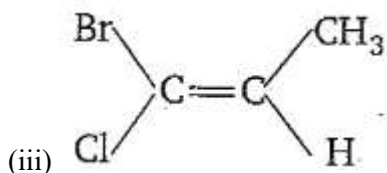
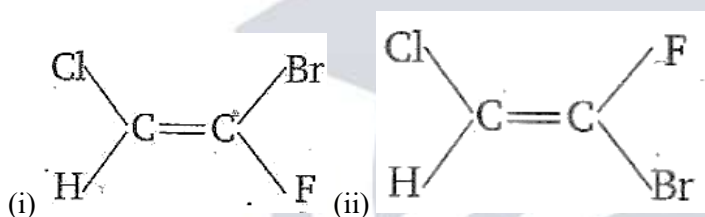
112. $[\text{Co}(\text{NH}_3)_5 \text{SO}_4] \text{Br}$ and $[\text{Co}(\text{NH}_3)_5 \text{Br}]\text{SO}_4$ are a pair of isomers.



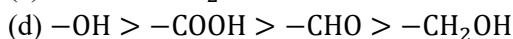
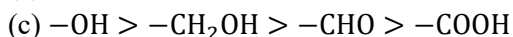
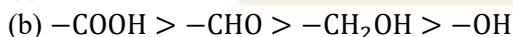
113. Among the following compounds, which one is not responsible for depletion of ozone layer?



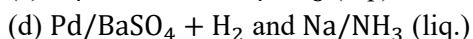
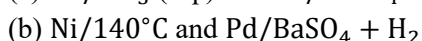
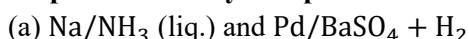
114. Which of the following correspond (s) has 'Z' configuration?



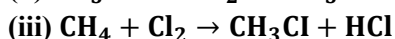
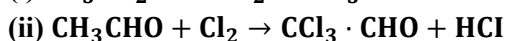
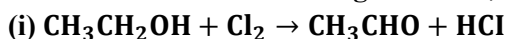
115. According to Cahn-Ingold-Prelog sequence rules, the correct order of priority for the given groups is



116. What are X and Y respectively in the following reaction?



117. In which of the following reactions, chlorine acts as an oxidising agent?



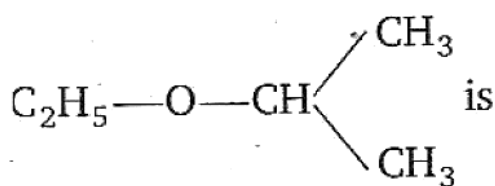
The correct answer is

- (a) (i) only (b) (ii) only
(c) (i) and (iii) (d) (i), (ii) and (iii)

118. The correct order of reactivity of hydrogen halides with ethyl alcohol is

- (a) $\text{HF} > \text{HCl} > \text{HBr} > \text{HI}$
(b) $\text{HCl} > \text{HBr} > \text{HF} > \text{HI}$
(c) $\text{HBr} > \text{HCl} > \text{HI} > \text{HF}$
(d) $\text{HI} > \text{HBr} > \text{HCl} > \text{HF}$

119. The IUPAC name of



- (a) ethoxy propane'
(b) 1,1-dimethyl ether
(c) 2-ethoxy isopropane
(d) 2-ethoxy propane

120. Acetone on addition to methyl magnesium bromide forms a complex, which on decomposition with acid gives X and $\text{Mg}(\text{OH})\text{Br}$. Which one of the following is X ?

- (a) CH_3OH (b) $(\text{CH}_3)_3\text{COH}$
(c) $(\text{CH}_3)_2\text{CHOH}$ (d) $\text{CH}_3\text{CH}_2\text{OH}$

121. Identify A and B in the following reaction



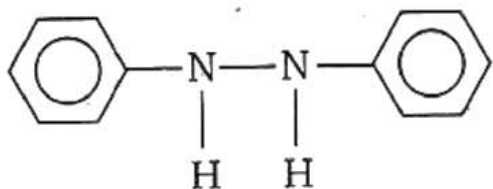
A

- (a) $\text{HI} + \text{red}$
(b) NV/Δ
(c) LiAlH_4
(d) $\text{Pd} - \text{BaSO}_4$

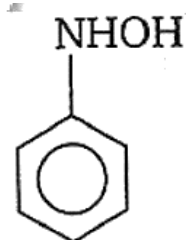
B

- P LiAlH_4
 LiAlH_4
 $\text{HI} + \text{red P}$
 $\text{Zn} + \text{HCl}$

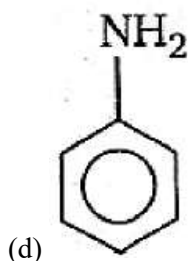
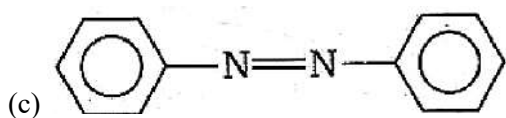
122. The structure of the compound formed, when nitrobenzene is reduced by lithium aluminum hydride (LiAlH_4) is



(a)



(b)



123. Match the following:

List-I

List-II

- | | |
|-------------------|-----------------------------------|
| (A) Oxyhemoglobin | (i) Analgesic |
| (B) Aspirin | (ii) Oxygen carrier |
| (C) emoglobin | (iii) Photosynthesis |
| (D) Chlorophyll | (iv) Oil of winter green |
| | (v) Fe^{2+} paramagnetic |

The correct match is

- | | A | B | C | D |
|-----|-------|------|-------|-------|
| (a) | (v) | (i) | (ii) | (iii) |
| (b) | (iv) | (ii) | (i) | (iii) |
| (c) | (iii) | (i) | (ii) | (iv) |
| (d) | (v) | (ii) | (iii) | (i) |

124. If $\bar{M}_w$ is the weight average molecular weight and $\bar{M}_n$ is the number average molecular weight of a polymer, the poly dispersity index (PDI) of the polymer is given by

- | | |
|-----------------------------------|--|
| (a) $\frac{\bar{M}_n}{\bar{M}_w}$ | (b) $\frac{\bar{M}_w}{\bar{M}_n}$ |
| (c) $\bar{M}_w \times \bar{M}_n$ | (d) $\frac{1}{\bar{M}_w \times \bar{M}_n}$ |

125. Hydrolysis of sucrose with dilute aqueous sulphuric acid yields

- (a) 1:1 D-(+)- glucose; D-(-)-fructose
 (b) 1: 2D – (+)-glucose; D-(-)-fructose
 (c) 1: 1D – H-glucose; p – (+)-fructose
 (d) 1: 2 D-(-)-glucose; D- (+) -fructose

ENGLISH & REASONING

Directions: In each of the following questions, choose the most, appropriate alternative to fill in the blank.

126. The teacher ordered Kamal to leave the room... Him to return.

- (a) stopped (b) refused
(c) forbade (d) challenged

127. I hope you must have by now that failures are the stepping stones to success

- (a) know (b) felt
(c) decided (d) realised

128. In a little published deal, Pepsi Cola has the entire soft drink market in Afghanistan.

- (a) conquered (b) swallowed
(c) captured (d) occupied

Directions: In each of the following questions, put the parts P, Q, R and S in their proper order to produce the correct sentence.

129. The Bible,

- (P) has in many respects
(Q) the sacred book of all Christians
(R) among all the books of the world
(S) a unique character and position

- (a) QPSR (b) QRPS
(c) RPQS (d) RQPS

130. The ultimate hope

- (P) will force the nations
(Q) that the destructive nature of weapons
(R) to give up war
(S) has not been fulfilled

- (a) PQRS (b) PRQS
(c) QPRS (d) RSQP

131. It was

- (P) in keeping with my mood
(Q) a soft summer evening,
(R) as I walked sedately
(S) in the direction of the new house

- (a) QPRS (b) QRPS
(c) SQPR (d) SRPQ

Directions: In each of the following questions, choose the alternative which is most nearly the same in meaning to the "word given in capital letters.

132. EPHEMERAL

- (a) Uneral (b) Mythical
(c) Short-living (d) Artificial

133. STUBBORN

- (a) Easy (b) Obstinate
(c) Willing (d) Pliable

134. PROGNOSIS

- (a) Indentification (b) Preface
(c) Forecast (d) Scheme

Directions: In each of the following questions, choose the alternative which is opposite in meaning to the word given in capital letters.

135. INFALLIBLE

- (a) Erring (b) Untrustworthy
(c) Dubious (d) Unreliable

136. GATHER

- (a) Separate (b) Suspend
(c) Scatter (d) Spend

137. EXALT

- (a) Depreciate (b) Ennoble
(c) Glorify (d) Simplify

Directions: In each of the following questions, choose the alternative which can be substituted for the given words/sentence.

138. Elderly woman in charge of a girl on social occasions

- (a) Spinster (b) Matron
(c) Chaperon (d) Chandler

139. Land so surrounded by water as to be almost an island

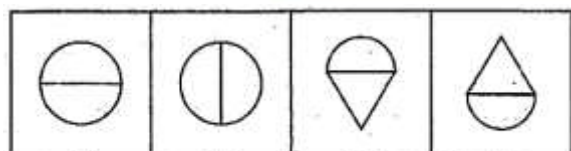
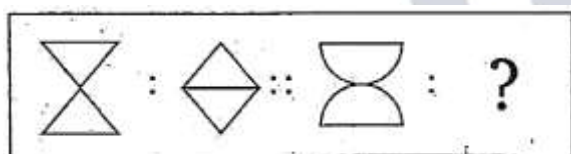
- (a) Archipelago (b) Isthmus
(c) Peninsular (d) Lagoon

140. A Place adjoining kitchen, for washing dishes etc.

- (a) Cellar (b) Wardrobe
(c) Scullery (d) Pantry

Direction: In each of these questions, two figure/words are given to the left of the sign:: and one figure's word to the right of the sign:: with four alternatives under it out of which one of the alternatives has the same relationship with the figures/words to the right of the sign:: as between the two figures/words to the left of the sign (::). Find the correct alternative.

141.



(a) (b) (c) (d)

142. Direction: In the question, three words are given. They are followed by four words one of which stands for the class to which these three words belong. Identify that word.

Newspaper, Hoarding, Television

- (a) Press (b) Media
(c) Broadcast (d) Rumour

143. Direction: Find out the number which will come next in the series.

2, 5, 14, 122, 365

- (a) 1029 (b) 1094
(c) 1059 (d) 1000

144. **Direction:** In the given question, some, statements are followed by one or more inferences. The inference or inferences may be wrongly or correctly drawn. Select one of the alternatives which contains the correctly drawn inference or inferences.

Which of the conclusions drawn from the given statements are correct?

Given statements

Foreigners in Jordan without a valid work permit will be deported. A few Indian employees in the building industry in Jordan do not possess valid work permits.

Inferences

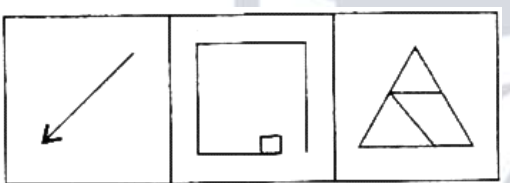
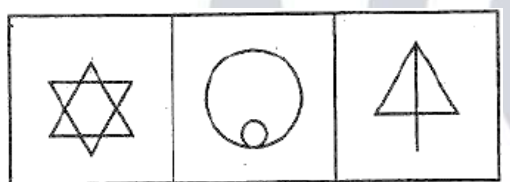
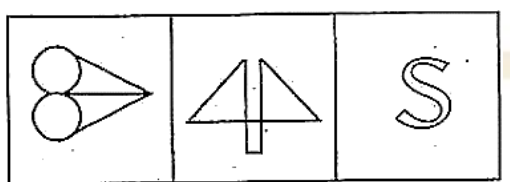
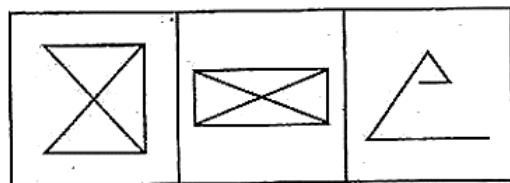
- (1) All Indians engaged in building industry in Jordan will be deported to India.
(2) A few Indians in building industry in Jordan will be deported.
(3) A bulk of Indians in Jordan will be deported to India.
(4) Indian employees in building industry without work permit will be deported from Jordan.

The inferences correctly drawn are

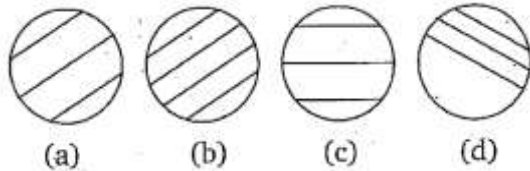
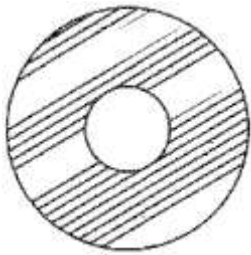
- (a) 1 and 3 (b) – 3 and 4
(c) -2 and 4 (d) 1 and 2

145. **Select the series which obeys the given rule:**

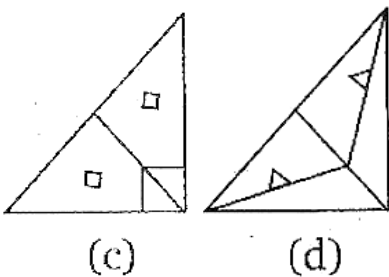
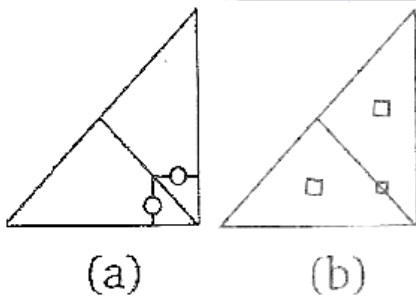
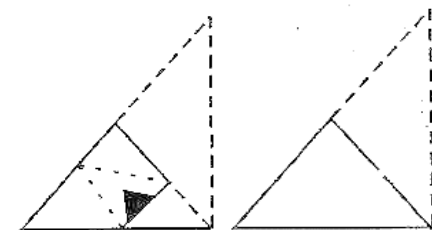
Any figure can be traced by a single unbroken line without retracing

- (a) 
- (b) 
- (c) 
- (d) 

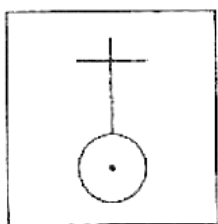
146. **Select from amongst the four alternative figures, the one which complete the pattern in the problem figure.**

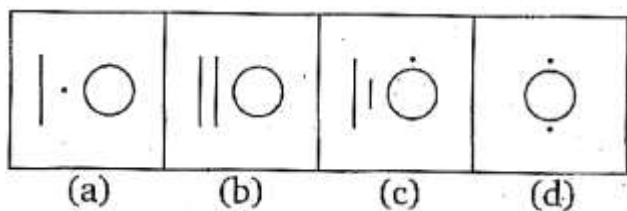


147. Direction: In the following question a piece of paper is folded, cut and unfolded. One of the four figures given below is exactly like this unfolded paper. Find this out.



148. Direction: In the question a figure is given, its components are given in one of the four alternative figures. Find this one





149. Direction: In the given question, four numbers/number-pairs are given. Select the one which is different from the other three.

- (a) 1234 (b) 2345
(c) 4567 (d) 7896

Direction: Find the group of letters from the four alternative which is obtained by applying the same rule to this given word to the right of the sign::

150. FILM: ADGH: : MILK: ?

- (a) ADGF (b) HDGE
(c) HDGF (d) HEGF

