TARGET IIT-JEE

HINT & SOLUTIONS

ANSWER KEY WITH SOLUTION

PAPER-II CLASS XII (DATE 05-07-09)

MATHEMATICS

1. A **2.** B **3.** C **4.** B **5.** A,B,C **6.** B,C,D **7.** A,B,C
8. B,C,D **9.** A,B,C

10. (A) $\rightarrow$ R ; (B) $\rightarrow$ S; (C) $\rightarrow$ Q; (D) $\rightarrow$ T

11. (A) $\rightarrow$ Q,S ; (B) $\rightarrow$ Q,R,S; (C) $\rightarrow$ P,Q,R,S; (D) $\rightarrow$ P,R

12. 8 **13.** 1 **14.** 3 **15.** 3 **16.** 0 **17.** 2 **18.** 0
19. 5

PHYSICS

20. B **21.** D **22.** C **23.** B **24.** B,D **25.** A,B,C **26.** B,D
27. B,C **28.** B,D

29. A $\rightarrow$ Q,R,S, (B) $\rightarrow$ Q,R,S, (C) $\rightarrow$ R, (D) $\rightarrow$ Q,R

30. A $\rightarrow$ P ; (B) $\rightarrow$ Q,R; (C) $\rightarrow$ P, (D) $\rightarrow$ P

31. $f = \frac{1}{2\pi}\sqrt{\frac{T}{m}\left(\frac{b+c}{bc}\right)}$ **32.** $\sqrt{61}\,m/s^2$ **33.** 8080g N **34.** $t_1 = 1$ **35.** 2475 cm/s

36. –24 J **37.** $v = \frac{1}{\sin\alpha}\sqrt{v_1^2 + v_2^2 + 2v_1v_2\cos\alpha}$ **38.** $v_0 = \sqrt{\frac{q^2}{6\pi\varepsilon_0 md}}$, Loss in KE = $\frac{q^2}{8\pi\varepsilon_0 d}$

CHEMISTRY

39. A **40.** A **41.** B **42.** D **43.** C **44.** B **45.** C
46. A,C **47.** B,C

48. (A) $\rightarrow$ P,S, (B) $\rightarrow$ Q,R, (C) $\rightarrow$ P,U, (D) $\rightarrow$ P, U

49. (A) $\rightarrow$ P,Q,R,S (B) $\rightarrow$ Q,R, (C) $\rightarrow$ R,S, (D) $\rightarrow$ P,

50. 10 min **51.** 298.8 **52.** $\Delta S = 4.425\ JK^{-1} \approx 4\ J\ K^{-1}$

53. Total stereoisomer = 4
meso form = 2
optically active = 2
Racemic mix = 1

54. 9 **55.** 6 **56.** 900 J **57.** 48%

1. Note that g is discontinuous at x = 1, hence g '(1) does not exist; also f ' (x) $= e^{x-1} - 2ax$

f ' (1) = 1 – 2a = 2 ⇒ $\boxed{a = -\frac{1}{2}}$

now, h (x) = *f* (x) · *g* (x)

h'(x) = f (x) · g'(x) + g(x) · f '(x)

for h ' (1) to exist, f (1) = 0

hence 1 – a + b ⇒ a – b = 1 ⇒ $\boxed{b = -\frac{3}{2}}$

2. $I = \int \frac{(e^x + \cos x + 1) - (e^x + \sin x + x)}{e^x + \sin x + x} dx$

$= ln(e^x + \sin x + x) - x + C$

∴ f (x) = e^x + sin x + x and g (x) = – x

f (x) + g (x) = e^x + sin x Ans.

3. Let f(x) = ax + b

fof = a (ax + b) + b

$= a^2x + ab + b = a^2x + (a + 1)b.$

fofof = $a(a^2x + ab + b) + b = a^3x + (a^2 + a + 1)b$

fofo.....of = $a^6x + (a^5 + a^4 + ... + 1)b$

$= a^6x + \frac{(a^6 - 1)}{a - 1} b$

It is equal to 2x – 1 if $a^6 = 2$ ⇒ $a = 2^{\frac{1}{6}}$

and $\left(\frac{a^6 - 1}{a - 1}\right) b = -1$ ⇒ $\frac{(2 - 1)}{2^{\frac{1}{6}} - 1} b = -1$

⇒ $b = -2^{\frac{1}{6}} + 1.$

4. $\frac{1}{2} - \frac{1}{4} + \frac{1}{8} - .... = \frac{\frac{1}{2}}{1 + \frac{1}{2}} = \frac{1}{3}$

limiting angle = $\frac{1}{3}$ × 60° = 20°.

5. (A) f(x) = x^2 (x + 2),

x + 2 is a perfect square

when x = 7. It is prime.

(B) f(x + c) = $x^3 + (3c + 2)x^2 + 7cx + c^3 + 2c^2$

(C) y = f(x +c) + k is odd when

3c + 2 = 0 ⇒ $c = -\frac{2}{3}$

$c^3 + 2c^2 + k = 0$ ⇒ $k = -\frac{16}{27}$

6. f(g(x)) = x + 2

$\frac{4 - g(x)}{g(x) + 1} = x + 2$ ⇒ $g(x) = \frac{2 - x}{x + 3}$

A linear fractional function is one-one

Since a + d = 0, g(x) is identical with its inverse.

f(x) = g(x) ⇒ $\frac{4 - x}{x + 1} = \frac{2 - x}{x + 3}$ ⇒

12 = 2 no solution

7. square both sides, differentiate and rationalise.

8. $f(x) = \begin{cases} x^3(1-x)\sin\left(\frac{1}{x^2}\right) & \text{if } 0 < x \le 1 \\ 0 & \text{if } x = 0 \end{cases}$

$f'(0^+) = \lim_{h \to 0} \frac{h^3(1-h)\sin\frac{1}{h^2} - 0}{h} = 0$

$f'(1^-) = \lim_{h \to 0} \frac{(1-h)^3(+h)\sin\frac{1}{(1-h)^2} - 0}{-h}$

$= \lim_{h \to 0} -(1-h)^3 \sin\frac{1}{(1-h)^2} = -\sin 1$

Hence f is derivable in [0, 1]

obviously f is continuous in [0, 1]

hence f is bounded

hence

$f'(x) = \begin{cases} (x^3 - x^4)\cos\left(\frac{1}{x^2}\right)\left(-\frac{2}{x^3}\right) + \sin\frac{1}{x^2}(3x^2 - 4x^3) & x \ne 0 \\ 0 \quad \text{if } x = 0 \end{cases}$

$\lim_{x \to 1^-} = (0) + \sin 1(3 - 4)$

hence f ' is also bounded ⇒ B, C, D]

9. $\left|\sum_{k=1}^{n} 3^k(f(x+ky) - f(x-ky))\right| \le 1$

$\left|\sum_{k=1}^{n-1} 3^k(f(x+ky) - f(x-ky))\right| \le 1$

Substracting, $|3^n (f(x + ny) - f(x - ny)| \le 2$

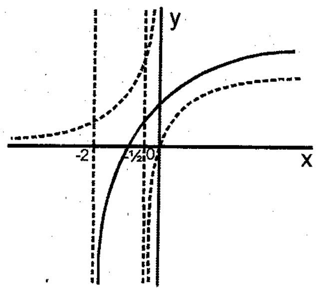
⇒ $|f(u) - f(v)| \le \frac{2}{3^n}$

As n becomes large $|f(u) - f(v)| \le 0$

⇒ f(u) = f(v).

⇒ f is a constant function.

10. (A)–(R), (B) – (S), (C) – (Q), (D) – (T) Ans.



(A) Let $x > 0$ $\dfrac{6x}{2x+1} > \log_2(x+2)$

Let $x < 0$ $\dfrac{6x}{2x+1} < \log_2(x+2)$

From the graph the solution is $\left(\dfrac{-1}{2}, 0\right)$

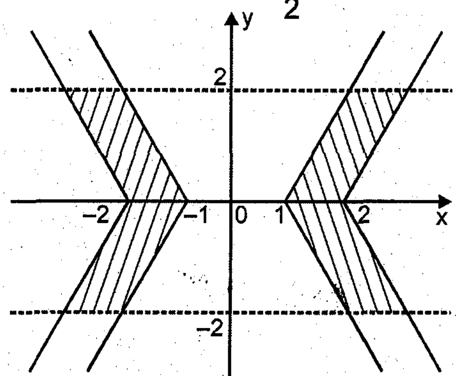
(B) $\lim\limits_{n \to \infty} \dfrac{(-1)^{n^4+n+1} n\, n! + 3^{n+1}}{(n+1)! + 3^n}$

Divide Nr & Dr by (n + 1)!.
Also $n^4 + n + 1$ is odd.

$$= \lim_{n \to \infty} \frac{(-1)\dfrac{n}{n+1} + \dfrac{3^{n+1}}{(n+1)!}}{1 + \dfrac{3^n}{(n+1)!}} = -1$$

(C) Area of the shaded region

$$= 4 \times \frac{1}{2} \times 1 \times 2 = 4$$



(D) $|x + y + z| = |x + 2 + y + 3 + z - 5| \le |x + 2| + |y + 3| + |z - 5|$

$\Rightarrow$ $|x + y + z| \le 1$

Also $|x + y + z| \ge 0$

When $x = -\dfrac{5}{2}, y = -3, z = \dfrac{11}{2}$

$|x + y + z| = 0$

11. (A)–Q,S;(B)–Q,R,S; (C)–P, Q, R, S ; (D) –P, R

(A) $f_2(x) = f(f(x)) = f(x) = x$

$f_3(x) = f(f_2(x)) = f(x) = x$

$\Rightarrow$ $x^3 - 25x^2 + 175x - 375 = 0$

$(x - 5)(x^2 - 20x + 75)$

$(x - 5)^2 (x - 15) = 0$

$\Rightarrow$ $x = 5, 15$ $\Rightarrow$ Q, S

(B) Range of f(f(f(x))) is [4, 17] $\Rightarrow$ Q, R, S

Domain of f(x) is [–1, 1]

(C) If $x \in [-1, 0)$, $f(x) = 8(x + \pi) + 5x + 4x - x$

$= 16x + 8\pi$

$f(x) \in [8\pi - 16, 8\pi]$

If $x \in (0, 1]$, $f(x) = 8x + 5x + 4x - x = 16x$

$f(x) \in (0, 16]$ $\Rightarrow$ P, Q, R, S

(D) $x \in [-1, 0]$

$$x + \frac{1+x^2}{2} = -2x$$

$x^2 + 6x + 1 = 0 \Rightarrow x = \dfrac{-6 \pm \sqrt{36-4}}{2} = -3 \pm 2\sqrt{2}$

$x = 2\sqrt{2} - 3$ $\Rightarrow$ $|10a| = |20\sqrt{2} - 30|$

$x \in [0, 1]$

$$x + \frac{1+x^2}{2} = 2x$$

$1 + x^2 = 2x \Rightarrow x = 1$ $\Rightarrow$ $|10a| = 10$

$|10a| = 10, |20\sqrt{2} - 30|$

$\Rightarrow$ $[|10a|] = 1, 10$ $\Rightarrow$ P, R

12. **Ans.** 8

f is symmetrical about the line x = 2. All the distinct roots come is pairs, each pair having a sum of 4. Since there are exactly four distinct roots, 2 is not a root. There are exactly two pair and two sum is 8.

13. **Ans.** 1

$a_2 - a_1 = 2.1$

$a_3 - a_2 = 2.2$

$a_n - a_{n-1} = 2 . (n - 1)$

Adding, $a_n - a_1 = n(n - 1)$

$$\lim_{n\to\infty} \frac{a_n}{n^2} = \lim_{n\to\infty} \frac{n(n-1)+2}{n^2} = 1$$

14. **Ans.** 3

$x + 5 \sin y = 5$

$x + 5 \cos y = 4$

subtract $\sin y - 5 \cos y = 1$

$\sin y = 1 + 5 \cos y$

$\Rightarrow$ $\cos y = 0$ $\Rightarrow$ $y = \dfrac{\pi}{2}$

$x = 5 - \sin \dfrac{\pi}{2} = 4$

$$[x+y] = \left[4+\frac{\pi}{2}\right] = 5.$$

$f(t) = 2t - 3(t-2) - (3-4t)$ for $t > 2$

$= 3t + 3$

$f'(t) = 3$. for $t > 2 \Rightarrow \quad f'(5) = 3$.

15. **Ans.** 3

Let $x^{\log_{10} 3} = t = 3^{\log_{10} x}$

$\therefore t^2 - t - 2 = 0 \Rightarrow \quad t = 2, -1$(not possible)

$x^{\log_{10} 3} = 2 \quad \Rightarrow \quad x = 2^{\log_3 10}$

$b = 3$.

$$f(p) = \lim_{h\to 0}\frac{(1+h)^p - p(1+h) + p - 1}{h^2}$$

$$= \lim_{h\to 0}\frac{1 + ph + \frac{p(p-1)}{2}h^2 ..... - p - ph + p - 1}{h^2}$$

$$= \frac{p(p-1)}{2} \quad \therefore \quad f(3) = 3.$$

16. **Ans.** 0

Apply L' Hospital rule twice on $\dfrac{f(x)e^{x^2/2}}{e^{x^2/2}}$

$$\lim_{x\to\infty} f(x) = \lim_{x\to\infty}\frac{f(x)e^{x^2/2}}{e^{x^2/2}} = \lim_{x\to\infty}\frac{(f'(x) + xf(x))e^{x^2/2}}{xe^{x^2/2}}$$

$$= \lim_{x\to\infty}\frac{(f''(x) + 2xf'(x) + (x^2+1)f(x))e^{x^2/2}}{(x^2+1)e^{x^2/2}}$$

$$= \lim_{x\to\infty}\frac{f''(x) + 2xf'(x) + (x^2+1)f(x)}{x^2+1} = 0$$

17. **Ans.** 2

(fof) (k) can have four values $\frac{k}{9}, \frac{2k}{3}+1, \frac{2k+1}{3}$ or $2(2k+1)+1$. Only the second and third of these give values of k for which $f(f(k)) = k$. These values are 1 and 3.

18. **Ans.** 0

$$\left(f(x) + \frac{1}{x}\right) = \frac{1}{f(x)} \qquad ...(1)$$

$$f\left(f(x) + \frac{1}{x}\right). f\left(f\left(f(x) + \frac{1}{x}\right) + \frac{1}{f(x) + \frac{1}{x}}\right) = 1 \quad ....(2)$$

Putting (1) in (2).

$$f\left(\frac{1}{f(x)} + \frac{1}{f(x) + \frac{1}{x}}\right) = f(x) \qquad ....(3)$$

Since f is strictly increasing, it is one-one. From (3)

$$\frac{1}{f(x)} + \frac{1}{f(x) + \frac{1}{x}} = x \Rightarrow f(x) = \frac{1 \pm \sqrt{5}}{2x}$$

We select the increasing function f(x)

$$= \frac{1-\sqrt{5}}{2x}, x > 0$$

$$[-f(1)] = \left[\frac{\sqrt{5}-1}{2}\right] = 0$$

19. $a = f\left(\frac{\pi}{6}\right) = \underset{x\to\frac{\pi}{6}}{\text{Limit}}\dfrac{\sin(x-(\pi/6))}{\sqrt{3} - 2\cos x}$

$$= \underset{x\to\pi/6}{\text{Lim}}\frac{\sin(x-(\pi/6))}{2(\cos(\pi/6) - \cos x)}$$

$$= \underset{x\to\pi/6}{\text{Lim}}\frac{2\sin((x/2)-(\pi/12))\cos((x/2)-(\pi/12))}{4\sin((\pi/12)+(x/2))\sin((\pi/12)+(x/2))} = \frac{2}{2} = 1$$

hence $a = 1$

$$r = \underset{x\to 0}{\text{Limit}}\frac{\sin(x)^{1/3}.\ell n(1+3x)}{x\left(\frac{\tan^{-1}\sqrt{x}}{\sqrt{x}}\right)^2\left(e^{5.x^{1/3}} - 1\right)}\frac{(5x^{1/3})}{(5x^{1/3})}$$

$$= \underset{x\to 0}{\text{Limit}}\frac{3\ell n(1+3x)^{1/3x}}{5} = \frac{3}{5}$$

$$\therefore \qquad \text{sum (S)} = \frac{a}{1-r} = \frac{1}{1-\frac{3}{5}} = \frac{5}{2}$$

$$\Rightarrow \qquad 2S = 5$$

20. **[B]** $a_c = k^2 rt^2$ or $\frac{v^2}{r} = k^2rt^2$ or $v = krt$

Therefore, tangential acceleration, $a_t = \frac{dv}{dt} = kr$

or Tangential foce, $F_t = ma_t = mkr$

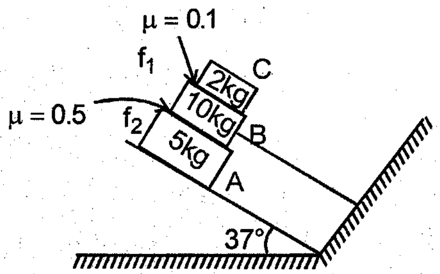
Only tangential force does work.

Power = $F_t v$ = (mkr) (krt)

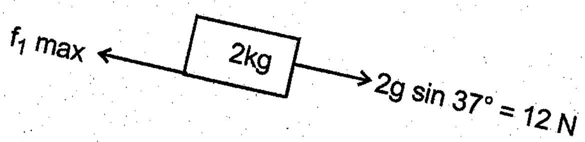
or Power = $mk^2r^2 t$

21. **[D]**

Sol.



F.B.D. of 2 kg block



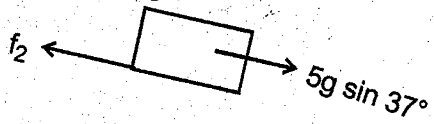
$f_{1\,max}$ = (0.1) (2) (10) cos 37° = 1.6 N

∴ frictional force acting on 2 kg block = 1.6 N

Maximum frictional force acting betweel 5 kg block and 10 kg block

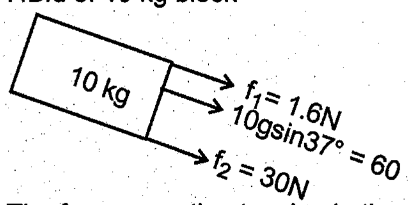
⇒ $f_{2\,max}$ = (0.5) (12) (10) cos 37° = 48 N

F.B.D. of 5 kg block



so the friction force acting on 5 kg block = 30 N

F.B.d of 10 kg block



The forces creating tension in the rod are shown in FBD

∴ T = 30 + 1.6 + 60 = 91.6 N

22. **[C]**

The maximum velocity of the insect is $A\sqrt{\frac{k}{M}}$

Its component perpendicular to the mirror is

$$A\sqrt{\frac{k}{M}}\sin 60^\circ$$

thus maximum relative speed = $\sqrt{3}A\sqrt{\frac{k}{M}}$

23. **[B]**

Using Snell's law = $\mu_0 \sin(90° - \theta) = \mu_0\left(1-\frac{x}{d}\right)\sin 90°$

$\Rightarrow \left(1-\frac{x}{d}\right) = \cos\theta \Rightarrow x = d(1-\cos\theta)$

24. **[B,D]**

Let the mass of ball be m.

When A throws the ball momentum of A

$\Delta P_A = mv_1$(left)

v_1 is velocity of ball in ground frame.

When B gather and throws the ball in air with velocity v_2

$\Delta P_{ball} = m(v_1 + v_2)$ (left)

$\Delta P_B = m(v_1 + v_2)$ (right) = p_B

Final momenta of A + ball

$= \Delta p_A + mv_2$(left) $= mv_1 + mv_2$

(Only momentum of A) $p_A < mv_1 + mv_2 = p_B$

$$v_A = \frac{p_A}{m_A}, \qquad v_B = \frac{p_B}{m_B}$$

Since $m_A > m_B$

$\Rightarrow v_A < v_B$

$$K_A = \frac{p_A^2}{2m_A} \qquad K_B = \frac{p_B^2}{2m_B} \Rightarrow K_A < K_B]$$

25. **[A,B,C]**

26. **[B,D]**

$v^2 = \omega^2(A^2 - x^2) = 3\omega^2a^2 \Rightarrow \omega = \frac{v}{\sqrt{3}a} = 1$ rad/sec

$x = 2a\sin(\omega t + \phi)$, $v = 2a\omega\cos(\omega t + \phi)$

$\frac{1}{2} = \sin\phi \Rightarrow \phi = n\pi + (-1)^n\frac{\pi}{6} = \begin{cases}\pi/6 \\ 5\pi/6\end{cases}$

v at $\phi = \pi/6$ = +ve and v at $\phi = 5\pi/6$ = – ve

So, $\phi = \pi/6$

$x = 2a\sin(\omega t + \phi) = 2a[\sin\omega t\cos\phi + \cos\omega t\sin\phi]$

$x = a(\sqrt{3}\sin t + \cos t)$

27. **[B,C]**

Intensity of reflected wave is 64% of incident wave

$$\frac{A_R}{A_I} = \sqrt{\frac{I_R}{I_I}} = 0.8$$

Amplitude of reflected wave A_R = 0.8 A

d = 2 × 0.8 A = 1.6 A

Given resultant wave is constituted by the following wave.

y = 0.8 A cos (bt + ax) – 0.8 A cos (bt – ax) + 0.2 A cos (bt + ax)

First two waves constitute stationary wave

Hence c = 0.2

28. **[B,D]**

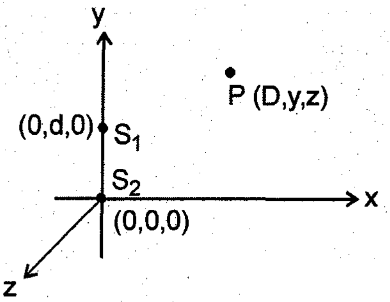
29. $A \to Q,R,S$, $(B) \to Q,R,S$, $(C) \to R$, $(D) \to Q,R$

30. $A \to P$; $(B) \to Q,R$; $(C) \to P$, $(D) \to P$

$S_1P^2 = D^2 + (y - d)^2 + z^2$

$S_2P^2 = D^2 + y^2 + z^2$

Path difference = $S_2P - S_1P$



$S_2P - S_1P =$

$$D\left[1+\frac{y^2}{D^2}+\frac{z^2}{D^2}\right]^{1/2} - D\left[1+\frac{(y-d)^2}{D^2}+\frac{z^2}{D^2}\right]^{1/2} = n\lambda$$

(equation of hyperbola)

If d << D

$$S_2P - S_1P = \frac{y^2-(y-d)^2}{2D} = \frac{d(2y-d)}{2D} = n\lambda$$

(equation of straight line)

31. Let the particle is displaced from its position by x

$\cos\theta_1 = \frac{x}{b}$ and $\cos\theta_2 = x/c$

$$\sum F = -(T\cos\theta_1 + T\cos\theta_2) = \frac{md^2x}{dt^2}$$

$$\frac{d^2x}{dt^2} + \frac{x}{m}\left(\frac{T}{c}+\frac{T}{b}\right) = 0$$

$$\therefore\ f = \frac{1}{2\pi}\sqrt{\frac{T}{m}\left(\frac{b+c}{bc}\right)}$$

Even if b and c are inter changed, the restoring force is NOT changed, therefore new frequency remains same, restoring force in first case

$$= -x\left[\frac{T}{c}+\frac{T}{b}\right]$$

32. $F\cos\theta = ma$, $13\cos\theta = 5$, $\cos\theta = \frac{5}{13}$

$F\sin\theta - \mu mg = ma_1$

$13 \times \frac{12}{13} - 0.6 \times 10 = ma_1$

(a_1 = acceleration of the particle with respect to train)

$a_1 = 6\ m/s^2$

$a_{net} = \sqrt{36+25} = \sqrt{61}\ m/s^2$

33. The person has mechanical energy $E_1 = mg(h + s)$ just before he lands. The work done by him during deceleration is $E_2 = fs$, where f is the total force on his legs. As $E_1 = E_2$

$$f = \frac{mgh}{s} + mg = \left(\frac{80\times 1}{0.01} + 80\right)g = 8080\,gN$$

34. Slope of V_y versus t graph is $-g$

$$\therefore\quad -g = \frac{-10}{t_1}$$

35. At = 0.2 sec, velocity of lens $V_i = gt = 2$ m/s (downward)

$\therefore$ for lens the fish appears to approach with a speed of

$$2 + \left(1\times\frac{3}{4}\right) = \frac{11}{4}\ m/s$$

At a distance of $\left[42 + \frac{24}{\left(\frac{4}{3}\right)}\right] = 60\,cm$

$\therefore$ Image of fish from lens,

$$V = \frac{-60\times 90}{-60\times 90} = -180cm$$

$\therefore$ Velocity of image w.r.t. lens

$$V_1 = \left(\frac{v^2}{u^2}\right)\frac{du}{dt} = \left(\frac{-180}{-60}\right)^2 \times \frac{11}{4} = \frac{99}{4} m/s = 2475\ cm/s$$

36. $f_{limiting} = \mu\,mg = 0.3 \times 2.10 = 6$ N

Force needed for accn of 2 m/s^2

F = ma = 4 N

So friction force is static, f = 4 N

Displacement w.r.t observer in t = 2 sec is

$S = u_{rel}t + \frac{1}{2}a_{rel}t^2 \qquad = 0 + \frac{1}{2}(-3) \times 4 = -6m$

$W = \vec{f}.\vec{S} = 4(-6) = $ **–24 J**

37.

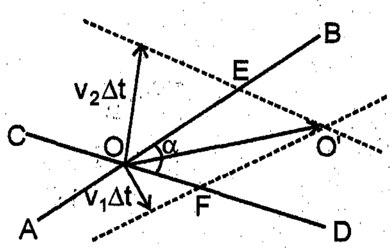


Figure shows the initial and final positions of straight lins AB and CD. AB moves with veloicty v_1 and CB with v_2 respectively.

The point of intersection of the two lines will travel to O′.

$$OF = \frac{v_1\Delta t}{\sin\alpha} = EO'$$

$$OE = \frac{v_2 \Delta t}{\sin\alpha} = FO'$$

Hence $OO' = \sqrt{OF^2 + OE^2 + 2OF.OE\cos\theta} = v\Delta t$

where v is velocity of point of intersection.

$$v = \frac{1}{\sin\alpha}\sqrt{v_1^2 + v_2^2 + 2v_1v_2\cos\alpha}$$

38. Since there is no external force acting on the them, their center of mass will be at rest. At minimum separation, the velocity of approach of the two particles along the line joining the particles will be zero. Their velocities will be perpendicular to the line joining them. let v be the velocity and 2d be their separation.

From energy conservation

$$2 \times \frac{1}{2}mv_0^2 = \frac{1}{4\pi\varepsilon_0}\frac{q^2}{2d} + 2 \times \frac{1}{2}mv^2 \quad ...(i)$$

From conservation of angular momentum about C.M.

$$2 \times mv_0 \times \frac{d}{2} = 2mv \times \frac{2d}{2}$$

...(ii)

From equations (i) and (ii)

$$v = \frac{v_0}{2} \text{ and } v_0 = \sqrt{\frac{4}{3} \times \frac{1}{m} \times \frac{1}{4\pi\varepsilon_0}\frac{q^2}{2d}} = \sqrt{\frac{q^2}{6\pi\varepsilon_0 md}}$$

$$\text{Loss in KE} = \frac{3}{4} \times mv_0^2 = \frac{q^2}{8\pi\varepsilon_0 d}$$

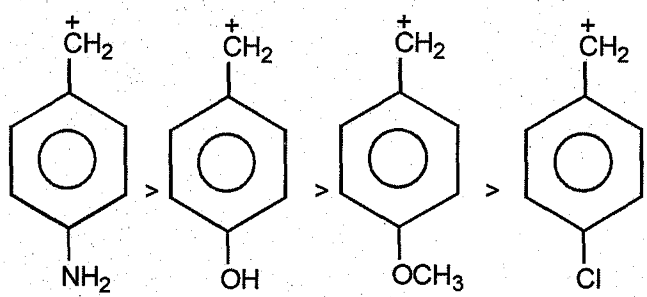
CHEMISTRY

39. **[A]**

40. **[A]**

41. **[B]** + M of NH_2 > OH > OCH_3

Hence



Stability order

42. **[D]**

Stability of free radical

3 > 2 > 1 > 4

Hence Bond energy

4 > 1 > 2 > 3

43. **[C]**

44. **[B]**

A → no chiral

B → meso

C → Nochiral

45. **[C]**

B → Trans is more stable than cis due to intra molecular H-bonding

46. **[A,C]**

no $P\pi - P\pi$ bonding in complex. That's why B – F bond length increases.

47. **[B,C]**

48. **(A) → P,S, (B) → Q,R, (C) → P,U, (D) → P, U**

49. **(A) → P,Q,R,S (B) → Q,R, (C) → R,S, (D) → P, Q**

50.

$$\begin{array}{ccc} A & \longrightarrow & B + C \\ a & & 0 \quad 0 \\ a - x & & x \quad x \end{array}$$

t = 0 $\quad 30 \times a = 30 \quad \Rightarrow \quad a = 1$

t = 20 min

$(a - x) \times 30 + x \times -60 + x \times 50 = 0$

$x = 3/4$

$t_{3/4} = 20 \text{ min} \Rightarrow 2t_{1/2} = t_{3/4} \Rightarrow t_{1/2} = 10 \text{ min}$

51. $w = -P\Delta V = -3 \times 2$ litre atm

$= -6 \times 100 \text{ J} = 600 \text{ J}$

$w = n \times C \times (T_2 - T_1)$ where C is molar heat capacity

$600 = 10 \times 4.184 \times 18 \times \Delta T$ where molecular weight of H_2O = 18 g mol^{-1}

$$\Delta T = T_2 - T_1 = \frac{600}{41.84 \times 18} = \frac{607.8}{753.12} = 0.8$$

$T_2 = 298 + 0.8 = 298.8$

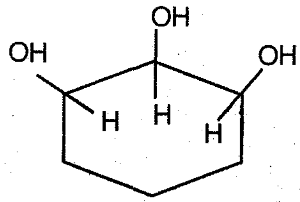
52.

$$\Delta S = q_{rev}\frac{(T_2 - T_1)}{T_1T_2}$$

$$= \frac{5230(423 - 311.5)}{423 \times 311.5} = 4.425 \text{ JK}^{-1}$$

$\Delta S = 4.425 \text{ J K}^{-1} \approx 4 \text{ J K}^{-1}$

53. total stereoisomer = 4
meso form = 2
optically active = 2
Racemic mix = 1



54. 9

55.

$$CH_3-CH=CH-\underset{CH_3}{\overset{OH}{\overset{|}{\underset{|}{C}}}}-CH=CH-CH_3$$

Isomers
Cis R cis
Cis S Cis
Trans R Trans
Trans S Trans
Cis S Trans
Trans S Cis } — Both are same

Cis R Trans
Trans R Cis } — Both are same

Total stero isomer = 6

56. $\Delta U = \Delta Q + \Delta W$

for adiabatic process $\Delta Q = 0$

$\therefore \; \Delta U = \Delta W = -P\Delta V = -100 \times 10^5 (-10^{-6}) = 10$ J

$\Delta H = \Delta U + \Delta(PV)$

$\therefore \; \Delta H = \Delta U + P_2V_2 - P_1V_1$

$= 10 + 100 \times 10^5 \times 99 \times 10^{-6} - 10 \times 10^5 \times 10 \times 10^{-6}$

$= 10 + 990 - 100 = 900$ J

57. $C_{12}H_{22}O_{11} + H_2O \rightarrow C_6H_{12}O_6 + C_6H_{12}O_6$
glucose frontose

$$[\text{sugar}] = \frac{10}{342}\frac{1}{100} \times 100 = \frac{100}{342} = 0.2924$$

	$C_{12}H_{22}O_{11}$ + H_2O ⟶	$C_6H_{12}O_6$	+ $C_6H_{12}O_6$
t = 0	0.2924	0	0
t = t	0.2924 – x	0.2924	0.2924

t = ∞

at t = 0

$0.2924 \times r_1^\circ = 13.1 \Rightarrow r_1^\circ = 44.8$ ...(1)

After complete hydrolysis

$0.2924\, r_2^\circ - 0.2924\, r_3^\circ = -3.75$

$\Rightarrow r_2^\circ - r_3^\circ = -12.82$ ...(2)

at t = t

$(0.2924 - x)\, r_1^\circ + x \times r_2^\circ - x\, r_3^\circ = 5$

$x = 0.14$

$$\% \text{ Hydrolysis} = \frac{0.14}{0.2924} \times 100 = 48\%$$