63487
[Q. Booklet Number]

ANSWERS & HINTS
for
WBJEE - 2011

MULTIPLE CHOICE QUESTIONS
SUB : MATHEMATICS

1. The eccentricity of the hyperbola $4x^2 - 9y^2 = 36$ is

(A) $\frac{\sqrt{11}}{3}$ (B) $\frac{\sqrt{15}}{3}$ (C) $\frac{\sqrt{13}}{3}$ (D) $\frac{\sqrt{14}}{3}$

Ans : (C)

Hints : $\frac{x^2}{9} - \frac{y^2}{4} = 1$

$a = 3,\ b = 2$

$\therefore e = \sqrt{\frac{a^2 + b^2}{a^2}} = \sqrt{\frac{13}{9}} = \frac{\sqrt{13}}{3}$

2. The length of the latus rectum of the ellipse $16x^2 + 25y^2 = 400$ is

(A) 5/16 unit (B) 32/5 unit (C) 16/5 unit (D) 5/32 unit

Ans : (B)

Hints : Length of latus rectum = $2\frac{b^2}{a} = \frac{2 \times 16}{5} = \frac{32}{5}$

$16x^2 + 25y^2 = 400$

$\frac{x^2}{25} + \frac{y^2}{16} = 1;$

$a^2 = 25;\ b^2 = 16$

3. The vertex of the parabola $y^2 + 6x - 2y + 13 = 0$ is

$(y-1)^2 = -6x - 12$

$(y-1)^2 = -6(x+2) = 4\left(\frac{-6}{4}\right)(x+2)$

Vertex $\to (-2, 1)$

(A) (1, –1) (B) (–2, 1) (C) $\left(\frac{3}{2}, 1\right)$ (D) $\left(-\frac{7}{2}, 1\right)$

Ans : (B)

Hints :

4. The coordinates of a moving point p are $(2t^2 + 4, 4t + 6)$. Then its locus will be a

(A) circle (B) straight line (C) parabola (D) ellipse

Ans : (C)

Hints : $x = 2t^2 + 4,\ y = 4t + 6,\quad y = 4t + 6 \rightarrow t = \left(\frac{y-6}{4}\right)$

$$x = 2\left(\frac{y-6}{4}\right)^2 + 4 \Rightarrow \frac{(y-6)^2}{8} = x - 4$$

$$(y-6)^2 = 4(2)(x-4)$$

5. The equation $8x^2 + 12y^2 - 4x + 4y - 1 = 0$ represents

(A) an ellipse (B) a hyperbola (C) a parabola (D) a circle

Ans : (A)

Hints : $ax^2 + by^2 + 2hxy + 2gx + 2fy + c = 0$

represents ellipse if $h^2 - ab < 0$

$$3x^2 + 12y^2 - 4x + 4y - 1 = 0$$

$$h = 0,\ a = 3,\ b = 12$$

$$h^2 - ab < 0$$

6. If the straight line $y = mx$ lies outside of the circle $x^2 + y^2 - 20y + 90 = 0$, then the value of m will satisfy

(A) $m < 3$ (B) $|m| < 3$ (C) $m > 3$ (D) $|m| > 3$

Ans : (B)

Hints : $x^2 + m^2x^2 - 20mx + 90$

$$x^2\left(1+m^2\right) - 20mx + 90 = 0$$

$$D < 0$$

$$400m^2 - 4 \times 90\left(1+m^2\right) < 0$$

$$40m^2 < 360$$

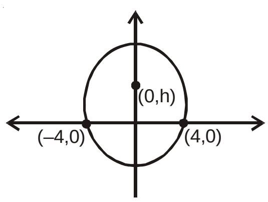
$$m^2 < 9\ ;\ |m| < 3$$

7. The locus of the centre of a circle which passes through two variable points (a, 0), (–a, 0) is

(A) $x = 1$ (B) $x + y = a$ (C) $x + y = 2a$ (D) $x = 0$

Ans : (D)

Hints :



Centre lies on y-axis locus $x = 0$

8. The coordinates of the two points lying on $x + y = 4$ and at a unit distance from the straight line $4x + 3y = 10$ are
(A) (–3, 1), (7, 11) (B) (3, 1), (–7, 11) (C) (3, 1), (7, 11) (D) (5, 3), (–1, 2)

Ans : (B)

Hints : Let $p(h, 4-h)$

$$\left|\frac{4h+3(4-h)-10}{5}\right| = 1$$

$$|h+2| = 5$$

$$h = 3, -7;\ p = 1, 1$$

$$(3,1), (-7,11)$$

9. The intercept on the line $y = x$ by the circle $x^2 + y^2 - 2x = 0$ is AB. Equation of the circle with AB as diameter is
(A) $x^2 + y^2 = 1$ (B) $x(x-1) + y(y-1) = 0$
(C) $x^2 + y^2 = 2$ (D) $(x-1)(x-2)+(y-1)+(y-2) = 0$

Ans : (B)

Hints : $2x^2 - 2x = 0 \quad x(x+1) = 0 \quad x = 0,1;\ y = 0,1$

$(0,0), (1,1)$ as diametric ends

$$(x-0)(x-1)+(y+0)(y-1) = 0$$

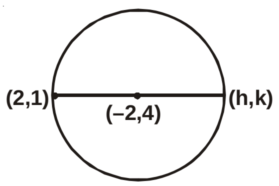
$$x^2 + y^2 - x - y = 0$$

10. If the coordinates of one end of a diameter of the circle $x^2+y^2+4x-8y+5=0$, is (2,1), the coordinates of the other end is
(A) (–6, –7) (B) (6, 7) (C) (–6, 7) (D) (7, –6)

Ans : (C)

Hints : $x^2 + y^2 + 9x - 8y + 5 = 0$

Centre circle (–2, 4)



$$\frac{h+2}{2} = -2$$

$$h = -4 - 2 = -6$$

$$\frac{k+1}{2} = 4 \Rightarrow k = 7$$

$$(h,k) \to (-6, 7)$$

11. If the three points A(1,6), B(3, –4) and C(x, y) are collinear then the equation satisfying by x and y is
(A) $5x + y - 11 = 0$ (B) $5x + 13y + 5 = 0$ (C) $5x - 13y + 5 = 0$ (D) $13x - 5y + 5 = 0$

Ans : (A)

Hints : $\begin{vmatrix} 1 & 1 & 6 \\ 1 & 3 & -4 \\ 1 & x & y \end{vmatrix} = 0$

$\Rightarrow 1(3y+4x)-(y-6x)+1(-4-18)=0 \quad \Rightarrow 3y+4x-y+6x-12=0$

$\Rightarrow 2y+10x-22=0$

$y+5x=11$

12. If $\sin\theta = \dfrac{2t}{1+t^2}$ and θ lies in the second quadrant, then cosθ is equal to

(A) $\dfrac{1-t^2}{1+t^2}$ (B) $\dfrac{t^2-1}{1+t^2}$ (C) $\dfrac{-|1-t^2|}{1+t^2}$ (D) $\dfrac{1+t^2}{|1-t^2|}$

Ans : (C)

Hints : θ in 2nd quad Cosθ < 0

$|\cos\theta| = \left|\dfrac{1-t^2}{1+t^2}\right| = \dfrac{|1-t^2|}{1+t^2}$

$\cos\theta = -\dfrac{|1-t^2|}{1+t^2}$

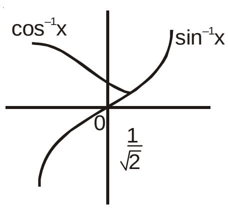
13. The solutions set of inequation $\cos^{-1}x < \sin^{-1}x$ is

(A) $[-1, 1]$ (B) $\left[\dfrac{1}{\sqrt{2}},1\right]$ (C) $[0, 1]$ (D) $\left(\dfrac{1}{\sqrt{2}},1\right]$

Ans : (D)

Hints : $\cos^{-1}x < \sin^{-1}x$

$x \in \left(\dfrac{1}{\sqrt{2}},1\right]$, $\cos^{-1}x < \sin^{-1}x$



14. The number of solutions of $2\sin x + \cos x = 3$ is

(A) 1 (B) 2 (C) infinite (D) No solution

Ans : (D)

Hints : $\sqrt{5} < 3$ No solution

15. Let $\tan\alpha = \dfrac{a}{a+1}$ and $\tan\beta = \dfrac{1}{2a+1}$ then $\alpha+\beta$ is

(A) $\dfrac{\pi}{4}$ (B) $\dfrac{\pi}{3}$ (C) $\dfrac{\pi}{2}$ (D) π

Ans : (A)

Hints : $\tan\alpha = \dfrac{a}{a+1}$, $\tan\beta = \dfrac{1}{2a+1}$

$$\tan(\alpha+\beta) = \frac{\frac{a}{a+1}+\frac{1}{2a+1}}{1-\frac{a}{(a+1)(2a+1)}} = \frac{\frac{a(2a+1)+a+1}{(a+1)(2a+1)}}{\frac{(a+1)(2a+1)-a}{(a+1)(2a+1)}} = \frac{2a^2+2a+1}{2a^2+2a+1} = 1$$

$$\alpha+\beta = \frac{\pi}{4}$$

16. If $\theta+\phi = \dfrac{\pi}{4}$, then $(1+\tan\theta)(1+\tan\phi)$ is equal to

(A) 1 (B) 2 (C) 5/2 (D) 1/3

Ans : (B)

Hints : $(1+\tan\theta)\left(1+\dfrac{(1-\tan\theta)}{1+\tan\theta}\right)$

$$= (1+\tan\theta)\frac{2}{1+\tan\theta} = 2$$

17. If $\sin\theta$ and $\cos\theta$ are the roots of the equation $ax^2 - bx + c = 0$, then a, b and c satisfy the relation

(A) $a^2 + b^2 + 2ac = 0$ (B) $a^2 - b^2 + 2ac = 0$

(C) $a^2 + c^2 + 2ab = 0$ (D) $a^2 - b^2 - 2ac = 0$

Ans : (B)

Hints : $\sin\theta + \cos\theta = \dfrac{b}{a}$

$$\sin\theta.\cos\theta = \frac{c}{a}$$

$$\left(\frac{b}{a}\right)^2 = 1+\frac{2c}{a}$$

$$b^2 = a^2 + 2ac$$

$$a^2 - b^2 + 2ac = 0$$

18. If A and B are two matrices such that A+B and AB are both defined, then

(A) A and B can be any matrices (B) A, B are square matrices not necessarily of the same order

(C) A, B are square matrices of the same order (D) Number of columns of A = number of rows of B

Ans : (C)

Hints : Addition is defined if order of A is equal to order of B

$\underset{n\times m}{A}\ \underset{n\times m}{B}$ is defined if m = n

$\Rightarrow$ A, B are square matrices of same order

19. If $A = \begin{pmatrix} 3 & x-1 \\ 2x+3 & x+2 \end{pmatrix}$ is a symmetric matrix, then the value of x is

(A) 4 (B) 3 (C) –4 (D) –3

Ans : (C)

Hints : $A = A^T$

$$\begin{pmatrix} 3 & x-1 \\ 2x+3 & x+2 \end{pmatrix} = \begin{pmatrix} 3 & 2x+3 \\ x-1 & x+2 \end{pmatrix}$$

$\Rightarrow x - 1 = 2x + 3$ or $x = -4$

20. If $z = \begin{vmatrix} 1 & 1+2i & -5i \\ 1-2i & -3 & 5+3i \\ 5i & 5-3i & 7 \end{vmatrix}$ then $\left(i = \sqrt{-1}\right)$

(A) z is purely real (B) z is purely imaginary

(C) $z + \bar{z} = 0$ (D) $\left(z - \bar{z}\right) i$ is purely imaginary

Ans : (A)

Hints : $z = \begin{vmatrix} 1 & 1+2i & -5i \\ 1-2i & -3 & 5+3i \\ 5i & 5-3i & 7 \end{vmatrix} = 1(-21-64) - \left((1-2i)\left(7(1+2i)+5i(5-3i)\right)\right) + 5i\left((1+2i)(5+3i)-15i\right)$

= Real

21. The equation of the locus of the point of intersection of the straight lines x sin θ + (1 – cos θ) y = a sin θ and x sin θ – (1 + cos θ) y + a sin θ = 0 is

(A) $y \pm ax$ (B) $x = \pm ay$ (C) $y^2 = 4x$ (D) $x^2 + y^2 = a^2$

Ans : (D)

Hints : y = a sin θ

x = a cos θ.

$\boxed{x^2 + y^2 = a^2}$

22. If sinθ + cosθ = 0 and 0 < θ < π, then θ

(A) 0 (B) $\frac{\pi}{4}$ (C) $\frac{\pi}{2}$ (D) $\frac{3\pi}{4}$

Ans : (D)

Hints : sin θ + cos θ = 0

$\Rightarrow \tan\theta = -1$ $\theta = \frac{3\pi}{4}$

23. The value of cos 15° – sin 15° is

(A) 0 (B) $\frac{1}{\sqrt{2}}$ (C) $-\frac{1}{\sqrt{2}}$ (D) $\frac{1}{2\sqrt{2}}$

Ans : (B)

Hints : $\cos 15^\circ - \sin 15^\circ = \sqrt{2}\cos 60^\circ = \frac{1}{\sqrt{2}}$

24. The period of the function f(x) = cos 4x + tan 3x is

(A) π (B) $\frac{\pi}{2}$ (C) $\frac{\pi}{3}$ (D) $\frac{\pi}{4}$

Ans : (A)

Hints : $\text{LCM}\left(\frac{2\pi}{4}, \pi/3\right) = \pi$

25. If $y = 2x^3 - 2x^2 + 3x - 5$, then for $x = 2$ and $\Delta x = 0.1$ value of Δy is

(A) 2.002 (B) 1.9 (C) 0 (D) 0.9

Ans : (B)

Hints : $\frac{dy}{dx} = 6x^2 - 4x + 3$ $\Delta y = \left(\frac{dy}{dx}\right)_{x=2} \Delta x = 1.9$

26. The approximate value of $\sqrt[5]{33}$ correct to 4 decimal places is

(A) 2.0000 (B) 2.1001 (C) 2.0125 (D) 2.0500

Ans : (C)

Hints : $y = x^{1/5}$ $\Delta y = \left(\frac{dy}{dx}\right)\Delta x = 1/80 \times 1$

$y = 2 + 1/80$

27. The value of $\int_{-2}^{2}(x\cos x + \sin x + 1)\,dx$ is

(A) 2 (B) 0 (C) -2 (D) 4

Ans : (D)

Hints : $\int_{-2}^{2}(x\cos x + \sin x + 1)\,dx = \int_{-2}^{2} dx = 4$

28. For the function $f(x) = e^{\cos x}$, Rolle's theorem is

(A) applicable when $\frac{\pi}{2} \le x \le \frac{3\pi}{2}$

(B) applicable when $0 \le x \le \frac{\pi}{2}$

(C) applicable when $0 \le x \le \pi$

(D) applicable when $\frac{\pi}{4} \le x \le \frac{\pi}{2}$

Ans : (A)

Hints : $f\left(\pi/2\right) = f\left(3\pi/2\right)$

29. The general solution of the differential equation $\frac{d^2y}{dx^2} + 8\frac{dy}{dx} + 16y = 0$ is

(A) $(A + Bx)e^{5x}$ (B) $(A + Bx)e^{-4x}$ (C) $(A + Bx^2)e^{4x}$ (D) $(A + Bx^4)e^{4x}$

Ans : (B)

Hints : $\frac{d^2y}{dx^2} + 8\frac{dy}{dx} + 16y = 0$

auxilary equation $m^2 + 8m + 16 = 0 \Rightarrow m = -4$

Solution $\boxed{y = (ax + b)e^{-4x}}$

30. If $x^2 + y^2 = 4$, then $y\frac{dy}{dx} + x =$

(A) 4 (B) 0 (C) 1 (D) -1

Ans : (B)

Hints : $x + y\frac{dy}{dx} = 0$

31. $\int \frac{x^3 dx}{1+x^8} =$

(A) $4\tan^{-1}x^3 + c$ (B) $\frac{1}{4}\tan^{-1}x^4 + c$ (C) $x + 4\tan^{-1}x^4 + c$ (D) $x^2 + \frac{1}{4}\tan^{-1}x^4 + c$

Ans : (B)

Hints : $\int \frac{x^3 dy}{1+\left(x^4\right)^2} = \frac{1}{4}\tan^{-1}\left(x^4\right)$

32. $\int_{\pi}^{16\pi} |\sin x| dx =$

(A) 0 (B) 32 (C) 30 (D) 28

Ans : (C)

Hints : $15\int_0^{\pi} \sin x\, dx = 15\left(-\cos x\right)_0^{\pi} = 30$

33. The degree and order of the differential equation $y = x\left(\frac{dy}{dx}\right)^2 + \frac{dy}{dx}$ are respectively

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

Ans : (C)

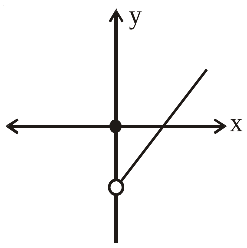
Hints : $y\left(\frac{dy}{dx}\right)^2 = x\left(\frac{dy}{dx}\right)^4 + 1$

34. $f(x) = \begin{cases} 0 & , \quad x = 0 \\ x-3, & \quad x > 0 \end{cases}$ The function f (x) is

(A) increasing when $x \geq 0$
(B) strictly increasing when $x > 0$
(C) Strictly increasing at $x = 0$
(D) not continuous at $x = 0$ and so it is not increasing when $x > 0$

Ans : (B)

Hints :



35. The function $f(x) = ax + b$ is strictly increasing for all real x if

(A) $a > 0$ (B) $a < 0$ (C) $a = 0$ (D) $a \leq 0$

Ans : (A)

Hints : $f'(x) = a$

$f'(x) > 0 \Rightarrow a > 0$

36. $\int \frac{\cos 2x}{\cos x} dx =$

(A) $2\sin x + \log|\sec x + \tan x| + C$ (B) $2\sin x - \log|\sec x - \tan x| + c$
(C) $2\sin x - \log|\sec x + \tan x| + C$ (D) $2\sin x + \log|\sec x - \tan x| + C$

Ans : (C)

Hints : $\int \frac{2\cos^2 x - 1}{\cos x} dx = 2\sin x - \log|\sec x + \tan|$

37. $\int \frac{\sin^8 x - \cos^8 x}{1 - 2\sin^2 x \cos^2 x} dx$

(A) $-\frac{1}{2}\sin 2x + C$ (B) $\frac{1}{2}\sin 2x + C$ (C) $\frac{1}{2}\sin x + C$ (D) $-\frac{1}{2}\sin x + C$

Ans : (A)

Hints : $\int (\sin^2 x - \cos^2 x) dx = -\int \cos^{2x} dx = -\frac{1}{2}\sin 2x + C$

38. The general solution of the differential equation $\log_e\left(\frac{dy}{dx}\right) = x + y$ is

(A) $e^x + e^{-y} = C$ (B) $e^x + e^y = C$ (C) $e^y + e^{-x} = C$ (D) $e^{-x} + e^{-y} = C$

Ans : (A)

Hints : $\frac{dy}{dx} = e^x . e^y \Rightarrow \int e^{-y} dy. = \int e^x dx \Rightarrow \boxed{e^x + e^{-y} = c}$

39. If $y = \frac{A}{x} + Bx^2$, then $x^2 \frac{d^2y}{dx^2} =$

(A) $2y$ (B) y^2 (C) y^3 (D) y^4

Ans : (A)

Hints : $\frac{x^2 d^2 y}{dx^2} = 2\left(A/x + Bx^2\right) = 2y$

40. If one of the cube roots of 1 be ω, then

$$\begin{vmatrix} 1 & 1+\omega^2 & \omega^2 \\ 1-i & -1 & \omega^2 - 1 \\ -i & -1+\omega & -1 \end{vmatrix} =$$

(A) ω (B) i (C) 1 (D) 0

Ans : (D)

Hints : $C_2 \to C_2 - C_3$

$C_3 \to C_3 + C_2$

$C_3 \to C_3 + \omega C_1$

$C_2 \to C_2 - C_1$

41. 4 boys and 2 girls occupy seats in a row at random. Then the probability that the two girls occupy seats side by side is

(A) $\frac{1}{2}$ (B) $\frac{1}{4}$ (C) $\frac{1}{3}$ (D) $\frac{1}{6}$

Ans : (C)

Hints : $n(e) = \lfloor 5 . \lfloor 2$

$n(s) = \lfloor 6$

$p = \frac{\lfloor 5 . \lfloor 2}{\lfloor 6} = \frac{2}{6} = \frac{1}{3}$

42. A coin is tossed again and again. If tail appears on first three tosses, then the chance that head appears on fourth toss is

(A) $\frac{1}{16}$ (B) $\frac{1}{2}$ (C) $\frac{1}{8}$ (D) $\frac{1}{4}$

Ans : (B)

Hints : $p = 1.1.1.\frac{1}{2} = \frac{1}{2}$

43. The coefficient of x^n in the expansion of $\frac{e^{7x}+e^x}{e^{3x}}$ is

(A) $\frac{4^{n-1}-(-2)^{n-1}}{\underline{|n}}$ (B) $\frac{4^{n-1}-2^{n-1}}{\underline{|n}}$ (C) $\frac{4^n-2^n}{\underline{|n}}$ (D) $\frac{4^n+(-2)^n}{\underline{|n}}$

Ans : (D)

Hints : $\frac{e^{7x}+e^x}{e^{3x}} = e^{4x}+e^{-2x}$

Co-efficient of x^n

$$\frac{(4)^n}{n!}+\frac{(2)^n}{n!}(-1)^n = \frac{4^n+(-2)^n}{n!}$$

44. The sum of the series $\frac{1}{1.2}-\frac{1}{2.3}+\frac{1}{3.4}-.....\infty$ is

(A) $2\log_e 2+1$ (B) $2\log_e 2$ (C) $2\log_e 2-1$ (D) $\log_e 2-1$

Ans : (C)

Hints : $s = \frac{1}{1.2}-\frac{1}{2.3}+\frac{1}{3.4}......\infty$

$$=\left(\frac{1}{1}-\frac{1}{2}\right)-\left(\frac{1}{2}-\frac{1}{3}\right)+\left(\frac{1}{3}-\frac{1}{4}\right).....$$

$$=\frac{1}{1}-\frac{1}{2}-\frac{1}{2}+\frac{1}{3}+\frac{1}{3}-\frac{1}{4}-\frac{1}{4}+\frac{1}{5}....$$

$$=\frac{1}{1}-\frac{2}{2}+\frac{2}{3}-\frac{2}{4}+\frac{2}{5}-...$$

$$=2\left[\frac{1}{1}-\frac{1}{2}+\frac{1}{3}-\frac{1}{4}+\frac{1}{5}....\right]-1 = 2\log 2-1$$

45. The number $(101)^{100}-1$ is divisible by

(A) 10^4 (B) 10^6 (C) 10^8 (D) 10^{12}

Ans : (A)

Hints : $(101)^{100}-1 = {}^{100}C_1 100 + {}^{100}C_2 100^2 + {}^{100}C_3 100^3 + ... + {}^{100}C_{100} 100^{100}$

$= 100^2 [1 + {}^{100}C_2 + {}^{100}C_3 100 + ...]$

$= (10^4)$

46. If A and B are coefficients of x^n in the expansions of $(1+x)^{2n}$ and $(1+x)^{2n-1}$ respectively, then A/B is equal to

(A) 4 (B) 2 (C) 9 (D) 6

Ans : (B)

Hints : $A = {}^{2n}C_n$

$B = {}^{2n-1}C_n$

$$\frac{A}{B}=\frac{{}^{2n}C_n}{{}^{2n-1}C_n}=\frac{2n}{n}=2$$

47. If n > 1 is an integer and $x \neq 0$, then $(1 + x)^n - nx - 1$ is divisible by

(A) nx^3 (B) n^3x (C) x (D) nx

Ans : (C)

Hints : $(1+x)^n = {}^nC_0 + {}^nC_1x + {}^nC_2x^2 + {}^nC_3x3 + ...$

$= 1 + nx + x^2\,({}^nC_2 + {}^nC_3\,x + ...)$

$(1+x)^n - nx - 1 = x^2\,({}^nC_2 + {}^nC_3x + ...)$

48. If ${}^nC_4$, ${}^nC_5$ and ${}^nC_6$ are in A.P., then n is

(A) 7 or 14 (B) 7 (C) 14 (D) 14 or 21

Ans : (A)

Hints : ${}^nC_4$, ${}^nC_5$, ${}^nC_6$ are in AP

$2.\,{}^nC_5 = {}^nC_4 + {}^nC_6$

$$\frac{2}{5(n-5)}=\frac{1}{(n-4)}+\frac{1}{30}$$

by solving n = 14 or 7

49. The number of diagonals in a polygon is 20. The number of sides of the polygon is

(A) 5 (B) 6 (C) 8 (D) 10

Ans : (C)

Hints : ${}^nC_2 - n = 20$

n = 8

50. ${}^{15}C_3 + {}^{15}C_5 + ... + {}^{15}C_{15} =$

(A) 2^{14} (B) $2^{14} - 15$ (C) $2^{14} + 15$ (D) $2^{14} - 1$

Ans : (B)

Hints : ${}^{15}C_3 + {}^{15}C_5 + ... + {}^{15}C_{15} = 2^{14} - {}^{15}C_1 = 2^{14} - 15$

51. Let a , b, c be three real numbers such that a + 2b + 4c = 0. Then the equation $ax^2 + bx + c = 0$

(A) has both the roots complex (B) hat its roots lying within $-1 < x < 0$

(C) has one of roots equal to $\frac{1}{2}$ (D) has its roots lying within $2 < x < 6$

Ans : (C)

Hints : $\frac{1}{4}a+\frac{1}{2}b+c=0$

$$\left(\frac{1}{2}\right)^2 a+\left(\frac{1}{2}\right)b+c=0$$

$$\therefore\ x=\frac{1}{2}$$

52. If the ratio of the roots of the equation $px^2 + qx + r = 0$ is a : b, then $\frac{ab}{(a+b)^2} =$

(A) $\frac{p^2}{qr}$ (B) $\frac{pr}{q^2}$ (C) $\frac{q^2}{pr}$ (D) $\frac{pq}{r^2}$

Ans : (B)

Hints : Let roots are $a\alpha$ and $b\alpha$

$$\Rightarrow (a+b)\alpha=\frac{-q}{p}$$

$$ab\alpha^2 = \frac{r}{p}$$

$$\frac{ab\alpha^2}{(a+b)^2\alpha^2} = \frac{r}{p}.\frac{p^2}{q^2}$$

$$\frac{ab}{(a+b)^2} = \frac{rp}{q^2}$$

53. If α and β are the roots of the equation $x^2 + x + 1 = 0$, then the equation whose roots are α^{19} and β^7 is

(A) $x^2 - x - 1 = 0$ (B) $x^2 - x + 1 = 0$ (C) $x^2 + x - 1 = 0$ (D) $x^2 + x + 1 = 0$

Ans : (D)

Hints : α and β are the roots of $x^2 + x + 1 = 0$

$\alpha = \omega$ $\beta = \omega^2$

$\alpha^{19} = \omega$ $\beta^7 = \omega^2$

$x^2 - (\alpha^{19} + \beta^7)x + \alpha^{19}\beta^7 = 0$

Thou,

$x^2 - (\omega + \omega^2)\,x + \omega\,.\,\omega^2 = 0$

$x^2 + x + 1 = 0$

54. For the real parameter t, the locus of the complex number $z = (1 - t^2) + i\sqrt{1+t^2}$ in the complex plane is

(A) an ellipse (B) a parabola (C) a circle (D) a hyperbola

Ans : (B)

Hints : Given $z = (1 - t^2) + i\sqrt{1+t^2}$

Let $z = x + iy$

$x = 1 - t^2$

$y^2 = 1 + t^2$

Thus, $x + y^2 = 2$

$y^2 = 2 - x$

$y^2 = -(x - 2)$

Thus parabola

55. If $x + \frac{1}{x} = 2\cos\theta$, then for any integer n, $x^n + \frac{1}{x^n} =$

(A) $2\cos n\theta$ (B) $2\sin n\theta$ (C) $2i\cos n\theta$ (D) $2i\sin n\theta$

Ans : (A)

Hints : $x + \frac{1}{x} = 2\cos\theta$

Let $x = \cos\theta + 1\sin\theta$

$\frac{1}{x} = \cos\theta - 1\sin\theta$

Thus $x^n + \frac{1}{x^n} = 2\cos n\theta$

56. If $\omega \neq 1$ is a cube root of unity, then the sum of the series $S = 1 + 2\omega + 3\omega^2 + ... + 3n\omega^{3n-1}$ is

(A) $\frac{3n}{\omega - 1}$ (B) $3n(\omega - 1)$ (C) $\frac{\omega - 1}{3n}$ (D) 0

Ans : (A)

Hints : $s = 1 + 2\omega + 3\omega^2 + ... + 3n\,\omega^{3n-1}$

$s\omega = \omega + 2\omega^2 + ... + (3n-1)\omega^{3n} + 3n\omega^{3n}$

$s(1-\omega) = 1 + \omega + \omega^2 + ...+ \omega^{3n-1} - 3n\omega^{3h}$

$= 0 - 3n$

$$s = \frac{-3n}{1-\omega} = \frac{3n}{\omega - 1}$$

57. If $\log_3 x + \log_3 y = 2 + \log_3 2$ and $\log_3(x + y) = 2$, then

(A) $x = 1, y = 8$ (B) $x = 8, y = 1$ (C) $x = 3, y = 6$ (D) $x = 9, y = 3$

Ans : (C)

Hints : $\log_3 x + \log_3 y = 2 + \log_3 2$

$\Rightarrow x.y = 18$

$\log (x + y) = 2 \Rightarrow x + y = 9$

we will get $x = 3$ and $y = 6$

58. If $\log_7 2 = \lambda$, then the value of $\log_{49}(28)$ is

(A) $(2\lambda + 1)$ (B) $(2\lambda + 3)$ (C) $\frac{1}{2}(2\lambda+1)$ (D) $2(2\lambda + 1)$

Ans : (C)

Hints : $\log_{49}28 = \log_{7^2}4 \times 7$

$$= \frac{1}{2}[2\log_7 2 + \log_7 7] = \frac{1}{2}[2\lambda + 1]$$

59. The sequence $\log a$, $\log\frac{a^2}{b}$, $\log\frac{a^3}{b^2}$, ... is

(A) a G.P. (B) an A.P. (C) a H.P. (D) both a G.P. and a H.P

Ans : (B)

Hints : $\log a . (2\log a - \log b)(3\log a - 2\log b)$

$= T_2 - T_1 = \log a - \log b$

$= T_3 - T_2 = \log a - \log b$

60. If in a triangle ABC, sin A, sin B, sin C are in A.P., then

(A) the altitudes are in A.P. (B) the altitudes are in H.P.

(C) the angles are in A.P. (D) the angles are in H.P.

Ans : (B)

Hints : $\frac{1}{2}ap_1 = \frac{1}{2}bp_2 = \frac{1}{2}cp_3 = \Delta$

$$a = \frac{2\Delta}{p_1} \,|\, b = \frac{2\Delta}{p_2} \,|\, c = \frac{2\Delta}{p3}$$

H.P.

61. $\begin{vmatrix} a-b & b-c & c-a \\ b-c & c-a & a-b \\ c-a & a-b & b-c \end{vmatrix} =$

(A) 0 (B) -1 (C) 1 (D) 2

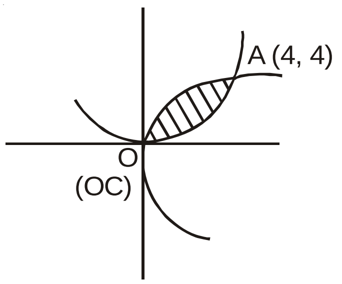
Ans : (A)

Hints : $c_1 \to c_1 + c_2 + c_3$

62. The area enclosed between $y^2 = x$ and $y = x$ is

(A) $\frac{2}{3}$ sq. units (B) $\frac{1}{2}$ units (C) $\frac{1}{3}$ units (D) $\frac{1}{6}$ units

Ans : (D)



Hints : $A = \int_0^1 \left(\sqrt{x} - x\right) dx$

$= \frac{2}{3}\left(x^{3/2}\right)_0^1 - \frac{1}{2}(x^2)_o^1 = \frac{2}{3}[1-0] - \frac{1}{2}[1-0]$

$= \frac{2}{3} - \frac{1}{2} = \frac{4-3}{6} = \frac{1}{6}$

63. Let $f(x) = x^3e^{-3x}$, $x > 0$. Then the maximum value of $f(x)$ is

(A) e^{-3} (B) $3e^{-3}$ (C) $27e^{-9}$ (D) ∞

Ans : (A)

Hints : $f(x) = x^3.e^{-3x}$

$= f'(x) = 3x^2e^{-3x} + x^3\,e^{-3x}(-3)$

$= x^23e^{-3x}[1-x] = 0, x = 1$

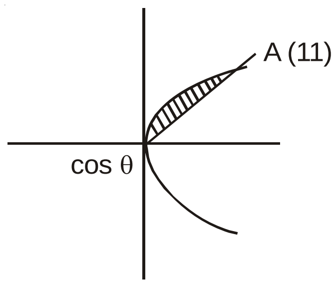
Maximum at $x = 1$

$f(1) = e^{-3}$

64. The area bounded by $y^2 = 4x$ and $x^2 = 4y$ is

(A) $\frac{20}{3}$ sq. unit (B) $\frac{16}{3}$ sq. unit (C) $\frac{14}{3}$ sq. unit (D) $\frac{10}{3}$ sq. unit

Ans : (B)



Hints : $A = \int_0^4 \left(\sqrt{4x} - \frac{x^2}{4}\right) dx$

$= 2.\frac{2}{3}\left(x^{3/2}\right)_0^4 - \frac{1}{4.3})(x^3)_0^4$

$= \frac{4}{3}\left[4^{3/2} - 0\right] - \frac{1}{4.3}[4^3 - 0]$

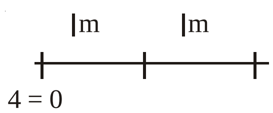
$= \frac{4^{5/2}}{3} - \frac{16}{3} = \frac{32-16}{3} = \frac{16}{3}$

65. The acceleration of a particle starting from rest moving in a straight line with uniform acceleration is 8m/sec^2. The time taken by the particle to move the second metre is

(A) $\frac{\sqrt{2}-1}{2}$ sec (B) $\frac{\sqrt{2}+1}{2}$ sec (C) $(1+\sqrt{2})$ sec (D) $\left(\sqrt{2}-1\right)$ sec

Ans : (A)

Hints :



$S = ut + \frac{1}{2}at^2$	$S = uT + \frac{1}{2}aT^2$
$1 = \frac{1}{2}.8.t^2$	$2 = \frac{1}{2}8.T^2$
$\frac{1}{4} = t^2$	$T^2 = \frac{1}{2}$
$t = \frac{1}{2}$	$T = \frac{1}{\sqrt{2}}$

$$\text{Time} = \frac{1}{\sqrt{2}} - \frac{1}{2} = \frac{2}{2} = \frac{\sqrt{2}-1}{2}$$

66. The solution of

$$\frac{dy}{dx} = \frac{y}{x} + \tan\frac{y}{x} \text{ is}$$

(A) $x = c\sin(y/x)$ (B) $x = c\sin(xy)$ (C) $y = c\sin(y/x)$ (D) $xy = c\sin(x/y)$

Ans : (A)

Hints : $\frac{dy}{dx} = \frac{y}{x} + \tan\frac{y}{x}$

Put $\frac{y}{x} = \theta$, $y = \theta x$

$$\frac{dy}{dx} = \theta + \frac{xd\theta}{dx}$$

$$\theta + x.\frac{d\theta}{dx} = \theta + \tan\theta, \ \frac{d\theta}{\tan\theta} = \frac{dy}{x}$$

$$\int \cot\theta \, d\theta = \int \frac{dx}{x}$$

$\log \sin\theta = \log x + \log c$

$\sin\theta = x.c.$, $\sin\frac{y}{x} = x.c$

$x = c.\sin\frac{y}{x}$

67. Integrating Factor (I.F.) of the defferential equation

$$\frac{dy}{dx} - \frac{3x^2y}{1+x^3} = \frac{\sin^2(x)}{1+x} \text{ is}$$

(A) e^{1+x^3} (B) $\log(1+x^3)$ (C) $1+x^3$ (D) $\frac{1}{1+x^3}$

Ans : (D)

Hints : If $e^{\int pdx} = e^{-\int\frac{3x^2dx}{1+x^3}} = e^{-\log(1+x^3)} = e^{\log(1+x^3)^{-1}}$

$= (1+x^3)^{-1} = \frac{1}{1+x^3}$

68. The differential equation of $y = ae^{bx}$ (a & b are parameters) is

(A) $yy_1 = y_2^2$ (B) $yy_2 = y_1^2$ (C) $yy_1^2 = y_2$ (D) $yy_2^2 = y_1$

Ans : (B)

Hints : $y = a.e^{bx}$ .... (i)

$y_1 = abe^{bx}$

$y_1 = by$ .... (ii)

$y_2 = by_1$ .... (iii)

Dividing (ii) & (iii) $\dfrac{y_1}{y_2} = \dfrac{y}{y_1} \Rightarrow y_1^{\,2} = yy_2$

69. The value of

$$\lim_{n\to\infty}\sum_{r=1}^{n}\frac{r^3}{r^4+n^4} \text{ is}$$

(A) $\dfrac{1}{2}\log_e(1/2)$ (B) $\dfrac{1}{4}\log_e(1/2)$ (C) $\dfrac{1}{4}\log_e 2$ (D) $\dfrac{1}{2}\log_e 2$

Ans : (C)

Hints : $\displaystyle \underset{n\to\infty}{Lt}.\sum\frac{n^3\left(\frac{r}{n}\right)^3}{n^4\left[\left(\frac{r}{n}\right)^4+1\right]}$

$= \dfrac{1}{4}.4\displaystyle\int_0^1\frac{x^3}{1+x^4}dx = \frac{1}{4}\left[\log(1+x^4)\right]_0^1$

$= \dfrac{1}{4}(\log 2 - \log 1) = \dfrac{1}{4}\log 2$

70. The value of $\displaystyle\int_0^{\pi}\sin^{50}x\cos^{49}x\ dx$ is

(A) 0 (B) $\pi/4$ (C) $\pi/2$ (D) 1

Ans : (A)

Hints : $I = \displaystyle\int_0^{\pi}\sin^{50}x.\cos^{49}x\ dx \quad \int_0^4 f(x) = \int_0^4 f(a-x)$

$I = \displaystyle\int_0^{\pi}\sin^{50}x(-\cos^{49}(x)) = -\int_0^{\pi}\sin^{50}x.\cos^{49}x$

$= I = -I$

$I = 0$

71. $\displaystyle\int 2^x(f'(x)+f(x)\log 2)dx$ is

(A) $2^x f'(x)+C$ (B) $2^x f(x)+C$ (C) $2^x(\log 2)f(x)+C$ (D) $(\log 2)\,f(x)+C$

Ans : (B)

Hints : $I = \displaystyle\int 2^x f'(x)dx + \int 2^x f(x)\log 2dx$

$= 2^x f(x)$

72. Let $f(x) = \tan^{-1}x$. Then $f'(x) + f''(x)$ is = 0, when x is equal to

(A) 0 (B) + 1 (C) i (D) – i

Ans : (B)

Hints : $f(x) = \tan^{-1}x$

$$f'(x) = \frac{1}{1+x^2}$$

$$f''(x) = \frac{-1}{(1+x^2)}.2x \;,\; \frac{1}{1+x^2} = \frac{2x}{(1+x^2)^2}$$

$1 + x^2 = 2x,\ (x-1)^2 = 0$

$x = 1$

73. If $y = \tan^{-1}\frac{\sqrt{1+x^2}-1}{x}$, then $y'(1) =$

(A) 1/4 (B) 1/2 (C) – 1/4 (D) – 1/2

Ans : (A)

Hints : $y = \tan^{-1}\left(\frac{\sqrt{1+x^2}-1}{x}\right)$ Put $x = \tan\theta$

$$= \tan^{-1}\left(\frac{\sec\theta-1}{\tan\theta}\right) = \tan^{-1}\left(\frac{1-\cos\theta}{\sin\theta}\right)$$

$$= \tan^{-1}\left(\frac{2\sin^2\frac{\theta}{2}}{2\sin\frac{\theta}{2}\cos\frac{\theta}{2}}\right) = \tan^{-1}\tan\frac{\theta}{2}$$

$$= \frac{\theta}{2} = \frac{1}{2}.\tan^{-1}x,\quad y' = \frac{1}{2(1+x^2)}$$

$$y'(1) = \frac{1}{2.2} = \frac{1}{4}$$

74. The value of $\lim\limits_{x\to1}\frac{x+x^2+...+x^n-n}{x-1}$ is

(A) n (B) $\frac{n+1}{2}$ (C) $\frac{n(n+1)}{2}$ (D) $\frac{n(n-1)}{2}$

Ans : (C)

Hints : $\mathop{Lt}\limits_{x\to1}\frac{(x-1)+(x^2-1)+(x^3-1)............(x^4-1)}{x-1}$

$$= 1+2+3 .... + n = \frac{n(n+1)}{2}$$

75. $\lim\limits_{x\to0}\frac{\sin(\pi\sin^2 x)}{x^2} =$

(A) π^2 (B) 3π (C) 2π (D) π

Ans : (D)

Hints : $= \underset{x\to 0}{\text{Lt}} \dfrac{\sin\left(\pi \sin^2 x\right)}{x^2} = \underset{x\to 0}{\pi} \dfrac{\sin^2 x}{x^2} = \pi$

$= \pi$

76. If the function

$$f(x) = \begin{cases} \dfrac{x^2 - (A+2)x + A}{x-2} & \text{for } x \neq 2 \\ 2 & \text{for } x = 2 \end{cases}$$

is continuous at x = 2, then

(A) $A = 0$ (B) $A = 1$ (C) $A = -1$ (D) $A = 2$

Ans : (A)

Hints : $\dfrac{4-(A+2)2+A}{0} = \dfrac{-A}{0}$ Put A = 0.

77. $f(x) = \begin{cases} [x]+[-x], & \text{when } x \neq 2 \\ \lambda & \text{when } x = 2 \end{cases}$

If f(x) is continuous at x = 2, the value of λ will be

(A) -1 (B) 1 (C) 0 (D) 2

Ans : (A)

Hints : LHL $= \underset{h\to 0}{\text{Lt}} [2-h]+[-(2-h)]$

$= \underset{h\to 0}{\text{Lt}}\ 1+(-2+h) = 1-2 = -1$

RML $= \underset{h\to 0}{\text{Lt}} [2+h]+(-(2+h))$

$= 2 + (-2-h) = 2-3 = -1$

$\lambda = -1$

78. The even function of the following is

(A) $f(x) = \dfrac{a^x + a^{-x}}{a^x - a^{-x}}$ (B) $f(x) = \dfrac{a^x + 1}{a^x - 1}$

(C) $f(x) = x.\dfrac{a^x - 1}{a^x + 1}$ (D) $f(x) = \log_2\left(x + \sqrt{x^2+1}\right)$

Ans : (C)

Hints : $f(-x) = (-x)\dfrac{a^{-x}-1}{a^{-x}+1}$

$= (-n)\ \dfrac{1-a^x}{1+a^x}$

$= n\dfrac{(a^x-1)}{(a^x+1)} = f(x)$

79. If f(x + 2y, x – 2y) = xy, then f(x, y) is equal to

(A) $\dfrac{1}{4}xy$ (B) $\dfrac{1}{4}(x^2 - y^2)$ (C) $\dfrac{1}{8}(x^2 - y^2)$ (D) $\dfrac{1}{2}(x^2 + y^2)$

Ans : (C)

Hints :
$$\begin{array}{l} x+2y=a \\ \underline{x-2y=b} \\ 2x=a+b \\ 4y=a-b \end{array}$$

$$f(a,b)=\left(\frac{a+b}{2}\right)\left(\frac{a-b}{4}\right)=\frac{a^2-b^2}{8}$$

80. The locus of the middle points of all chords of the parabola $y^2 = 4ax$ passing through the vertex is

(A) a straight line (B) an ellipse (C) a parabola (D) a circle

Ans : (C)

Hints : $2h=x,\ 2k=y$

$y^2=4ax$

$k^2=2ah$

$y^2=2ax$

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DESCRIPTIVE TYPE QUESTIONS

SUB : MATHEMATICS

1. The harmonic mean of two numbers is 4. Their arithemetic mean A and the geometric mean G satisfy the relation $2A + G^2 = 27$. find the numbers.

Ans. (3, 6)

Sol : Let the number be a, b

$\boxed{A.H = G^2}$ $\boxed{H = 4}$

$\Rightarrow G^2 = 4A$

$2A + G^2 = 27$ $\Rightarrow 2A + 4A = 27$

$$\Rightarrow A = \frac{27}{6} = \frac{9}{2}$$

$\Rightarrow G^2 = 18 \Rightarrow G = \sqrt{18}$

$\Rightarrow$ a.b = 18

a + b = 9 $\Rightarrow \boxed{\begin{matrix} a=6 & \text{or} & a=3 \\ b=3 & & b=6 \end{matrix}}$

2. If the area of a rectangle is 64 sq. unit, find the minimum value possible for its perimeter.

Ans. 32

Sol. Let the dimesions be a, b

Area = ab

Paimeter = 2(a + b)

We have ab = 64 $\Rightarrow b = \dfrac{64}{a}$

Perimeter as function of a

$$P(a) = 2\left(a + \frac{64}{a}\right)$$

for maxima or minimum

$$P'(a) = 2\left(1 - \frac{64}{a^2}\right) = 0 \Rightarrow a = \pm 8 = 8$$

$$P''(a) = 2 \times \frac{64}{a^3} = \frac{2 \times 64}{8^3} > 0$$

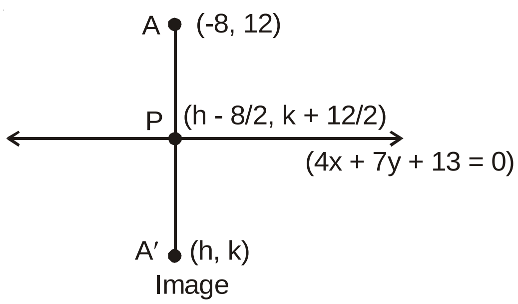
P (8) is minimum

Minimum P (8) = 2 (8 + 8) = 32

3. Find the image of the point (–8, 12) with respect to the line 4x + 7y + 13 = 0

Ans. (–16, –2)

Sol.



$$4\left(\frac{h-8}{2}\right)+7\left(\frac{k+12}{2}\right)+13=0$$

$$2h-16+\frac{7k}{2}+42+13=0$$

$$4h + 7k + 78 = 0$$

$$\boxed{4h+7k=-78} \text{.......(i)}$$

2 nd equation, we can get

Slope of $AA' = \frac{7}{4}$

$$\frac{k-12}{n+18}=\frac{7}{4}$$

$\Rightarrow 4k-48=75+56$

$4k-7h=104$ ....(ii)

Solving (i) & (ii)

Equation (i) × 7 + Equation (ii) × 4

$$\begin{aligned} & 28h+49k=-546 \\ \Rightarrow\ & \underline{-28h+16k=416} \\ & \quad 65k=-130 \end{aligned}$$

$$\boxed{k=-2}$$

$$\boxed{h=-16}$$

A′ (– 16, –2) is the image of (–8, 12)

4. How many triangles can be formed by joining 6 points lying on a circle ?

Ans. 20

Sol. Number of triangle

$${}^6C_3=\frac{\lfloor 6}{\lfloor 3\,\lfloor 3}=20$$

5. If $r^2 = x^2 + y^2 + z^2$, then prove that

$$\tan^{-1}\left(\frac{yz}{rx}\right)+\tan^{-1}\left(\frac{zx}{ry}\right)+\tan^{-1}\left(\frac{xy}{rz}\right)=\frac{\pi}{2}$$

A. $\theta=\tan^{-1}\left(\frac{S_1-S_3}{1-S_2}\right)$

$$1 - S_2 = 1 - \left(\frac{z^2}{r^2} + \frac{x^2}{r^2} + \frac{y^2}{r^2}\right) = 0 \qquad \Rightarrow \theta = \pi/2$$

6. Determine the sum of imaginary roots of the equation

$$(2x^2 + x - 1)(4x^2 + 2x - 3) = 6$$

Ans. $-\frac{1}{2}$

Sol. Put $2x^2 + x = y$

$\Rightarrow (4-1)\ (24-3) = 6$, on solving

$$\Rightarrow 2x^2 + x + 1/2 = 0$$

$$\boxed{\alpha + \beta = -1/2}$$

7. If cos A + cos B + cos C = 0, prove that

$$\cos 3A + \cos 3B + \cos 3C = 12 \cos A \cos B \cos C$$

A. $\text{L.H.S} = \sum 4\cos^3 A - 3\cos A$

$$= 4\sum \cos^3 A - 3\sum \cos A$$

$= 12 \cos A \,.\, \cos B.\, \cos C$

8. Let IR be the set of real numbers and $f : IR \to IR$ be such that for all $x, y \in IR$, $|f(x) - f(y)| \le |x - y|^3$. Prove that f is a constant function.

A. $\lim_{x \to y} \left|\frac{f(x) - f(y)}{x - y}\right| \le |x - y|^3$

$= |f'(x)| \le |0| \quad \Rightarrow |f'(x)| = 0$

$\Rightarrow f(x) = \text{constant}$

9. Find the general solution of

$$(x + \log y)\, dy + y\, dx = 0$$

Ans. $xy + y \ln y - y = 0$

Sol. $x\, dy + y\, dx + \log y\, dy = 0$

$$\int d(xy) + \int \log y\, dy = 0$$

$xy + y \ln y - y = 0$

10. Prove that $I = \int_0^{\pi/2} \frac{\sqrt{\sec x}}{\sqrt{\operatorname{cosec} x} + \sqrt{\sec x}} dx = \frac{\pi}{4}$

A. $I = \int_0^{\pi/2} \frac{\sqrt{\sec x}}{\sqrt{\operatorname{cosec} x} + \sqrt{\sec x}} dx = \int_0^{\pi/2} \frac{\sqrt{\operatorname{cosec} x}}{\sqrt{\operatorname{cosec} x} + \sqrt{\sec x}}$

$$2I = \int_0^{\pi/2} dx \quad \Rightarrow \boxed{I = \pi/4}$$

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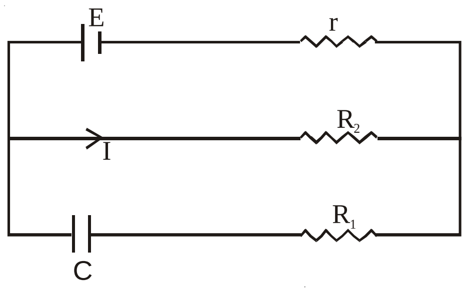
ANSWERS & HINTS
for
WBJEE - 2011

MULTIPLE CHOICE QUESTIONS
SUB : PHYSICS & CHEMISTRY

1. The charge on the capacitor of capacitance C shown in the figure below will be



(A) CE (B) $\frac{CE\,R_1}{R_1+r}$ (C) $\frac{CE\,R_2}{R_2+r}$ (D) $\frac{CE\,R_1}{R_2+r}$

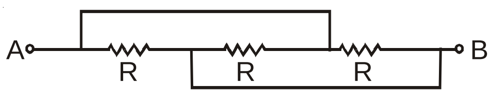
Ans : (C)

Hints : $I=\frac{E}{R_2+r}$ (Since finally no current flows through capacitor)

$\therefore$ Potential difference across R_2, $V=IR_2=\frac{ER_2}{R_2+r}$

$\therefore$ Charge on the capacitor $Q=CV=\frac{CER_2}{R_2+r}$

2. The resistance across A and B in the figure below will be

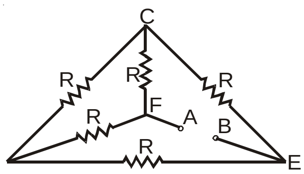


(A) 3R (B) R (C) $\frac{R}{3}$ (D) None of these

Ans : (C)

Hints : Resistance are in parallel $\therefore Req=\frac{R}{3}$

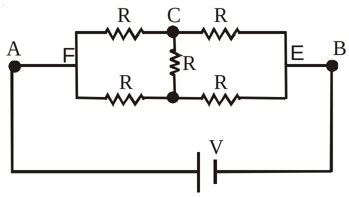
3. Five equal resistance, each of resistance R, are connected as shown in figure below. A battery of V volt is connected between A and B. The current flowing in FC will be



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

Ans : (C)

Hints :



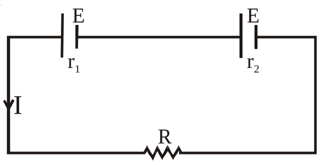
$$I = \frac{V}{R} \therefore \text{Current in FC} = \frac{I}{2} = \frac{V}{2R}$$

4. Two cells with the same e.m.f. E and different internal resistances r_1 and r_2 are connected in series to an external resistance R. The value of R so that the potential difference across the first cell be zero is

(A) $\sqrt{r_1 r_2}$ (B) $r_1 + r_2$ (C) $r_1 - r_2$ (D) $\frac{r_1 + r_2}{2}$

Ans : (C)

Hints :



$$I = \frac{2E}{R + r_1 + r_2}$$

Potential difference across first cell $V = E - Ir_1 = 0$

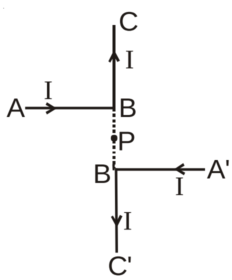
$$E - \frac{2Er_1}{R + r_1 + r_2} = 0$$

$$\left[\frac{R + r_1 + r_2 - 2r_1}{R + r_1 + r_2}\right] = 0$$

$$\Rightarrow R + r_2 - r_1 = 0$$

$$R = r_1 - r_2$$

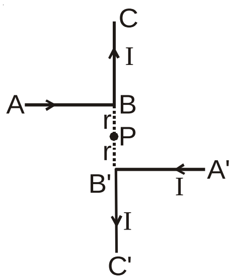
5. Current through ABC and A'B'C' is I. What is the magnetic field at P? BP = PB' = r (Here C'B' PBC are collinear)



(A) $B = \frac{1}{4\pi}\frac{2I}{r}$ (B) $B = \frac{\mu_0}{4\pi}\left(\frac{2I}{r}\right)$ (C) $B = \frac{\mu_0}{4\pi}\left(\frac{I}{r}\right)$ (D) Zero

Ans : (B)

Hints :



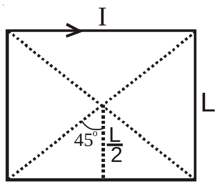
$$B = 2\left[\frac{\mu_o}{4\pi}\frac{I}{r}\right]$$

6. The magnetic field at the point of intersection of diagonals of a square wire loop of side L carrying a current I is

(A) $\frac{\mu_0 I}{\pi L}$ (B) $\frac{2\mu_0 I}{\pi L}$ (C) $\frac{\sqrt{2}\mu_0 I}{\pi L}$ (D) $\frac{2\sqrt{2}\mu_0 I}{\pi L}$

Ans : (D)

Hints : $B = 4\left[\frac{\mu_o}{4\pi}\frac{I}{\left(\frac{L}{2}\right)}\left(\sin 45^o + \sin 45^o\right)\right]$



$$= \frac{\mu_o}{\pi}\frac{2I}{L}\cdot\frac{2}{\sqrt{2}}; \quad B = \frac{\mu_o}{\pi}\frac{2\sqrt{2}I}{L}$$

7. In an inelastic collision an electron excites as hydrogen atom from its ground state to a M-shell state. A second electron collides instantaneously with the excited hydrogen atom in the M-State and ionizes it. At least how much energy the second electron transfers to the atom in the M-state?

(A) +3.4 eV (B) +1.51 eV (C) –3.4 eV (D) –1.51 eV

Ans : (B)

Hints : $E_m = -\frac{13.6}{(3)^2} = -1.51$

Minimum energy required by electron should be +1.51 eV

8. A radioactive nucleus of mass number A, initially at rest, emits an α-particle with a speed ν. The recoil speed of the daughter nucleus will be

(A) $\frac{2\nu}{A-4}$ (B) $\frac{2\nu}{A+4}$ (C) $\frac{4\nu}{A-4}$ (D) $\frac{4\nu}{A+4}$

Ans : (C)

Hints : From conservation of momentum $4.V = (A-4)V_1$; $V_1 = \frac{4V}{A-4}$

9. In the nuclear reaction

$^{14}_{7}N + X \rightarrow ^{14}_{6}C + ^{1}_{1}H$ the X will be

(A) $^{0}_{-1}e$ (B) $^{1}_{1}H$ (C) $^{2}_{1}H$ (D) $^{1}_{0}n$

Ans : (D)

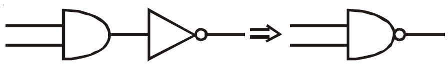
Hints : $X \rightarrow {}^{1}_{0}n$

10. Which type of Gate the following truth table represents?

Input		Output
A	B	Q
0	0	1
0	1	1
1	0	1
1	1	0

(A) NOT (B) AND (C) OR (D) NAND

Ans : (D)

Hints : 

11. Given $\vec{A} = 2\hat{i} + 3\hat{j}$ and $\vec{B} = \hat{i} + \hat{j}$. The component of vector $\vec{A}$ along vector $\vec{B}$ is

(A) $\frac{1}{\sqrt{2}}$ (B) $\frac{3}{\sqrt{2}}$ (C) $\frac{5}{\sqrt{2}}$ (D) $\frac{7}{\sqrt{2}}$

Ans : (C)

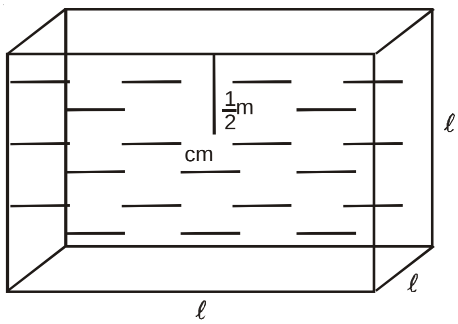
Hints : Component of $\vec{A}$ along $\vec{B}$ = $\vec{A}.\frac{\vec{B}}{|\vec{B}|}$

Component of $\vec{A}$ along $\vec{B} = \frac{5}{\sqrt{2}}$

12. A cubical vessel of height 1 m is full of water. What is the amount of work done in pumping water out of the vessel? (Take g = 10 m s^{-2})

(A) 1250 J (B) 5000 J (C) 1000 J (D) 2500 J

Ans : (B)

Hints : 

$V = \ell^3 = 1m^3$

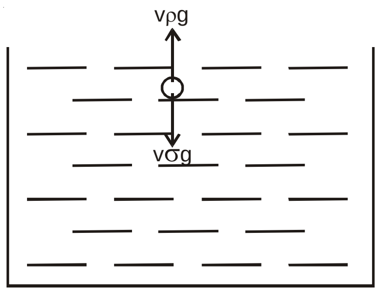
$m = 1 \times 1000 = 1000kg$; $W = mgh = 1000 \times 10 \times \frac{1}{2} = 5000J$

13. A stone of relative density K is released from rest on the surface of a lake. If viscous effects are ignored, the stone sinks in water with an acceleration of

(A) g(1–K) (B) g(1+K) (C) $g\left(1 - \frac{1}{K}\right)$ (D) $g\left(1 + \frac{1}{K}\right)$

Ans : (C)

Hints :



$$F = v\sigma g - v\rho g = v\sigma g\left(1-\frac{\rho}{\sigma}\right) = mg\left(1-\frac{1}{k}\right)$$

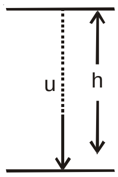
$$a = g\left(1-\frac{1}{k}\right)$$

14. If a person can throw a stone to maximum height of h metre vertically, then the maximum distance through which it can be thrown horizontally by the same person is

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

Ans : (C)

Hints :



$$h = \frac{u^2}{2g} \Rightarrow u^2 = 2gh$$

Maximum horizontal distance

$$R_{max} = \frac{u^2}{g}\left(\text{when } \theta = 45^o\right)$$

$$R_{max} = 2h$$

15. A body of mass 6 kg is acted upon by a force which causes a displacement in it given by $x = \frac{t^2}{4}$ metre where t is the time in second. The work done by the force in 2 seconds is

(A) 12 J (B) 9J (C) 6 J (D) 3 J

Ans : (D)

Hints : $m = 6kg \quad x = \frac{t^2}{4}$

$$\frac{dx}{dt} = v = \frac{t}{2} \quad v(0) = 0;\ v(2) = \frac{2}{2} = 1$$

$$K_i = \frac{1}{2}m(0)^2 = 0;\ K_f = \frac{1}{2}m(1)^2 = \frac{1}{2}\times 6\times 1 = 3;\ W = K_f - K_i = 3 - 0 = 3J$$

16. A box is moved along a straight line by a machine delivering constant power. The distance moved by the body in time t is proportional to

(A) $t^{\frac{1}{2}}$ (B) $t^{\frac{3}{4}}$ (C) $t^{\frac{3}{2}}$ (D) t^2

Ans : (C)

Hints : $P = Fv = m.\frac{dv}{dt}.v$

$$\int vdv = \int P/m\,dt\,; \quad \frac{v^2}{2} = \frac{Pt}{m}$$

$$V = \sqrt{\frac{2p}{m}}\,t^{\frac{1}{2}}\,; \quad \frac{dx}{dt} = \sqrt{\frac{2p}{m}}\,t^{\frac{1}{2}}$$

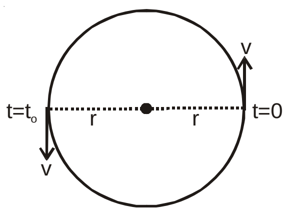
$$\int dx = \sqrt{\frac{2p}{m}}\int t^{\frac{1}{2}}dt\,; \quad x = \sqrt{\frac{2p}{m}}\,\frac{t^{\frac{3}{2}}}{\frac{3}{2}} = \frac{2}{3}\sqrt{\frac{2p}{m}}\,t^{\frac{3}{2}}$$

$$x \,\alpha\, t^{\frac{3}{2}}$$

17. A particle is moving with a constant speed ν in a circle. What is the magnitude of average velocity after half rotation?

(A) 2ν (B) $2\frac{\nu}{\pi}$ (C) $\frac{\nu}{2}$ (D) $\frac{\nu}{2\pi}$

Ans : (B)

Hints : 

$$T = \frac{2\pi r}{V}\,; \quad t_o = \frac{T}{2} = \frac{\pi r}{V}\,; \quad V_{av} = \frac{2r}{\frac{\pi r}{v}} = \frac{2v}{\pi}$$

18. A cricket ball of mass 0.25 kg with speed 10 m/s collides with a bat and returns with same speed within 0.01 S. The force acted on bat is

(A) 25 N (B) 50 N (C) 250 N (D) 500 N

Ans : (D)

Hints : $\Delta P = 2mV = 2 \times 0.25 \times 10 = 5\frac{kgm}{s}$

$$F = \frac{\Delta P}{\Delta t} = \frac{5}{0.01} = 500N$$

19. If the Earth were to suddenly contract to $\frac{1}{n}$th of its present radius without any change in its mass, the duration of the new day will be nearly

(A) 24/n hr. (B) 24 n hr. (C) $24/n^2$ hr. (D) $24\,n^2$ hr.

Ans : (C)

Hints : $I_1\omega_1 = I_2\omega_2$

$$\frac{2}{5}MR^2\left(\frac{2\pi}{T_1}\right) = \frac{2}{5}M.\frac{R^2}{n^2}\left(\frac{2\pi}{T_2}\right)$$

$$T_2 = \frac{T_1}{n^2} = \frac{24}{n^2}$$

20. If g is the acceleration due to gravity on the surface of the earth, the gain in potential energy of an object of mass m raised from the earth's surface to a height equal to the radius R of the earth is

(A) $\frac{mg\ R}{4}$ (B) $\frac{mg\ R}{2}$ (C) $mg\ R$ (D) $2\,mg\ R$

Ans : (B)

Hints : $\Delta U = \dfrac{mgh}{1+\dfrac{h}{R}} = \dfrac{mgR}{1+\dfrac{R}{R}} = \dfrac{mgR}{2}$

21. A material has Poisson's ratio 0.50. If a uniform rod of it suffers a longitudinal strain of 2×10^{-3}, then the percentage change in volume is

(A) 0.6 (B) 0.4 (C) 0.2 (D) zero

Ans : (D)

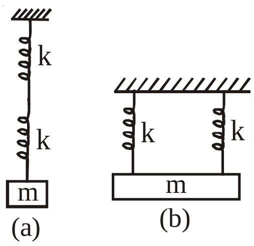
Hints : Poisson's ratio is 0.5 so there is no change in volume

22. Two identical springs are connected to mass m as shown (k = spring constant). If the period of the configuration in (a) is 2S, the period of the configuration (b) is

(A) $\sqrt{2}\,S$ (B) $1\,S$ (C) $\frac{1}{\sqrt{2}}S$ (D) $2\sqrt{2}\,S$

Ans : (B)

Hints : $\dfrac{T_1}{T_2} = \sqrt{\dfrac{k_2}{k_1}} \Rightarrow \dfrac{2}{T} = \sqrt{\dfrac{2k}{\frac{k}{2}}} = 2$



$\therefore T = 1\,S$

23. An object weighs m_1 in a liquid of density d_1 and that in liquid of density d_2 is m_2. The density d of the object is

(A) $d = \dfrac{m_2d_2 - m_1d_1}{m_2 - m_1}$ (B) $d = \dfrac{m_1d_1 - m_2d_2}{m_2 - m_1}$ (C) $d = \dfrac{m_2d_1 - m_1d_2}{m_1 - m_2}$ (D) $d = \dfrac{m_1d_2 - m_2d_1}{m_1 - m_2}$

Ans : (D)

Hints : $V(d - d_1)g = m_1g$

$V(d - d_2)g = m_2g$

$$\frac{d - d_1}{d - d_2} = \frac{m_1}{m_2} \quad \therefore d = \frac{m_1d_2 - m_2d_1}{m_1 - m_2}$$

24. A body floats in water with 40% of its volume outside water. When the same body floats in an oil, 60% of its volume remains outside oil. The relative density of oil is

(A) 0.9 (B) 1.0 (C) 1.2 (D) 1.5

Ans : (D)

Hints : $V\sigma g = 0.6\, V\sigma_1 g$ ...... (1)

$V\sigma g = 0.4\, V\sigma_2 g$ .... (2)

Dividing (1) and (2) $1 = \frac{6}{4}\frac{\sigma_1}{\sigma_2} \therefore \frac{\sigma_2}{\sigma_1} = \frac{3}{2}$

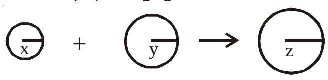
25. Two soap bubbles of radii x and y coalesee to constitute a bubble of radius z. Then z is requal to

(A) $\sqrt{x^2+y^2}$ (B) $\sqrt{x+y}$ (C) $x+y$ (D) $\frac{x+y}{2}$

Ans : (A)

Hints : $n = n_1 + n_2$

$pv = p_1v_1 + p_2v_2$



$p_1 = p_0 + \frac{4T}{x}$, $p_2 = p_0 + \frac{4T}{y}$, $p = p_0 + \frac{4T}{z}$

If the process takes place is vaccume then $p_0 = 0$

$p_1 = \frac{4T}{x}$, $p_2 = \frac{4T}{y}$, $p = \frac{4T}{z}$

If process is isothermal

$\therefore p_1v_1 + p_2v_2 = pv$

$\therefore z = \sqrt{x^2+y^2}$

26. A particle of mass m is located in a one dimensional potential field where potential energy is given by : $V(x) = A(1 - \cos px)$, where A and p are constants. The period of small oscillations of the particle is

(A) $2\pi\sqrt{\frac{m}{(Ap)}}$ (B) $2\pi\sqrt{\frac{m}{(Ap^2)}}$ (C) $2\pi\sqrt{\frac{m}{A}}$ (D) $\frac{1}{2\pi}\sqrt{\frac{Ap}{m}}$

Ans : (B)

Hints : $v_x = A(1-\cos px)$

$F = -\frac{du}{dx} = -Ap\,\sin px$

For small (x)

$F = -AP^2x$

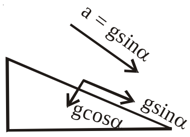
$a = -\frac{Ap^2}{m}x \quad a = -\omega^2 x$

$\omega = \sqrt{\frac{AP^2}{m}} \quad \therefore T = 2\pi\sqrt{\frac{m}{Ap^2}}$

27. The period of oscillation of a simple pendulum of length *l* suspended from the roof of a vehicle, which moves without friction down an inclined plane of inclination α, is given by

(A) $2\pi\sqrt{\frac{l}{g\cos\alpha}}$ (B) $2\pi\sqrt{\frac{l}{g\sin\alpha}}$ (C) $2\pi\sqrt{\frac{l}{g}}$ (D) $2\pi\sqrt{\frac{l}{g\tan\alpha}}$

Ans : (A)

Hints : 

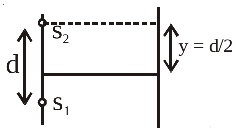
$g_{eff} = g\cos\alpha$

$T = 2\pi\sqrt{\dfrac{\ell}{g_{eff}}}$

28. In Young's double slit experiment the two slits are d distance apart. Interference pattern is observed on a screen at a distance D from the slits. A dark fringe is observed on the screen directly opposite to one of the slits. The wavelength of light is

(A) $\dfrac{D^2}{2d}$ (B) $\dfrac{d^2}{2D}$ (C) $\dfrac{D^2}{d}$ (D) $\dfrac{d^2}{D}$

Ans : (D)

Hints : 

n^{th} Dark fringe

$(2n-1)\dfrac{D\lambda}{2d} = \dfrac{d}{2}$

$\lambda = \dfrac{d^2}{(2n-1)D} = \dfrac{d^2}{D}$ [for n = 1]

29. A plane progressive wave is given by y = 2 cos 6.284 (330 t – x). What is period of the wave ?

(A) $\dfrac{1}{330}$S (B) $2\pi \times 330$ S (C) $(2\pi \times 330)^{-1}$S (D) $\dfrac{6.284}{330}$S

Ans : (A)

Hints : $y = 2\cos 2\pi(330t - x)$

$\omega = 2\pi \times 330$

$\therefore T = \dfrac{1}{330}$ s

30. The displacement of a particle in S.H.M. varies according to the relation $x = 4(\cos \pi t + \sin \pi t)$. The amplitude of the particle is

(A) – 4 (B) 4 (C) $4\sqrt{2}$ (D) 8

Ans : (C)

Hints : $R\sin\delta = 4$

$R\cos\delta = 4$

$R = 4\sqrt{2}$

31. Two temperature scales A and B are related by $\dfrac{A-42}{110} = \dfrac{B-72}{220}$. At which temperature two scales have the same reading ?

(A) -42^0 (B) -72^0 (C) $+12^0$ (D) -40^0

Ans : (C)

Hints : $\dfrac{A-42}{110} = \dfrac{B-72}{220}$, A = B

$\dfrac{A-42}{110} = \dfrac{A-72}{220}$

$2A - 84 = A - 72$

$A = 12$

32. An ideal gas is compressed isothermally until its pressure is doubled and then allowed to expand adiabatically to regain its original volume ($\gamma = 1.4$ and $2^{-1.4} = 0.38$). The ratio of the final to initial pressure is

(A) 0.76 : 1 (B) 1 : 1 (C) 0.66 : 1 (D) 0.86 : 1

Ans : (B)

Hints :
$$\begin{array}{ccc} P_i & V & T \\ \downarrow & \downarrow & \downarrow \\ 2P_i & \frac{V}{2} & T \end{array}$$

$$P_f V^{\gamma} = (2P_i)\left(\frac{V}{2}\right)^{\gamma}$$

$$\frac{P_f}{P_i} = 2\left(\frac{\gamma}{2\gamma}\right)^{\gamma} = 2\,(2)^{-\gamma}$$

$$= 2 \times 0.38 = 0.76$$

33. Air inside a closed container is saturated with water vapour. The air pressure is p and the saturated vapour pressure of water is $\overline{p}$. If the mixture is compressed to one half of its volume by maintaining temperature constant, the pressure becomes

(A) $2(p + \overline{p})$ (B) $2p + \overline{p}$ (C) $(p + \overline{p})/2$ (D) $p + 2\overline{p}$

Ans : (B)

Hints : $P_f = 2P + \overline{P}$

Saturated vapour pressure will not change if temperature remains constant

34. 1.56×10^5 J of heat is conducted through a 2 m^2 wall of 12 cm thick in one hour. Temperature difference between the two sides of the wall is 20^0C. The thermal conductivity of the material of the wall is (in W m^{-1} K^{-1})

(A) 0.11 (B) 0.13 (C) 0.15 (D) 1.2

Ans : (B)

Hints : $\frac{dQ}{dt} = \frac{KA\,\Delta T}{x}$

$$\frac{1.56 \times 10^5}{3600} = \frac{K \times 2 \times 20}{12 \times 10^{-2}}$$

$$K = \frac{1.56 \times 10^5 \times 12 \times 10^{-2}}{3600 \times 2 \times 20}$$

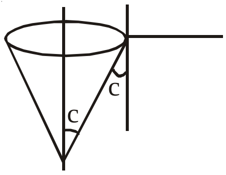
$$= \frac{1.56}{12} = 0.13$$

35. A diver at a depth of 12 m in water $\left(\mu = \frac{4}{3}\right)$ sees the sky in a cone of semivertical angle :

(A) $\sin^{-1}\left(\frac{4}{3}\right)$ (B) $\tan^{-1}\left(\frac{4}{3}\right)$ (C) $\sin^{-1}\left(\frac{3}{4}\right)$ (D) 90^0

Ans : (C)

Hints : $c = \sin^{-1}\left(\frac{1}{\mu}\right)$



$= \sin^{-1}\left(\frac{3}{4}\right)$

36. Two thin lenses of focal lengths 20 cm and 25 cm are placed in cotact. The effective power of the combination is

(A) 9D (B) 2D (C) 3D (D) 7D

Ans : (A)

Hints : $P = P_1 + P_2$

$= \frac{1}{f_1} + \frac{1}{f_2} = \frac{100}{20} + \frac{100}{25} = 5 + 4 = 9D$

37. A convex lens of focal length 30 cm produces 5 times magnified real image of an object. What is the object distance ?

(A) 36 cm (B) 25 cm (C) 30 cm (D) 150 cm

Ans : (A)

Hints : $\frac{1}{5u} - \left(\frac{1}{-u}\right) = \frac{1}{30}$

$\frac{1}{5u} + \frac{1}{u} = \frac{1}{30}, \ \frac{5+1}{5u} = \frac{1}{30}$

u = 36 cm.

38. If the focal length of the eye piece of a telescope is doubled, its magnifying power (m) will be

(A) 2m (B) 3m (C) $\frac{m}{2}$ (D) 4m

Ans : (C)

Hints : $m = \frac{-f_0}{f_e}$

$m' = \frac{m}{2}$

39. A plano-concave lens is made of glass of refractive index 1.5 and the radius of curvature of its curved face is 100 cm. What is the power of the lens ?

(A) + 0.5 D (B) – 0.5 D (C) – 2 D (D) + 2 D

Ans : (B)

Hints : $P = \frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$= (1.5 - 1)\left(\frac{1}{\infty} - \frac{1}{1m}\right)$

$= 0.5\,(-1)$

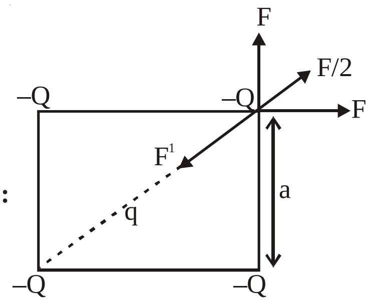
$P = -0.5\,D$

40. Four charges equal to –Q are placed at the four corners of a square and a charge q is at its centre. If the system is in equilibrium, the value of q is

(A) $\frac{-Q}{4}(1+2\sqrt{2})$ (B) $\frac{Q}{4}(1+2\sqrt{2})$ (C) $\frac{-Q}{2}(1+2\sqrt{2})$ (D) $\frac{Q}{2}(1+2\sqrt{2})$

Ans : (B)

Hints :



$$F' = \sqrt{2}F + \frac{F}{2} = F\left(\sqrt{2} + \frac{1}{2}\right)$$

$$\frac{qQ}{\left(\frac{\sqrt{2}a}{2}\right)^2} = \frac{Q^2}{a^2}\left(\sqrt{2} + \frac{1}{2}\right), \quad q = \frac{Q}{2}\left(\frac{2\sqrt{2}+1}{2}\right)$$

$$q = \frac{Q}{4}\left(2\sqrt{2}+1\right)$$

41. Two aromatic compounds having formula C_7H_8O which are easily identifiable by $FeCl_3$ solution test (violet colouration) are

(A) o- cresol and benzyl alcohol (B) m-cresol and p-cresol

(C) o-cresol and p-cresol (D) methyl phenyl ether and benzyl alcohol

Ans : (A)

Hints : O – cresol contains phenolic group, thus it gives violet coloration with $FeCl_3$ where as benzylalchol donot contains phenolic group, hence no coloration with $FeCl_3$. Hence Identifiable

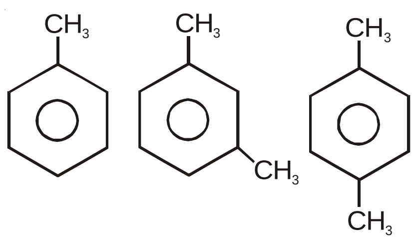
42. The ease of dehydrohalogenation of alkyl halide with alcoholic KOH is

(A) $3^o < 2^o < 1^o$ (B) $3^o > 2^o > 1^o$ (C) $3^o < 2^o > 1^o$ (D) $3^o > 2^o < 1^o$

Ans : (B)

Hints : Such dehydrohalogenation follows E_2 mechanism. The driving force of such reactions is the stability of alkene produced. Since tetriary alkyl halide can give more substituted alkene, it reacts fastest followed by secondary and primary i.e. $3^o > 2^o > 1^o$.

43. The ease of Nitration of the following three hydrocarbons follows the order



(A) II = III ≈ I (B) II > III > I (C) III > II > I (D) I = III > II

Ans : (D)

Hints : Stability order of Arenium ion

II > III > I

44. The correct order of decreasing acidity of nitrophenols will be

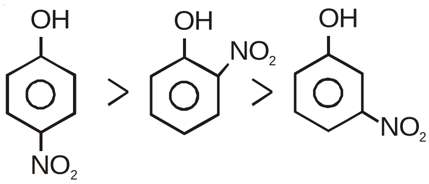
(A) m-Nitrophenol > p-Nitrophenol > o-Nitrophenol

(B) o-Nitrophenol > m- Nitrophenol > p-Nitrophenol

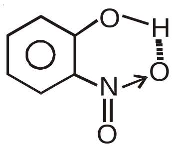
(C) p-Nitrophenol > m- Nitrophenol > o-Nitrophenol

(D) p-Nitrophenol > o-nitrophenol > m-Nitrophenol

Ans : (D)

Hints : 

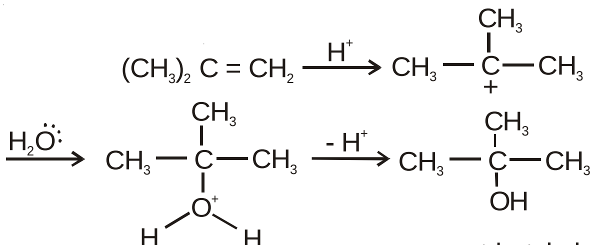
Due to – I and – R influence, NO_2 in ortho-postion should have raised the acidity to the maximum extent. But it is due to intramolecular H – bonding, ortho-nitrophenol is less acidic than para – nitrophenol.



45. Among the alkenes which one produces tertiary bytyl alcohol on acid hydration

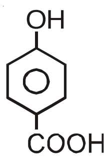
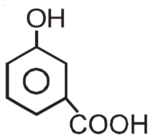
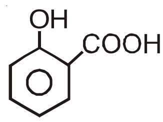
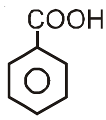
(A) $CH_3-CH_2-CH=CH_2$ (B) $CH_3-CH=CH-CH_3$ (C) $(CH_3)_2C=CH_2$ (D) $CH_3-CH=CH_2$

Ans : (C)

Hints : 

t-butyl alcohol

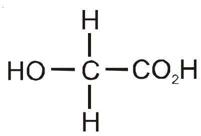
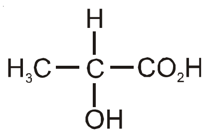
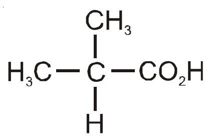
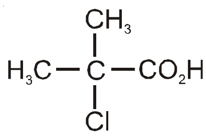
46. Which of the following compounds has maximum volatility?

(A)  (B)  (C)  (D) 

Ans : (C)

Hints : Due to intramolecular H – bonding

47. Which one of the following will show optical isomerism?

(A)  (B)  (C)  (D) 

Ans : (B)

Hints : The central carbon is attached to four different substituents, hence it is chiral carbon, therefore optically active.

48. The pH of an aqueous solution of CH_3COONa of concentrated C(M) is given by

(A) $7-\frac{1}{2}pK_a-\frac{1}{2}\log C$ (B) $\frac{1}{2}pK_w+\frac{1}{2}pK_b+\frac{1}{2}\log C$

(C) $\frac{1}{2}pK_w-\frac{1}{2}pK_b-\frac{1}{2}\log C$ (D) $\frac{1}{2}pK_w+\frac{1}{2}pK_a+\frac{1}{2}\log C$

Ans : (D)

Hints : In case of Hydrolysis of salt of weak acid and strong base, the pH is given by

$$\frac{1}{2}pK_w+\frac{1}{2}pK_a+\frac{1}{2}\log c$$

49. The standard reduction potential E° for half reations are

$Zn = Zn^{+2} + Ze$ $E^o = +0.76$ V

$Fe = Fe^{+2} + Ze$ $E^o = +0.41$ V

The EMF of hte cell reaction

$Fe^{+2} + Zn = Zn^{+2} + Fe$ is

(A) -0.35 V (B) + 0.35 (C) +1.17 V (D) – 1.17 V

Ans : (B)

Hints : $E_{cell} = E^o_{Anode(o.p)} - E^o_{cathode(o\,p)}$

$= 0.76 - 0.41$

$= +0.35$ V

50. If the equilibrium constants of the following equilibria

$$SO_2 + \frac{1}{2}O_2 \rightleftharpoons SO_3 \text{ and } 2SO_3 \rightleftharpoons 2SO_2 + O_2$$

are given by K_1 and K_2 respectively, which of the following relations is correct

(A) $K_2 = \left(\frac{1}{K_1}\right)^2$ (B) $K_1 = \left(\frac{1}{K_2}\right)^3$ (C) $K_2 = \left(\frac{1}{K_1}\right)$ (D) $K_2 = (K_1)^2$

Ans : (A)

Hints : $K_1 = \frac{[SO_3]}{[SO_2][O_2]^{1/2}}$

$$K_2 = \frac{[SO_2]^2[O_2]}{[SO_3]^2}$$

Thus $K_2 = \left(\frac{1}{K_1}\right)^2$

51. The energy of an electron in first Bohr orbit of H – atom is – 13.6 eV. The possible energy value of electron in the excited state of Li^{2+} is

(A) – 122.4 eV (B) – 30.6 eV (C) – 30.6 eV (D) 13.6 eV

Ans : (C)

Hints : $E_n = \frac{E_1}{n^2} \times z^2$

$$= \frac{-13.6}{4} \times 9 = -30.6\,eV$$

For the excited state, n = 2 and for Li^{++} ion, z = 3

52. The amount of the heat released when 20 ml 0.5 M NaOH is mixed with 100 ml 0.1 M HCl is x kJ. The heat of neutralization is

(A) – 100 x kJ/mol (B) – 50 x kJ/mol (C) + 100 x kJ/mol (D) +50 x kJ/mol

Ans : (A)

Hints : $\underset{20\times 0.5}{NaOH} + \underset{100\times 0.1}{HCl} \rightarrow NaCl + \underset{10\text{ millimole produced}}{H_2O}$

During formation of 10 millimole of H_2O the heat released is x KJ. Therefore heat of neutralisation is – 100 x KJ/mol (heat released hence negative)

53. Which one of the following has the lowest ionization energy?

(A) $1s^2\,2s^22p^6$ (B) $1s^22s^22p^63s^1$ (C) $1s^2\,2s^22p^5$ (D) $1s^22s^22p^3$

Ans : (B)

Hints : It's an alkalimetal; hence least I.P

54. The ozone layer forms naturally by

(A) the interaction of CFC with oxygen (B) the interaction of UV radiation with oxygen

(C) the interaction of IR radiation with oxygen (D) the interaction of oxygen and water vapour.

Ans : (B)

Hints : $O_2 \xrightarrow[\text{rays}]{h\upsilon} O+O \Rightarrow O_2+O \rightarrow O_3$

55. 2 gm of metal carbonate is neutralized completely by 100 ml of 0.1 (N) HCl. The equivalent weight of metal carbonate is
(A) 50 (B) 100 (C) 150 (D) 200
Ans : (D)
Hints : Number of gram equivalents of HCl

$$= \frac{100 \times 0.1}{1000} = 0.01$$

Number of gram equivalents of metal carbonate required for neutralisation must also be 0.01. Thus, mass of 1 gram eqivalent of carbonate salt $\frac{2}{0.01} = 200\,g$

$\therefore$ Equivalent mass of carbonate salt = 200

56. Which one of the following is not true at room temperature and pressure
(A) P_4O_{10} is a white solid (B) SO_2 is a coloureless gas (C) SO_3 is a colourless gas (D) NO_2 is a brown gas
Ans : (C)
Hints : SO_3 is colorless, crystalline transparent solid at room temperature.

57. An electric current is passed through an aqueous solution of a mixture of alanine (isoelectric point 6.0) glutamic acid (3.2) and arginine (10.7) buffered at pH 6. What is the fate of the three acids?
(A) Glutamic acid migrates to anode at pH 6. Arginine is present as a cation and migrates to the cathode. Alanine in a dipolar ion remains uniformly distributed in solution.
(B) Glutamic acid migrates to cathode and others remain uniformly distributed in solution.
(C) All three remain uniformly distributed in solution.
(D) All three move to cathode
Ans : (A)
Hints : At pH = 6, glutamic acid exists as a dianionic species & migrates to anode while arginine exists as cationic species & moves to cathode. Alanine does not migrate to any electrode at its isoelectric point .

58. The representation of the ground state electronic configuration of He by box – diagram as $\boxed{\uparrow\uparrow}$ is wrong because it violates
(A) Hysenberg's Uncertainty Principle (B) Bohr's Quantization Theory of Angular Momenta
(C) Pauli Exclusion Principle (D) Hund's Rule
Ans : (A)
Hints : According to Pauli Exclusion Principle, In any orbital, maximum two electrons can exist, having opposite spin.

59. The electronic transitions from n = 2 to n = 1 will produce shortest wavelength in (where n = principal quantum state)
(A) Li^{+2} (B) He^{+} (C) H (D) H^{+}
Ans : (A)

Hints : $\frac{1}{\lambda} = z^2.R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

$$\Rightarrow \frac{1}{\lambda} = (z)^2.R_H\left\{\frac{1}{1} - \frac{1}{4}\right\} = \frac{3}{4}R_H z^2$$

$\therefore\ \lambda \propto \frac{1}{z^2}$

Hence, for shortest λ, z must be maximum, which is for Li^{+2}.

60. In the following electron – dot structure, calculate the formal charge from left to right nitrogen atom;
$\ddot{\underset{\cdot\cdot}{N}} = N = \ddot{\underset{\cdot\cdot}{N}}$
(A) $-1, -1, +1$ (B) $-1, +1, -1$ (C) $+1, -1, -1$ (D) $+1, -1, +1$
Ans : (B)
Hints : Formal chargl = Number of electrons in

Valence shell – ($\frac{1}{2}$ × numbers of electrons as bond pair + numbers of electrons as lone pair)

$$\overset{1}{:\ddot{N}} = \overset{2}{N} = \overset{3}{\ddot{N}:}$$

For N_1 & N_3

Formal charge $= 5 - \left(\frac{4}{2} + 4\right) = 5 - (6) = -1$

For $N_2 = 5 - \frac{1}{2} \times 8 - 0 = 5 - 4 = +1$

61. If the molecular wt. of $Na_2S_2O_3$ and I_2 are M_1 and M_2 respectively, then what will be the equivalent wt. of $Na_2S_2O_3$ and I_2 in the following reaction?

$2S_2O_3^{2-} + I_2 \longrightarrow S_4O_6^{2-} + 2I^-$

(A) M_1, M_2 (B) $M_1, M_2/2$ (C) $2M_1, M_2$ (D) $M_1, 2M_2$

Ans : (B)

Hints : $\overset{(+2)}{2S_2O_3^{2-}} + \overset{(0)}{I_2} \longrightarrow \overset{(+2.5)}{S_4O_6^{2-}} + \overset{(-1)}{2I^-}$

Change in O.N per mole = 0.5×2=1

Change in O.N per mole = 1×2=2

$\text{n.f.}\left(S_2O_3^{2-}\right) = 1$, Equivalent mass $= \frac{M_1}{1} = M_1$

n f. $(I_2) = 2$, Equivalent mass $= \frac{M_2}{2}$

62. A radioactive atom $^{X}_{Y}M$ emits two α particles and one β particle successively. The number of neutrons in the nucleus of the product will be

(A) X – 4 – Y (B) X – Y – 5 (C) X – Y – 3 (D) X – Y – 6

Ans : (B)

Hints : $M^{X}_{Y} \xrightarrow{-\alpha} N^{X-4}_{Y-2} \xrightarrow{-\alpha} O^{X-8}_{Y-4} \xrightarrow{-\beta} P^{X-8}_{Y-3}$

Number of neutrons = Mass no. – Atomic no.

= X – 8 – Y + 3

= X – Y – 5

63. An element belongs to Group 15 and third period of the periodic table. Its electonic configuration will be

(A) $1s^22s^22p^3$ (B) $1s^22s^22p^4$ (C) $1s^22s^22p^63s^23p^3$ (D) $1s^22s^22p^63s^23p^2$

Ans : (C)

Hints : General valence shell electronic configuration of 15 group elements is ns^2np^3. where n = period number.

64. Which one of the following is paramagnetic?

(A) N_2 (B) NO (C) CO (D) O_3

Ans : (B)

Hints : $\dot{\dot{N}} \equiv \ddot{O}:$, Valence electron = 11

65. Platinum, Palladium and Iridium are called noble metals because

(A) Alfred Nobel discovered them

(B) They are shining lustrous and pleasing to look at

(C) They are found in native state

(D) They are inert towards many common reagents.

Ans : (D)

Hints : Fact

66. Which one is not a constituent of nucleic acid?

(A) Uracil (B) Guanidine (C) Phosphoric acid (D) Ribose sugar

Ans : (B)

Hints : Guanine is the constituent of nucleic acid and not guanidine.

67. The sp^3d^2 hybridization of central atom of a molecule would lead to

(A) square planar geometry (B) Tetrahedral geometry

(C) Trigonal bipyramidal geometry (D) Octahedral geometry

Ans : (D)

Hints : Fact

68. In aqueous solution glucose remains as

(A) Only in open chain form (B) Only in pyranoze form

(C) Only in furanose forms (D) In all three forms in equilibrium

Ans : (D)

Hints : $\underset{(\approx 64\%)}{\beta - D - \text{glucose}} \rightleftharpoons \underset{(\text{open chain} \approx 0.02\%)}{D - \text{glucose}} \rightleftharpoons \underset{(\approx 34\%)}{\alpha - D - \text{glucose}}$

69. Which of the following is used to prepare Cl_2 gas at room temperature from concentrated HCl?

(A) MnO_2 (B) H_2S (C) $KMnO_4$ (D) Cr_2O_3

Ans : (C)

Hints : $2MnO_4^- + 16H^+ + 10Cl^- \rightarrow 2Mn^{2+} + 5Cl_2 + 8H_2O$

70. NO_2 is not obtained on heating

(A) $AgNO_3$ (B) KNO_3 (C) $Cu(NO_3)_2$ (D) $Pb(NO_3)_2$

Ans : (B)

Hints : $KNO_3 \xrightarrow{\Delta} KNO_2 + \frac{1}{2}O_2$

71. The normality of 30 volume H_2O_2 is

(A) 2.678 N (B) 5.336 N (C) 8.034 N (D) 6.685 N

Ans : (B)

Hints : Volume strength = 5.6 × normality

$30 = 5.6 \times N$

$\Rightarrow N = \frac{30}{5.6} = 5.3$

72. Reaction of formaldehyde and ammonia gives

(A) Hexamethylene tetramine (B) Bakelite

(C) Urea (D) Triethylene Tetramine

Ans : (A)

Hints : $6HCHO + 4NH_3 \rightarrow (CH_2)_6N_4 + 6H_2O$

73. A plot of In k against $\frac{1}{T}$ (abscissa) is expected to be a straight line with intercept on ordinate axis equal to

(A) $\frac{\Delta S^\circ}{2.303R}$ (B) $\frac{\Delta S^\circ}{R}$ (C) $-\frac{\Delta S^\circ}{R}$ (D) $R \times \Delta S^\circ$

Ans : (B)

Hints : $\Delta G^\circ = -RT\ \text{In}K$

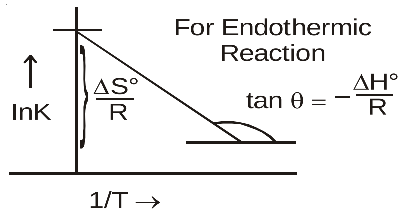
or, $\Delta H^\circ - T\Delta S^\circ = -RT\ \text{In}K$

or, $\ln K = \dfrac{-\Delta H^\circ}{RT} + \dfrac{\Delta S^\circ}{R}$

comparing with

$y = m.x + c$

$\therefore$ y intercept is $\dfrac{\Delta S^\circ}{R}$



74. Which of the following represents the composition of Carnallite mineral?

(A) $K_2O. Al_2O_3. 6SiO_2$ (B) KNO_3

(C) $K_2SO_4. MgSO_4. MgCl_2.6H_2O$ (D) $KCl. MgCl_2.6H_2O$

Ans : (D)

Hints : Fact

75. The solubility of $Ca_3(PO_4)_2$ in water is y moles / litre. Its solubility product is

(A) $6y^4$ (B) $36y^4$ (C) $64y^5$ (D) $108y^5$

Ans : (D)

Hints : $Ca_3(PO_4)_2(s) \rightleftharpoons 3Ca^{2+}(aq) + 2PO_4^{3-}(aq)$

3s 2s

$^{K}sp = [Ca^{2+}]^3.[PO_4^{3-}]^2$

$= (3s)^3. (2s)^2$

$= 27s^3 \times 4s^2$

$= 108\ s^5$

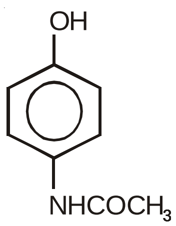
76. Paracetamol is

(A) Methyl salicylate (B) Phenyl salicylate

(C) N-acetyl p-amino phenol (D) Acetyl salicylic acid

Ans : (C)

Hints : Fact



77. Anhydrous ferric chloride is prepared by

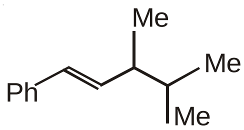
(A) Dissolving $Fe(OH)_3$ in concentrated HCl (B) Dissolving $Fe(OH)_3$ in dilute HCl

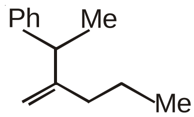
(C) Passing dry HCl over heated iron scrap (D) Passing dry Cl_2 gas over heated iron scrap

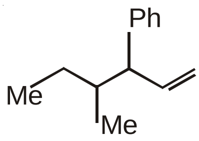
Ans : (D)

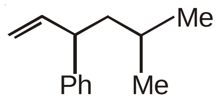
Hints : $2Fe + 3Cl_2 \xrightarrow{\Delta} 2FeCl_3$

78. Which one of the following is s-butyl phynylvinyl methane?

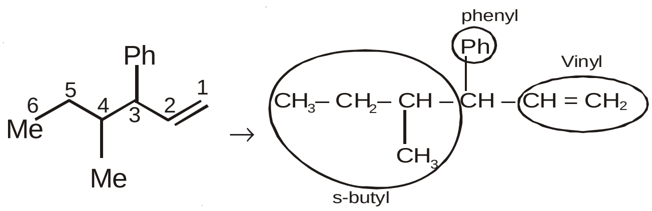
(A) 

(B) 

(C) 

(D) 

Ans : (C)

Hints : 

79. Hybridization of C_2 and C_3 of $H_3C-CH=C=CH-CH_3$ are

(A) Sp, Sp^3 (B) Sp^2, Sp (C) Sp^2, Sp^2 (D) Sp, Sp

Ans : (B)

Hints : $\overset{1}{C}H_3-\underset{\uparrow\,sp^2}{\overset{2}{C}H}=\underset{\uparrow\,sp}{\overset{3}{C}}=\overset{4}{C}H-\overset{5}{C}H_3$

80. Which of the following compounds is not formed in iodoform reaction of acetone

(A) CH_3COCH_2I (B) ICH_2COCH_2I (C) CH_3COCHI_2 (D) CH_3COCI_3

Ans : (B)

Hints :

$$CH_3-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow{OI^-} CH_3-\overset{O}{\overset{\|}{C}}-CH_2I + OH^-$$

$$CH_3-\overset{O}{\overset{\|}{C}}-CH_2I \xrightarrow{OI^-} CH_3-\overset{O}{\overset{\|}{C}}-CHI_2 + OH^-$$

$$CH_3-\overset{O}{\overset{\|}{C}}-CHI_2 \xrightarrow{OI^-} CH_3-\overset{O}{\overset{\|}{C}}-CI_3 + OH^-$$

$$CH_3-\overset{O}{\overset{\|}{C}}-CI_3 \xrightarrow{OH^-} CH_3-C\begin{matrix}\nearrow O\\ \searrow O^-\end{matrix} + CHI_3$$

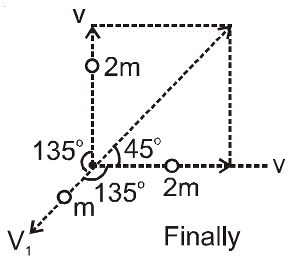
❑ ❑ ❑

DESCRIPTIVE TYPE QUESTIONS

SUB : PHYSICS & CHEMISTRY

1. A shell of mass m is at rest initially. It explodes into three fragments having masses in the ratio 2 : 2 : 1. the fragments having equal masses fly off along mutually perpendicular direction with speed *V*. What will be the speed of the third (lighter) fragment?

A.



From conservation of momentum

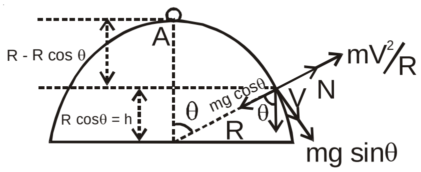
$$O = 2mv\sqrt{2} + mv_1$$

$$V_1 = -2\sqrt{2}\,v$$

Hence, velocity of third part is $2\sqrt{2}\,v$ at an angle of 135° with either part.

2. A small spherical ball of mass m slides without friction from the top of a hemisphere of radius R. AT what height will the ball lose contact with surface of the sphere ?

A. If the ball lose contact at B then, from conservation of energy.



$$\cancel{m}gR(1-\cos\theta) = \frac{1}{2}\cancel{m}v^2$$

$v^2 = 2gR\,(1 - \cos\theta)$ ......(i)

<u>At B</u>

$$N + \frac{mV^2}{R} = mg\cos\theta$$

When the ball will lose the contact

$N = O$

$$\cancel{m}g\cos\theta = \frac{\cancel{m}v^2}{R}$$

$V^2 = gR\cos\theta$ ....(ii)

$\therefore$ from (i) & (ii)

$2\cancel{R}\cancel{g}(1 - \cos\theta) = \cancel{g}\cancel{R}\cos\theta$

$2 - 2\cos\theta = \cos\theta.$

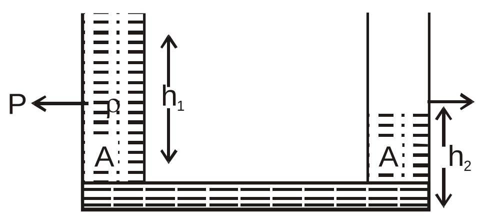
$2 = 3\cos\theta.$

$\therefore$ Height from the ground

$$h = R\cos\theta = \frac{2R}{3}$$

3. Two identical cylindrical vessels, with their bases at the same level, each cotain a liquid of density p. The height of liquid in one vessel in h_1 and that in the other is h_2. The area of either base is A. What is the work done by gravity in equalizing the levels when the vessles are interconnected ?

A.



Let find height = h

$$\therefore h = \left(\frac{h_1 + h_2}{2}\right)$$

decerese in height

$$\Delta h = h_1 - \left(\frac{h_1 + h_2}{2}\right) = \left(\frac{h_1 - h_2}{2}\right)$$

Mass of liquid

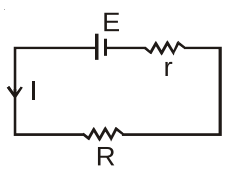
$$m = \frac{(h_1 - h_2)}{2}\rho A$$

$\therefore$ Work done

$$W = \left[\left(\frac{h_1 - h_2}{2}\right)\rho A\right]\left[\frac{h_1 - h_2}{2}\right] = \frac{(h_1 - h_2)^2}{4} g\rho A$$

4. A battery of emf E and internal resistance r is connected across a pure resistive device (such as an electric heater) of resistance R. Prove that the power output of the device will be maximum if R = r.

A.



$$I = \frac{E}{R + r}$$

Power $P = I^2R = \frac{E^2R}{(R+r)^2}$

For maximum power

$$\frac{dp}{dR} = 0$$

$$E^2\left[\frac{(R+r)^2.1 - R.2(R+r)}{(R+r)4}\right] = 0$$

$R + r - 2R = 0$

$r = R$

5. A radioactive isotope X with half life 1.5×10^9 yrs. decays into a stable nucleus Y. A rock sample contains both elements X and Y in ratio 1 : 15. Find the age of the rock.

A.

	X	→ Y
t = 0,	16	0
t = 1,	1	15

$T_{1/2} = 1.5 \times 10^9$ yr

$$N = N_o\left(\frac{1}{2}\right)^n$$

$$1 = 16\left(\frac{1}{2}\right)^n$$

$$\left(\frac{1}{2}\right)^n = \left(\frac{1}{2}\right)^4 \quad \therefore n = 4$$

$\therefore$ time $t = 4 \times 1.5 \times 10^9 = 6 \times 10^9$ yrs

6. The bacterial growth follows the rate l aw, $\frac{dN}{dt} = KN$ where 'K' is a constant and 'N' is the number of bacteria cell at any time. If the population of bacteria (no. of cell) is doubled in 5 minutes, find the time by which the population will be eight times of the initial one.

A. $\frac{dN}{dt} = KN$ (1st order kinetics)

$\Rightarrow N = N_0e^{kt}$ (integrating)

$\because$ in 5 min, $N = 2N_0$

$$K = \frac{2.303}{t}\log\frac{N}{N_0}$$

$$\Rightarrow K = \left(\frac{2.303}{5}\log\frac{2N_o}{N_0}\right)\min^{-1}$$

$$\Rightarrow K = \frac{2.303}{5}\log 2$$

for $8N_0$

$$t = \left(\frac{2.303}{\frac{2.303}{5}\log 2}\right)\log\frac{8N_o}{N_o}$$

$$\Rightarrow t = \frac{5\times 3\log 2}{\log 2} = 15\,\text{min}$$

$\therefore$ time required is 15 min.

7. In ‘x’ ml 0.3 (N) HCl, addition of 200 ml distilled water or addition of 100 ml 0.1 (N) NaOH, gives same final acid strength. Determine ‘x’.

A. When 200 ml H_2O is added to x ml solution

$(x)(0.3) = (x+200)(Y) \longrightarrow$ final conc.

$$Y = \frac{0.3x}{200+x}$$

in 2nd case

Number of equivalents of HCl after NaOH addition

$\frac{0.3x}{1000} - 0.01$ (no of eq. of NaOH added = 0.01)

$\therefore$ conc. would be $\dfrac{\left\{\frac{0.3x}{1000} - 0.01\right\}}{100+x}\times 1000(N)$

by condition,

$$\frac{\left\{\frac{0.3x}{1000} - 0.01\right\}1000}{100+x} = \frac{0.3x}{200+x} \Rightarrow \frac{0.3x-10}{100+x} = \frac{0.3x}{(200+x)} \Rightarrow (0.3x-10)\times(200+x) = (0.3x)(100+x)$$

$$\Rightarrow 60x - 2000 + 0.3x^2 - 10x = 30x + 0.3x^2$$

$$\Rightarrow 20x = 2000 \qquad \Rightarrow x = 100\,\text{ml}$$

8. Compound A treated with $NaNH_2$ followed by CH_3CH_2Br gave compound B. Partial hydrogenation of compound B produced compound C, which on ozonolysis gave a carbonyl compound D, (C_3H_6O). Compound D did not respond to iodoform test with I_2/Kl and NaOH. Find out the structures of A, B, C and D

A. Assuming 1 eq. of $NaNH_2$ is used,

$$CH_3CH_2C\equiv CH \xrightarrow[-NH_3]{NaNH_2} CH_3CH_2C\equiv \overset{\ominus}{C}\ \overset{\oplus}{Na}$$

$$\overset{\delta+}{CH_3CH_2}-\overset{\delta-}{Br}$$

$$\downarrow S_N2,\ -NaBr$$

$$\underset{(C)}{CH_3CH_2CH=CH\,CH_2CH_3} \xleftarrow[\text{Hydrogenation}]{\text{Partial}} \underset{(B)}{CH_3CH_2C\equiv C-CH_2CH_3}$$

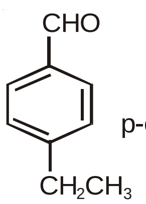
$$\downarrow \text{(i) } O_3 \text{ (ii) } Zn + H_2O \quad \text{Ozonolysis}$$

$$\underset{(D)}{2\,CH_3CH_2CHO} \text{ (No Keto Methyl group } \therefore \text{ –ve iodoform)}$$

9. An organic compound with molecular formula $C_9H_{10}O$ forms, 2, 4-DNP derivative, reduces Tollen's reagent and undergoes Cannizzaro reaction. On vigorous oxidation it gives a dicarboxylic acid which is used in the preparation of terylene. Identify the organic compound.

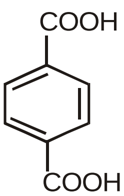
A. +ve Brady's test indicates carbonyl compound, Tollens & Cannizzaro reaction indicates aldehyde without $\alpha - H$

$\because$ end product is terepthalic acid, compound must be



p-ethyl-benzaldehyde

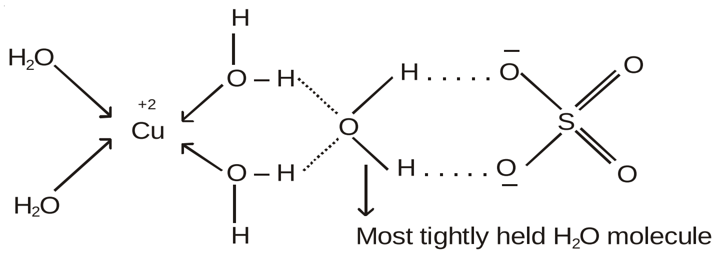
$\downarrow$ [Strong oxidation]



(Terepthalic acid)

10. Deep blue $CuSO_4.5H_4O$ is converted to a bluish white salt at 100°C. At 250°C and 750°C it is then transformed to a white powder and black material respectively. identify the salts.

A. One H_2O molecule in blue vitriol is Hydrogen bonded from 4 sides and is thus released with more difficulty than the rest four H_2O molecules.



$$CuSO_4.5H_2O \xrightarrow[\Delta]{-4H_2O} CuSO_4.H_2O \text{ bluish white salt (100°C)}$$

$$\downarrow [\Delta]$$

$$CuO + SO_3 \xleftarrow{\Delta} CuSO_4 \text{(White powder)}$$

(black powder) 750° 250°C

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43957
[Q. Booklet Number]

ANSWERS & HINTS
for
WBJEE - 2011

MULTIPLE CHOICE QUESTIONS
SUB : BIOLOGY

1. Glucose and amino acids are reabosorbed in the
(A) proximal tubule (B) distal tubule (C) collecting duct (D) loop of Henle
Ans : (A)
Hints : Glucose and amino acids are reabsorbed in the proximal tubule of nephron.

2. The amount of CSF in the cranial cavity
(A) 500 ml (B) 140 ml (C) 1 litre (D) 1.5 ml
Ans : (B)
Hints : The amount of CSF in the cranial cavity is 140 ml.

3. Which one is imino acid?
(A) Pepsin (B) Proline (C) Cysteine (D) Renin
Ans : (B)
Hints : Proline and hydroxyproline are imino acids.

4. The main difference between Gram positive and Gram negative bacteria is
(A) Cell membrane (B) Cell wall (C) Ribosome (D) Mitochondria
Ans : (B)

5. ACTH is secreted from
(A) Adrenal cortex (B) Pituitary (C) Adrenal Medulla (D) Thyroid
Ans : (B)
Hints : ACTH is secreted from anterior pituitary

6. Which of the following is the correct pathway for propagation of cardiac impulse?
(A) SA node $\rightarrow$ AV node $\rightarrow$ Bundle of His $\rightarrow$ Purkinje fibers
(B) AV node $\rightarrow$ Bundle of His $\rightarrow$ SA node $\rightarrow$ Purkinje fibers
(C) SA node $\rightarrow$ Purkinje fibers $\rightarrow$ AV node $\rightarrow$ Bundle of His
(D) Purkinje fibers $\rightarrow$ AV node $\rightarrow$ SA node $\rightarrow$ Bundle of His
Ans : (A)
Hints : Cardiac impulse is propagated in the following way : SA node $\rightarrow$ Av node $\rightarrow$ Bundle of His $\rightarrow$ Purkinje fibres.

7. Inner surface of the bronchi, bronchioles and fallopian tubes are lined by
(A) cubical epithelium (B) columnar epithelium (C) squamous epithelium (D) ciliated epithelium
Ans : (D)
Hints : Ciliated epithelium is found in inner surface of bronchi, bronchioles and fallopian tubes

8. Electric potential of the brain is recorded by
(A) CT Scan (B) Sphygmomanometer (C) ECG (D) EEG
Ans : (D)
Hints : Electrical potential of brain is recorded by EEG

9. Which of the following is related to humoral immunity?
(A) T-lymphocyte (B) B-lymphocyte (C) I-lymphocyte (D) P-lymphocyte
Ans : (B)
Hints : Humoral immunity is due to B-lymphocyte because it secretes antibody in the blood plasma.

10. Fertilization occur in
(A) Uterus (B) Ureter (C) Vagina (D) Fallopian tube
Ans : (D)
Hints : Fertilization occurs in fallopian tube at the junction of ampulla and isthmus.

11. The Gastrin is secreted from
(A) Intestine (B) Stomach (C) Pancreas (D) Rectum
Ans : (B)
Hints : Gastrin hormone is secreted from "G-cells" of stomach.

12. The cause of cretinism is
(A) Hypothyroidism (B) Hypoparathyroidism (C) Hyperthyroidism (D) Hyperparathyroidism
Ans : (A)
Hints : Cretinism is caused by hyposecretion of thyroxine in children.

13. Which of the following is a minerelocorticoid?
(A) Testosterone (B) Progesterone (C) Adrenalin (D) Aldosterone
Ans : (D)
Hints : Aldosterone is secreted from adrenal cortex and controls RAAS. mechanism.

14. The part of the brain where the centre for hunger and thirst is located is
(A) Cerebrum (B) Hypothalamus (C) Cerebellum (D) Medulla Oblongata
Ans : (B)
Hints : Hypothalamus is the centre for hunger and thirst.

15. The reflex arc, which is made of two neurones is known as
(A) Monosynaptic reflex arc (B) Disynaptic reflex arc
(C) Polysynaptic refles arc (D) Asynaptic reflex arc
Ans : (A)
Hints : Monosynaptic reflex are has two neurons sensory and motor, which forms one synapse in CNS.

16. The lactase hydrolyzes lactose into
(A) Glucose (B) Glucose and galactose (C) Fructose (D) Glucose and fructose
Ans : (B)
Hints : Lactose $\longrightarrow$ Glucose + Galactose

17. In 24 hours, total glomerular filtrate formed in human kidney is
(A) 1.7 litres (B) 7 litres
(C) 17 litres (D) 170 litres
Ans : (D)
Hints : GFR is 120 ml/min, so, approx. 170 litre ultra fitrate is produced in 24 hrs.

18. When the oxygen supply to the tissue is inadequate, the condition is
(A) Dyspnea (B) Hypoxia
(C) Asphyxia (D) Apnea
Ans : (B)
Hints : Inadequate supply of oxygen to the tissue is called hypoxia

19. Which one of the following is not a second messenger in hormone action?
(A) Calcium (B) Sodium (C) cAMP (D) cGMP
Ans : (B)

Hints : Sodium is not a secondary messenger in hormone action.

20. The name of the pace maker of the heart is
(A) Lymph node (B) S.A. node (C) Juxtaglumerular apparatus (D) Semilunar valve
Ans : (B)
Hints : Pace maker of heart is SA node.

21. What is a genophore?
(A) DNA in prokaryotes (B) DNA and RNA in prokaryotes
(C) DNA and protein in prokaryotes (D) RNA in prokaryotes
Ans : (B)
Hints : Genophore = DNA + RNA

22. Example of a typical homopolysaccharide is
(A) Ligin (B) Suberin (C) Inulin (D) Starch
Ans : (C)
Hints : Inulin is typical homopolysaccharide and is a polymer of fructose.

23. Who wrote the famous book 'Origin of Species'?
(A) Lamarck (B) Darwin (C) De Vries (D) Mendel
Ans : (B)
Hints : The book 'Origin of species' was written by Darwin.

24. Polyploid derived from two different species is called
(A) Autopolyploid (B) Triploid (C) Allopolyploid (D) Monoploid
Ans : (C)

25. Electrons used in Electron Microscope are of the wavelength
(A) 0.05 Å (B) 0.15 Å (C) 0.25 Å (D) 0.30 Å
Ans : (A)

26. Biolistic technique is used in
(A) Tissue culture process (B) Gene transfer process
(C) Hybridization process (D) Germplasm conservation process
Ans : (B)
Hints : Biolistic technique is a direct method of gene transfer.

27. Example of water soluble plant pigment is
(A) Chlorophyll-a (B) Chlorophyll-b (C) Anthocyanin (D) Xanthophyll
Ans : (C)
Hints : Anthocyanin is a water soluble pigment.

28. Structural element of Chromatin is
(A) Histone (B) Acid protein and DNA (C) Nuclear matrix (D) Nucleosomes
Ans : (D)
Hints : The structural element of chromatin is Nucleosomes.

29. Inulin is a polymer of
(A) Glucose (B) Galactose (C) Fructose (D) Arabinose
Ans : (C)

30. Mannitol is
(A) Amino Acid (B) Amino alcohol (C) Sugar alcohol (D) Sugar acid
Ans : (C)

31. A flower which can be divided into two equal halves by only one plane is
(A) Zygomorphic (B) Actinomorphic (C) Regular (D) Perfect
Ans : (A)

32. Pieces of plant tissue used in tissue culture is called
(A) Explant (B) Somaclone (C) Inoculant (D) Clone
Ans : (A)

33. VAM is
(A) Symbiotic bacteria (B) Saprophytic bacteria (C) Saprophytic fungi (D) Symbiotic fungi
Ans : (D)
Hints : VAM (Endomycorrhizae) represent symbiotic association between fungi and roots of higher plants.

34. Ovule integument gets transformed into
(A) seed (B) fruit wall (C) seed coat (D) cotyledons
Ans : (C)
Hints : Outer integument transforms into testa where as the inner integument into tegmen.

35. Acid rain is caused by
(A) NO_2 (B) SO_2 (C) SO_3 (D) CO_2
Ans : (B)

36. Which one of the following bacterium is used for production of transgenic plants
(A) *Escherichia coli* (B) *Bacillus thuringiensis*
(C) *Staphylococcus aureus* (D) *Agrobacterium tumefaciens*
Ans : (D)

37. A plant cell becomes turgid due to
(A) Plasmolysis (B) Exosmosis (C) Endosmosis (D) Electrolysis
Ans : (C)
Hints : Endosmosis leads to diffusion of water into the cell.

38. Restriction enzymes are used to cut
(A) Single stranded RNA (B) Double stranded DNA (C) Single stranded DNA (D) Double stranded RNA
Ans : (B)
Hints : Restriction endunuclease is used to cut dsDNA at palindromic sequence.

39. Spindle fibre is made up of
(A) Humulin (B) Intermediate filament
(C) Flagellin (D) Tubulin
Ans : (D)

40. Edible part of Mushroom is
(A) Basidiocarp (B) Primary mycelium (C) Fungal hyphae (D) Basidiospores
Ans : (A)

41. Calcium level decreases in the blood due to hyposecretion of
(A) Parathyroid hormone (B) Calcitonin (C) Thyroxine (D) Adrenaline
Ans : (A)
Hints : Hyposecretion of PTH causes decrease in the level of calcium in the blood.

42. Kupffer's cells are
(A) Phagocytic (B) Actin (C) Myosin (D) Fibrin
Ans : (A)
Hints : Kupffer's cells are phagocytic cells of liver.

43. Which centre is stimulated during increase in body temperature
(A) Anterior hypothalamus (B) Posterior hypothalamus (C) Limbic system (D) Red nucleus
Ans : (A)
Hints : Anterior hypothalamus is stimulated during increase in body temperature.

44. Name the following having oxygen storing capacity
(A) Myoglobin (B) Prophase II (C) Anaphase I (D) Metaphase II
Ans : (A)
Hints : Myoglobin present in muscles stroes oxygen

45. Longest phase of meiosis
(A) Prophase I (B) Prophase II (C) Anaphase I (D) Metaphase II
Ans : (A)

46. Tetany is caused by
(A) Hyperparathyroidism (B) Hypoparathyroidism (C) Hyperthyroidism (D) Hypothyroidism
Ans : (B)

47. Which the following is a gastrointestine hormone?
(A) Prolactin (B) Enterokinase (C) GH (D) FSH
Ans : (B)

48. Name the hormone that has no role in menstruation.
(A) LH (B) FSH (C) GH (D) TSH
Ans : (D)

49. Which of the following substances can cure Parkinson's disease?
(A) GABA (B) Acetylcholine (C) Dopamine (D) Glutamic acid
Ans : (C)
Hints : Dopamine deficiency causes parkinson's disease.

50. Movement of tongue muscle is controlled by
(A) facial nerve (B) trigeminal nerve (C) hypoglossal nerve (D) vagus nerve
Ans : (C)
Hints : 12th cranilal nerve (hypoglossal) is responsible for movement of tongue.

51. Which function will be lost due to damage of occipital lobe?
(A) Hearing (B) Speech (C) Vision (D) Memory
Ans : (C)
Hints : Damage of occipital lobe causes loss of vision.

52. Meissner's corpuscles occur in
(A) Brain (B) Nerve cells (C) Skin (D) Tongue
Ans : (C)

53. Osteomalacia is a deficiency disease of
(A) Infants due to protein energy malnutrition (B) Adults due ot protein energy malnutrition
(C) Adults due to Vitamin D deficiency (D) Infants due to Vitamin K deficiency
Ans : (C)

54. The gene of sickle cell anaemia is inherited by
(A) Blood cells (B) Bone cells (C) Sex chromosomes (D) Autosomes
Ans : (D)
Hints : The gene for sickle cell anaemia is located in chromosome number 11.

55. Ptyalin is inactivated by a component of gastric juice known as
(A) Pepsin (B) Mucus (C) Rennin (D) HCl
Ans : (D)
Hints : Ptylin or α -amylase of saliva is inactivated by HCl in stomach.

56. Which one of the following human cells do not contain mitochondria ?
(A) Nerve cell (B) Red blood cell (C) Liver cell (D) White blood cell
Ans : (B)
Hints : Matured Red blood cells are without mitochondria.

57. In which stage of the first meiotic division two sister chromatids are formed?
(A) Leptotene (B) Zygotene (C) Pachytene (D) Diplotene
Ans : (C)
Hints : During pachytene statge, chromosomes shortens & thickens with two sister chromatids and became clearly visible.

58. Which one of the following triplet codons is a chain termination codon?
(A) UGU (B) AAU (C) UUG (D) UAG
Ans : (D)
Hints : UAG is a non-sense codon.

59. How many pairs of contrasting characters in pea pod were chosen by Mendel?
(A) 3 (B) 5 (C) 7 (D) 9
Ans : (A)
Hints : Three pairs of contrasting characters with respect to pea pod are (i) Pod position (ii) pod colour (iii) Pod shape

60. If a cross between two individuals produces offsprings with 50% dominant character (A) and 50% recessive character (a) the genotype of parents are
(A) Aa × Aa (B) Aa × aa (C) AA × aa (D) AA × Aa
Ans : (B)
Hints : Aa × aa. This is a test cross.

61. Structural lipids of cell membrane
(A) Simple lipid (B) Chromolipids (C) Steroid (D) Phospholipids
Ans : (D)

62. Which one of the following is polysaccharide ?
(A) Glycogen (B) Sucrose (C) Lactose (D) Maltose
Ans : (A)
Hints : Glycogen is a polysaccharide of glucose.

63. What will be the codons in m-RNA if the DNA codes are ATG-CAG ?
(A) TAC – GTC (B) UAC – GUC (C) UCA – TUA (D) TCA – GTC
Ans : (B)

64. Which of the following species is restricted to a specific area ?
(A) Sibling species (B) Allopatric species (C) Sympatric species (D) Endemic species
Ans : (D)
Hints : Endemic species is restricted to a specific area.

65. Which of the following is NOT correctly matched ?
(A) Sycon – Canal system
(B) Star fish – Radial symmetry
(C) Ascaris – Flame cell
(D) Prawn – Haemocoel
Ans : (C)
Hints : Flame cells are found in flat worms.

66. Which one of the following animal phyla does not possess a coelom ?
(A) Platyhelminthes (B) Annelida (C) Mollusca (D) Echinodermata
Ans : (A)
Hints : Platyhelminthes are acoelomate.

67. Cardiac muscles are
(A) Striated and voluntary (B) Striated and involuntary (C) Smooth and voluntary (D) Smooth and involuntary
Ans : (B)

68. Which one of the following immunoglobulins is found as pentamer ?
(A) IgG (B) IgM (C) IgA (D) IgE
Ans : (B)
Hints : IgM is a pentamer with 10 paratopes

69. Which one of the following cells is not a phagocytic cell ?
(A) Macrophage (B) Monocyte (C) Neutrophil (D) Basophil
Ans : (D)
Hints : Basophil is non-phagocytic WBC.

70. Which one of the following is the most primitive ancestor of man ?
(A) Homo habilis (B) Australopithecus (C) Rampithecus punjabicus (D) Homo neanderthalensis
Ans : (C)
Hints : *Ramipithecus* is one of the most primitive ancestors of man.

71. A female Anopheles mosquito can be recognized by
(A) Proboscis and palpi are long and more or less of equal length
(B) Proboscis long and palpi short
(C) Proboscis short and palpi long
(D) Both proboscis and palpi are short
Ans : (A)
Hints : Proboscis and palpi are long and of equal in length in female *Anopheles*.

72. The anterior V-spot in microfilaria of Wuchereria represents
(A) Nerve ring (B) Cervical papilla (C) Excretory system (D) Reproductive
Ans : (C)
Hints : V-spot in microfilaria of *Wuchereria* represents excretory system.

73. In a population, unrestricted reproductive capacity is called
(A) Biotic potential (B) Fertility (C) Carrying capacity (D) Birth rate
Ans : (A)

74. When the two ecosystems overlap each other, the area is called
(A) Habitat (B) Niche (C) Ecotone (D) Ecotype
Ans : (C)
Hints : Ecotone represent transition zone between two ecosystems.

75. Pyramid of energy in ecosystems is
(A) Always upright (B) Always inverted (C) Mostly upright (D) Mostly inverted
Ans : (A)

76. Which one of the following is mainly responsible for green house effect ?
(A) SO_2 (B) CO_2 (C) CO (D) O_2
Ans : (B)
Hints : 60% of the total green house effect is due to CO_2.

77. Which one of the following is an exotic carp species ?
(A) Barbus stigma (B) Cyprinus carpio (C) Labeo bata (D) Cirrhinus mrigala
Ans : (B)

78. Which of following two hormones are essential for induced breeding of fishes ?
(A) TSH and ACTH (B) Oestrogen and progesterone
(C) FSH and LH (D) Vassopressin and oxytocin
Ans : (C)
Hints : FSH and LH present in pituitary extract helps in induced beeeding.

79. Which stage of malarial parasite is infective to man ?
(A) Gametocyte (B) Merozoite (C) Cryptomerozoite (D) Sporozoite
Ans : (D)
Hints : Sporozoite stage of Plasmodium is infective to man.

80. The scientific name of the moth which produce tasar is
(A) Bombyx mori (B) Antheraea mylitta (C) Antheraea assamensis (D) Philosomia ricini
Ans : (B)

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DESCRIPTIVE TYPE QUESTIONS

SUB : BIOLOGY

1. What are poikilothermic animals?

A. The body temperature of poikilothermic animals (cold blooded animals) changes according to environmental temperature. Example are invertebrates, fishes, amphibians and reptiles.

2. Write two functions of juxtaglomerular apparatus.

A. The Juxta glomerular apparatus (JGA) possesses Juxta glomerular cells and Macula densa. The Juxta glomerular cells secrete renin which regulates RAAS mechanism. Macula densa responds to the change in the mineral ion concentration of glomerular filtrate.

3. State two differences between red and white muscles.

A.

Red Muscle	White Muscle
1. Myoglobin present	Myoglobin absent
2. Slow fatigue muscle	Fast fatigue muscle
3. Mitochondria more in number	Mitochondria less in number
4. Sarcoplasmic reticulum less in number	Sarcoplasmic reticulum more in number

4. What is the difference between pinocytosis and phagocytosis?

A.

Pinocytosis	Phagocytosis
1. It is "Cell drinking" phenomenon where bulk intake of extracellular fluid with the help of vesicle called pinosome takes place.	It is a "Cell eating" phenomenon where bulk intake of solid material from outside to inside of a cell takes place with the help of phagosome.

5. State four important functions of plasma membrane.

A. Four important functions of plasma membrane are :

(i) Involved in active and passive transport

(ii) Involved in a variety of cellular processess such as cell adhesion, ion conductivity & cell signalling.

(iii) As a cell envelope it contain the protoplasm thus protective in nature.

(iv) In prokaryotes, plasma membrane is the site of E.T.S.

6. What is bioaccumulation?

A. Bioaccumulation is the accumulation of toxic substance at a rate greater than at which the substance is lost by an organism.

Longer the biological half life of the accumulated substance, greater is the risk of bioaccumulation.

7. What is a test cross? Why is it so named?

A. Test cross is a cross between F_1 hybrid and homozygous recessive parent.

Test cross is so named as it determines whether the individual with dominant phenotype is homozygous dominant or heterozygous dominant.

8. What is ribozyme?

A. A ribozyme is a RNA molecule possessing a well defined tertiary structure that enables it to catalyse a chemical reaction eg. 23S rRNA (peptidyl transferase).

9. What are mycorrhizae?

A. Mycorrhizae is a symbiotic association between roots of higher plants and fungi.

It plays a key role in mineral absorption specially phosphate.

10. Write down the scientific name of China rose plant. Give its floral formula.

A. Scientific name of China rose is *Hibiscus rosa - sinensis*

Floral formula : Br, $\oplus$, ⚥ $Epik_{3-9}$, $K(5)\ \overset{\frown}{C_5 A_{(\alpha)}}\ G_{(5-\alpha)}$

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