

SOLUTIONS

PROGRESS TEST-6

GRA

JEE ADVANCED PATTERN

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PHYSICS

1. (D)

The extension developed in the string due to small values of ' θ ' is :

$$x = h \sin \theta \cong h\theta$$

Torque about 'O' :

$$\tau_0 = (Mg \sin \theta) L + (kx)h$$

$$\text{or, } \tau_0 \cong mg \theta L + kh^2\theta = (mgL + kh^2)\theta \quad \dots (1)$$

Also;

$$\tau_0 = I_0 \alpha = mL^2 \alpha \quad \dots (2)$$

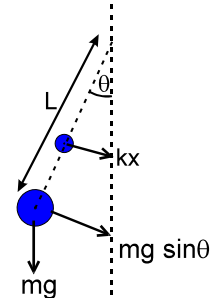
From (1) and (2) :

$$mL^2 \alpha = (mgL + kh^2)\theta$$

$$\text{or } \alpha = \frac{1}{L^2} \left(gL + \frac{kh^2}{m} \right) \theta$$

$$\text{Now : } T = 2\pi \sqrt{\frac{\theta}{\alpha}} = 2\pi \sqrt{\frac{\theta}{\frac{1}{L^2} \left(gL + \frac{kh^2}{m} \right) \theta}}$$

$$\Rightarrow v = \frac{1}{T} = \frac{1}{2\pi L} \sqrt{\left(gL + \frac{kh^2}{m} \right)} \quad \text{Hence (D).}$$



2. (B)

Let the charge on outer surface of plates (1) be x and on the inner (interfacing) surface of plate (1) be y , then charge distribution on other plates is shown in figure (by using charge conservation and $E = 0$ inside the metallic plates).

For electric field to be zero inside the plate 1

$$\frac{x}{2A\epsilon_0} = \frac{(q-x)}{2A\epsilon_0}$$

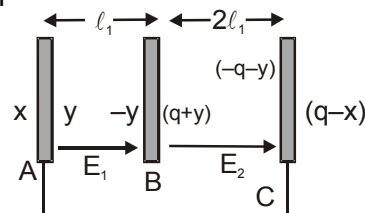
$$\Rightarrow x = \frac{q}{2} \quad \& \quad q - x = \frac{q}{2}$$

Since

$$V_A = V_C$$

$$\Rightarrow E_1 \ell_1 = E_2 \ell_2$$

$$\Rightarrow \frac{y}{A\epsilon_0} \ell_1 = \frac{(-q-y)}{A\epsilon_0} 2\ell_1$$



$$\Rightarrow V_A - V_B = V_C - V_B$$

$$yl_1 = -2ql_1 - 2yl_1$$

$$3yl_1 = -2ql_1$$

$$y = \frac{-2q}{3}$$

$$\text{So, } -q - y = -q + \frac{2q}{3} = \frac{-q}{3}$$

$$\text{So, Charge on outer surface of plate 1 is } x = \frac{q}{2}$$

$$\text{Charge on inner (interfacing) surface of plate 1 is } y = \frac{-2q}{3}$$

$$\text{Charge on outer surface of plate 2 is } q - x = \frac{q}{2}$$

$$\text{Charge on inner (interfacing) surface of plate 2 is } (-q - y) = \frac{-q}{3}$$

3. (A)

4. (C)

$$\int_5^v dV = -\int \vec{E} \cdot d\vec{r} = -\int_0^x E_x dx - \int_0^y E_y dy$$

$$\Rightarrow V - 5 = -\frac{2x^2}{2} - \frac{3y^2}{2}$$

$$\Rightarrow V = -\frac{2x^2}{2} - \frac{3y^2}{2} + 5.$$

5. (C)

6. (A)

7. (C)

8. (B)

$$B = \frac{\mu_0 i}{2\pi r} \quad r = \sqrt{2^2 + 3^2 + 6^2} = 7$$

$$\therefore B = \frac{4\pi \times 10^{-7}}{2\pi} \times \frac{7}{7} = 2 \times 10^{-7} \text{ T.}$$

9. (D)

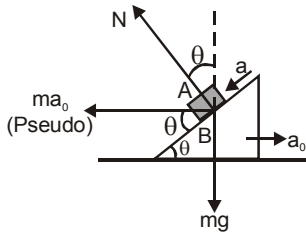
10. (A)

11. (C)

12. (A)

$$E = \frac{KQ}{r^2}, V = \frac{Kv}{r}$$

13. (A,D)



$$ma_0 \sin\theta + N = mg \cos\theta \Rightarrow mg \cos\theta \Rightarrow N = mg \cos\theta - ma_0 \sin\theta$$

$$\Rightarrow N < mg \cos\theta$$

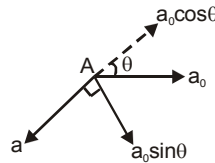
Hence, (D) is true.

$$ma_0 \cos\theta + mg \sin\theta = ma$$

$$\Rightarrow a = g \sin\theta + a_0 \cos\theta$$

Hence acceleration of A

$$= \sqrt{(a - a_0 \cos\theta)^2 + (a_0 \sin\theta)^2} > g \sin\theta.$$

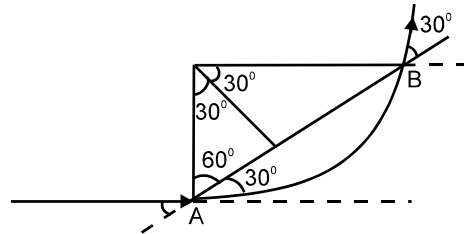


14. (B,C)

15. (B,C)

$$\text{Arc AB} = \frac{\pi}{3} r = \frac{\pi m V}{3qB}$$

$$\text{Time 't'} = \left(\frac{I}{2\pi}\right) \cdot \left(\frac{\pi}{3}\right) = \frac{T}{6} = \frac{\pi m}{3qB}$$



16. (3)

$$\tau_{\max} = 2mg \cdot \frac{3\ell}{4}$$

m : mass of one rod

$$I = \frac{m\ell^2}{12} + m\left(\frac{5\ell^2}{4}\right) + \frac{m\ell^2}{3} = \frac{5}{3}m\ell^2$$

$$\therefore \alpha = \frac{3mg\ell}{2} \times \frac{3}{5m\ell^2} = \frac{9}{10} \left(\frac{g}{\ell}\right)$$

17. (4)

$$\frac{\mu_0 i_1}{2\pi(d+r)} = \frac{N \times \mu_0 i_2}{2r}$$

$$\Rightarrow N = \frac{i_1}{i_2} \cdot \frac{r}{\pi(d+r)} = \frac{54}{3.5} \cdot \frac{0.22 \times 7}{22(0.27)} = 4$$

18. (1)

The particle will move along a circle of radius equal to the radius of circular region in which magnetic field is present. (See in fig.)

$$\text{From } R = \frac{mv}{qB} ; v = \frac{qBR}{m}$$

$$= \frac{5 \times 10^{-6} \times 4 \times (0.1)}{2 \times 10^{-3}} = 10^{-3} \text{ m/s} = 1 \text{ mm/s.}$$

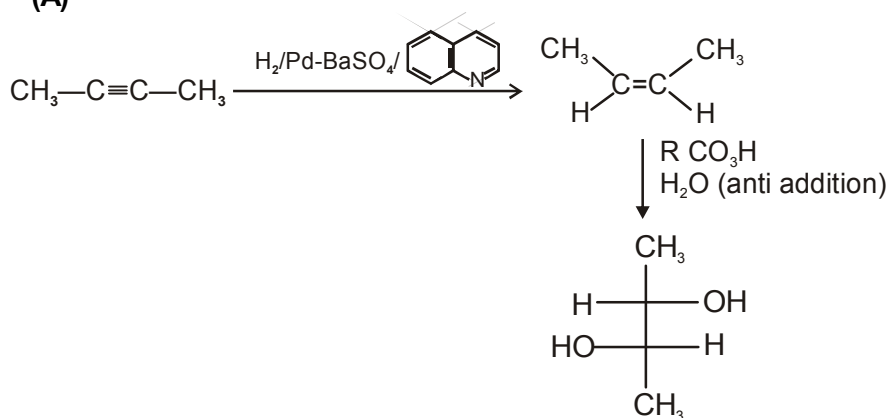
19. (1)

20. (2)

Twice the current flows through the single resistor as through each of the resistors in parallel. Therefore, $\frac{2}{3}$ of the total potential drop of 15 V appears across the single resistor, and $\frac{1}{3}$, or 5V, appears across each parallel resistor. Since the current through one parallel resistor is 2 A, its resistance must be $(5 \text{ V})/(2 \text{ A}) = \frac{5}{2}$ ohm.

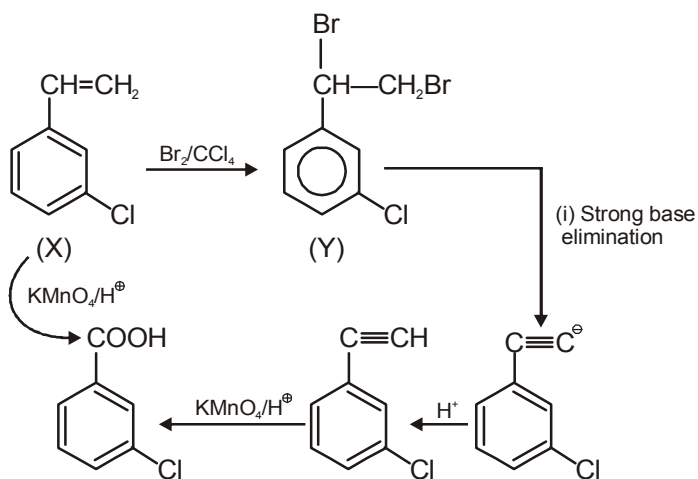
CHEMISTRY

21. (A)



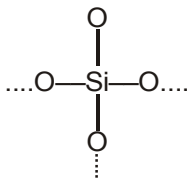
22. (B)

For C_8H_7Cl DU is 5 ie



23. (A)

each silicon atom is surrounded by four oxygen atoms and each oxygen atom is bonded to two silicon atoms



24. (C)

$$\Delta T_f = 8^\circ C = 8k \text{ in final solution}$$

$$\Delta T_f = k_f m$$

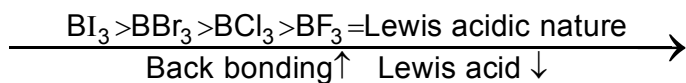
$$8 = 2 \times \frac{50}{100 w_1(\text{kg})}$$

$$\text{or, } w_1(\text{kg}) = \frac{1}{8} \text{ kg}$$

$$\text{or, } W_1 = \frac{1}{8} \times 1000\text{g} = 125\text{g}$$

ice separated = 375 g

25. (C)



26. (B)

$$\Delta T_f = 3 = i k_f m$$

$$3 = i \times 1.86 \times \frac{1}{1.86}$$

$$\text{or } i = 3$$

So, complex is $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$

27. (C)

$\text{NF}_3 < \text{NCl}_3 < \text{NBr}_3 < \text{NI}_3$ Dipole Moment.

28. (D)

$$P_{\text{ext}} = \pi_{\text{final}}$$

$$\pi = CRT$$

$$3 \times 82.1 = C \times 0.0821 \times 300$$

$$\text{or } C = 10 \text{ M}$$

$$M_1 V_1 = M_2 V_2$$

$$1 \times 1 = 10 \times V_2$$

$$\text{or } V_2 = 0.1 \text{ litre} = 100 \text{ ml}$$

water purified = 900 ml

29. (B)

30. (B)

$$W = \frac{i \times t}{F} E$$

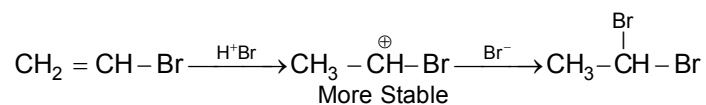
$$0.01 \times 2 = \frac{10}{1000} \times \frac{t}{96500} \times 1$$

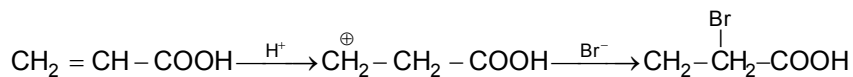
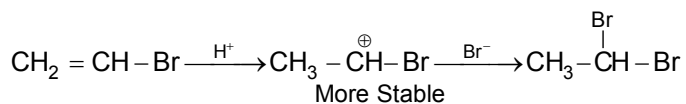
$$t = 19.3 \times 10^4 \text{ s}$$

31. (B), (C), (D)

32. (A), (B)

33. (B,D)





34. (A), (B), (C)

$$q = 0, \quad w = 0$$

$$\Delta U = q + w = 0$$

$$T_1 = T_2$$

$$P_1 V_1 = P_2 V_2$$

Note:- $P_2 V_2^\gamma = P_1 V_1^\gamma$ is for reversible adiabatic process

35. (C), (D)

No of particle = $i \times c$

no of particle are same solution are isotonic

(A) $.1 \times 1 \neq .1 \times 2$

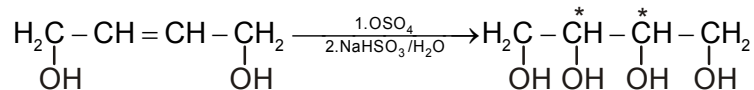
(B) $.1 \times 1 \neq .1 \times 3$

(C) $.1 \times 3 = .1 \times 3$

(D) $.1 \times 3 = .1 \times 3$

C, D have example of isotonic solution

36. (2)



$$C^* = 2 \text{ (similar)}$$

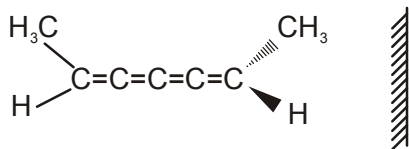
So, optically active compounds = 2

37. (1)

38. (4)

Total number of species are : $\text{N}_2^+, \text{O}_2, \text{B}_2, \text{N}_2^{2-}$

39. (2)



40. (3)

$$\text{Let } \lambda_{\text{HX}}^{0.01} = a, \lambda_{\text{HY}}^{0.1} = 10a$$

$$\lambda_{\text{HX}}^{\infty} = \lambda_{\text{HY}}^{\infty} = \lambda^{\infty}$$

$$\alpha_{\text{HX}} = \frac{a}{\lambda^{\infty}}, \quad \alpha_{\text{HY}} = \frac{10a}{\lambda^{\infty}}$$

$$K_a(\text{HX}) = 0.01 \times \left(\frac{a}{\lambda^{\infty}} \right)^2$$

$$K_a(\text{HY}) = 0.1 \left(\frac{10a}{\lambda^{\infty}} \right)^2$$

$$\frac{K_a(\text{HX})}{K_a(\text{HY})} = \frac{1}{1000}$$

$$pK_a(\text{HX}) - pK_a(\text{HY}) = 3$$

MATHEMATICS

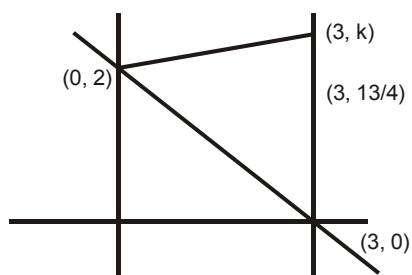
41. (C)

$$\int_0^1 \cos^{-1} \cos[x] dx + \int_1^2 \cos^{-1}(\cos[x]) dx + \int_2^3 \cos^{-1} \cos[x] dx + \int_3^4 \cos^{-1} \cos[x] dx + \int_4^5 \cos^{-1} \cos[x] dx$$

$$= \int_0^1 \cos^{-1}(1) dx + \int_1^2 1 \cdot dx + \int_2^3 2 dx + 3 \int_3^4 dx + \int_4^5 (2\pi - 4) dx$$

$$= 0 + 1 + 2 + 3 + 2\pi - 4 = 2\pi + 2$$

42. (B)



$$3^2 + (2 - k)^2 = k^2 \Rightarrow 9 + 4 - 4k + k^2$$

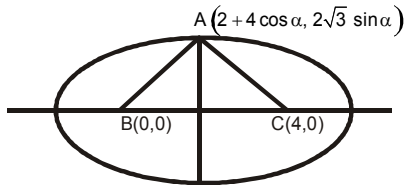
$$\Rightarrow k = \frac{13}{4}$$

$$\Rightarrow y - 2 = \frac{\frac{13}{3} - 2}{3 - 0}(x - 0),$$

$$\Rightarrow 5x - 12y = -24$$

$$-\frac{5}{24}x + \frac{y}{2} = 1$$

43. (C)



On solving equation of an ellipse

$$\frac{(x-2)^2}{4} + \frac{3}{4}y^2 = 1 \Rightarrow e = \sqrt{\frac{2}{3}}$$

44. (A)

$$\frac{a^2 + b^2}{2} > \sqrt{a^2 b^2}$$

$$a^2 + b^2 > 2ab \Rightarrow b^2 + c^2 > 2bc \Rightarrow c^2 + a^2 > 2ca$$

$$\Rightarrow a^2 + b^2 + c^2 > ab + bc + ca$$

$$\Rightarrow ab + bc + ca < 1$$

45. (C)

46. (B)

$$1 - 2\sin^2 x + k\sin x = 2k - 7 \Rightarrow 2\sin^2 x - k\sin x + (2k - 8) = 0$$

$$\sin x = \frac{k-4}{2} \text{ or } 2$$

$$2 \leq k \leq 6$$

47. (D)

$$\Rightarrow \cos^7 x - \cos^2 x(1 + \sin^2 x) = 0$$

$$\Rightarrow \cos^2 x(\cos^5 x + \cos^2 x - 2) = 0 \Rightarrow \cos x = 0 \text{ and } \cos x = 1$$

48. (C)

$$\sqrt{3h} - \sqrt{3k+2} - 1 = 0$$

On solving we get

$$9x^2 + 9y^2 - 18xy - 18x + 6y + 1 = 0 \quad \therefore h^2 = ab$$

So locus is parabola

49. (A)

$$I_n = -n[I_n - (n-1)I_{n-2} + (n-1)I_n]$$

$$\frac{I_3}{I_1} = \frac{3}{5}$$

50. (D)

$$\int_0^{\tan 1} [\tan^{-1} x] dx + \int_{\tan 1}^{1000} [\tan^{-1} x] dx = \int_0^{\tan 1} 0 \cdot dx + \int_{\tan 1}^{1000} 1 \cdot dx \Rightarrow 1000 - \tan 1$$

51. (A, C)

$$\frac{1}{1+x^2} > \frac{1}{1+x^{\frac{\pi}{2}}} > \frac{1}{1+x}$$

52. (A, B)

Put $\sin^2 x = t$

53. (A, D)

54. (A, B, C)

55. (A, D)

56. (0)

$$I = \int_0^{46} (x-1)(x-2)\dots(x-45) dx$$

$$I = \int_0^{46} (46-x-1)(46-x-2)\dots(46-x-45) dx$$

$$= \int_0^{46} (45-x)(43-x)\dots(1-x) dx \Rightarrow I = 0$$

57. (1)

$$P = \lim_{n \rightarrow \infty} \left(\frac{1}{n} \cdot \frac{2}{n} \cdot \frac{3}{n} \cdot \dots \cdot \frac{n}{n} \right)^{\frac{1}{n}}$$

$$\ln p = \lim_{n \rightarrow \infty} \frac{1}{n} \sum \ln \frac{r}{n}$$

$$\ln p = \int_0^1 \ln x dx = [x(\ln x - 1)]_0^1$$

$$\Rightarrow p = e^{-1}; k = -2 \quad \therefore 2k + 5 = 1$$

58. (2)

$$\int \tan^3 x (\sec^2 x - 1) dx$$

$$= \int \tan^3 x \cdot \sec^2 x dx - \int \tan^3 x dx \Rightarrow \frac{\tan^4 x}{4} - \frac{\tan^2 x}{2} + \ln \sec x + c$$

59. (1)

$$-1 \leq [x] \leq 1$$

$$-1 \leq x < 2$$

$$-1 \leq \cos^{-1}[x] \leq 1$$

$$\cos 1 \leq x < 2$$

$$\therefore [x] = 1$$

Domain [1, 2)

60. (3)

On solving we get

$$B = 12$$