

SOLUTIONS

PROGRESS TEST-5

RBS-1801 & 1802

JEE MAIN PATTERN

Test Date: 15-10-2017



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PHYSICS

1. Potential at this point, $V = \frac{q}{4\pi\epsilon_0 r} = rE = 2E$

Work done = $qV = 4E$ joules.

\therefore (B)

2. (A)

3. As $W = F ds \cos \theta = qE ds \cos \theta$

$$4 = 0.2E \times 2 \cos 60^\circ, E = 20 \text{ N/C.}$$

\therefore (D)

4. $E = \left| \frac{dV}{dx} \right| = (10x + 10) \Big|_{x=1} = 20 \text{ V/m}$

\therefore (A)

5. $\frac{K(4q)}{r_1^2} = \frac{K(q)}{r_2^2}$

$$\Rightarrow \frac{r_1}{r_2} = 2 \text{ and } r_1 + r_2 = 30$$

Hence, $r_1 = 20 \text{ cm}$

\therefore (B)

6. $U_i = \frac{(q)(-2q) + (q)(-2q) + (-2q)(-2q)}{4\pi\epsilon_0 a} = 0$

$$U_f = \frac{(q)(-2q) + (q)(-2q) + (-2q)(-2q)}{4\pi\epsilon_0 (2a)} = 0$$

$$W_{\text{ext}} = \Delta U = 0$$

\therefore (D)

7. $\vec{E} = - \left[\frac{\partial V}{\partial x} \hat{i} + \frac{\partial V}{\partial y} \hat{j} \right] = K(y\hat{i} + x\hat{j}) \quad \therefore$

$$E = \sqrt{E_x^2 + E_y^2} = \sqrt{(Ky)^2 + (Kx)^2} = Kr$$

i.e., $E \propto r$

\therefore (B)

8. For coherent source $I_{max.} = 4I$

\therefore for incoherent source $I = I_1 + I_2 = 2I$

\therefore Ratio = 2

\therefore (B)

9. $\omega = \frac{\lambda D}{d}, \omega' = \frac{\lambda D/2}{2d} = \frac{\omega}{4}$

\therefore (C)

10. (D)

11. (C)

12. $n_1 \frac{D\lambda_1}{d} = n_2 \frac{D\lambda_2}{d} \Rightarrow n_1 \lambda_1 = n_2 \lambda_2 \Rightarrow n_2 = \frac{n_1 \lambda_1}{\lambda_2} \approx 84$

\therefore (D)

13. Velocity of image = $v_0 - 2v_m = 0$

$$2A\omega \cos \omega t = -2A\omega \cos \left(\omega t - \frac{\pi}{3} \right) \Rightarrow t = \frac{2\pi}{3\omega}$$

\therefore (D)

14. $I = 4I_0 \cos^2 \frac{\phi}{2} \Rightarrow 2I_0 = 4I_0 \cos^2 \frac{\phi}{2}$

$$\Rightarrow \cos \frac{\phi}{2} = \frac{1}{\sqrt{2}}$$

$$\Rightarrow \phi = 2 \times \frac{\pi}{4} = \frac{\pi}{2}$$

Path difference $\Delta x = \frac{\lambda}{2\pi} \times \phi = \frac{\lambda}{2\pi} \times \frac{\pi}{2} = \frac{\lambda}{4}$

$$\Rightarrow (\mu - 1)t = \frac{\lambda}{4} \text{ or } 0.5t = \frac{\lambda}{4} \Rightarrow t_{\min} = \frac{\lambda}{2}$$

\therefore (C)

15. For refraction at spherical surface $\frac{\mu}{v} - \frac{1}{\infty} = \frac{\mu - 1}{R} \Rightarrow v = \frac{\mu}{\mu - 1} R = 3R$

\therefore (B)

16. $\frac{d|\vec{v}|}{dt}$ is the tangential acceleration.

∴ (D)

17. Initial velocity of boy with respect to bus = 10 ms^{-1}

acceleration of boy with respect to bus = -1 ms^{-2}

$$s = ut + \frac{1}{2}at^2$$

$$48 = 10t - \frac{1}{2}t^2$$

$$t^2 - 20t + 96 = 0$$

$$t^2 - 12t - 8t + 96 = 0$$

$$(t - 8)(t - 12) = 0$$

$$t = 8\text{s and } 12\text{s}$$

∴ (A)

18. $t = \frac{w}{v \sin \theta} \Rightarrow 10 = \frac{25}{5 \sin \theta}$

$$\sin \theta = \frac{1}{2} \Rightarrow \theta = 30^\circ$$

$$\therefore \alpha = 180^\circ - \theta = 150^\circ$$

∴ (A)

19. Horizontal component of velocity of A is $10 \cos 60^\circ$ or 5 m/s which is equal to the velocity of B in horizontal direction. They will collide at C if time of flight of both the particles are equal i.e.

$$t_A = t_B$$

$$\frac{2u \sin \theta}{g} = \sqrt{\frac{2h}{g}} \quad \left(h = \frac{1}{2}gt_B^2 \right)$$

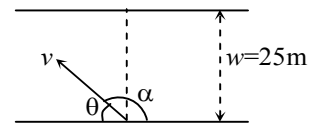
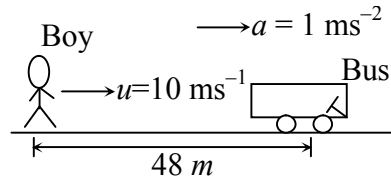
or $h = \frac{2u^2 \sin^2 \theta}{g}$

$$\frac{2(10)^2 \left(\frac{\sqrt{3}}{2} \right)^2}{10} = 15 \text{ m}$$

∴ (C)

20. $\vec{r} = 4 \sin 2\pi t \hat{i} + 4 \cos 2\pi t \hat{j}$

$$x = 4 \sin 2\pi t$$



$$y = 4 \cos 2\pi t$$

$$x^2 + y^2 = 16 \sin^2 2\pi t + 16 \cos^2 2\pi t$$

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

$$\therefore \quad \text{(C)}$$

$$21. \quad \frac{v_T + v_B}{2} = \frac{3}{0.5} = 6 \text{ or } v_T + v_B = 12 \text{ ms}^{-1}$$

$$\therefore \quad \text{(A)}$$

$$22. \quad \text{(A)}$$

$$\vec{a} = 6\hat{i} - 8\hat{j}$$

$$\therefore \quad a_r = 8 \text{ and } a_t = 6$$

$$r\omega^2 = 8 \text{ and } r\alpha = 6$$

$$23. \quad \text{(B)}$$

$$24. \quad \text{(B)}$$

$$25. \quad \text{(C)}$$

$$26. \quad a = \frac{mg - \mu mg}{2m} = 0.4 \text{ g m/s}^2$$

$$\therefore \quad \text{(B)}$$

27. Reading reduces when the lift starts accelerating downwards and then original value is restored as lift moves with constant velocity.

Apparent weight = $m(g \pm a)$, where a is acceleration of lift.

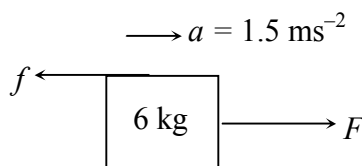
$$\therefore \quad \text{(C)}$$

$$28. \quad f = 0.4 \times 2 \times 10 = 8 \text{ N}$$

$$F - 8 = 6 \times 1.5$$

$$F = 17 \text{ N}$$

$$\therefore \quad \text{(A)}$$



$$29. \quad \text{Friction is static so } a = 0 \text{ m/s}^2, \quad f = T \cos 60 = 40 \cos 60 = 20 \text{ N}$$

$$\therefore \quad \text{(C)}$$

$$30. \quad T_1 = \frac{mg}{\cos \theta}, \quad T_2 = mg \cos \theta$$

$$\frac{T_1}{T_2} = \sec^2 \theta = 2$$

$$\therefore \quad \text{(B)}$$

CHEMISTRY

31. (A)

Output of CO₂ per hour = 44 g = 22.4 litre at S.T.P.Reduction of CO₂ per hour = 550 × 60 mL = 33 L

$$\text{Fraction of time the converter has to be operated} = \frac{\text{CO}_2 \text{ output rate}}{\text{CO}_2 \text{ reduction rate}} = \frac{22.4}{33} = 0.68$$

32. (A)

Gas with higher critical temperature and higher inversion temperature can be easily liquefied.

33. (B)

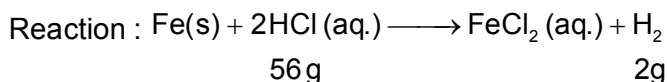
Volume of H₂ = Volume of Cylinder

$$= 0.025 \times 1 = 0.025 \text{ m}^3 = 25 \text{ L}$$

$$PV = \frac{W}{m} RT$$

$$1 \times 25 = \frac{W}{2} \times 0.082 \times 300$$

$$w_{\text{H}_2} = 2.032 \text{ g}$$



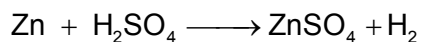
$$\text{Mass of Pure Iron} = \frac{56}{2} \times 2.032 = 56.896 \text{ g}$$

$$\% \text{ Purity} = \frac{\text{Mass of pure iron}}{\text{Mass of Impure iron}} \times 100$$

$$= \frac{56.896}{75} \times 100 = 75.86$$

34. (D)

$$\text{Mass of H}_2\text{SO}_4 = \frac{50 \times 1.3 \times 40}{100} = 26 \text{ g}$$



$$\text{Volume of H}_2 \text{ produced} = \frac{22.4}{98} \times 26 = 5.94 \text{ L}$$

35. (B)

36. (A)

Number of equivalents of KMnO_4 = Number of equivalents of FeSO_4 + Number of equivalents of FeC_2O_4

$$x \times 5 = 1 \times 1 + 1 \times 3 = 4$$

$$x = \frac{4}{5}$$

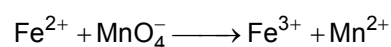
37. (A)

38. (C)

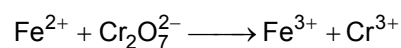
In N_2H_4 , O.S. of N is -2 . There is total loss of ten moles of e^- , each N atom is losing 5 mole e^- , therefore, the O.S. of nitrogen changes from -2 to $+3$.

The O.S. of nitrogen in compound Y is $+3$.

39. (D)



$$n_{\text{Fe}^{2+}} \times 1 = 1 \times 5$$



$$n_{\text{Fe}^{2+}} \times 1 = 1 \times 6$$

Since 5 : 6

40. (D)

$$T_C = \frac{8a}{27Rb} = 303 \quad P_C = \frac{a}{27b^2} = 73$$

$$\frac{T_C}{P_C} = \frac{8a}{27Rb} \cdot \frac{27b^2}{a} = \frac{303}{73} \Rightarrow \frac{8b}{R} = \frac{303}{73}$$

$$b = \frac{303}{73} \times \frac{0.0821}{8} = 0.0426$$

41. (A)

Phenol and Alcohol are functional group isomer of each other

42. (C)

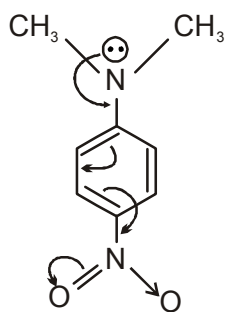
$$\text{B.L} \propto \frac{1}{\text{B.O}}$$

as delocalisation of >C=C< bond increases B.O decreases B.L, increases

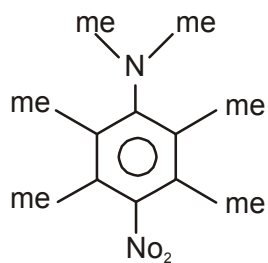
Delocalisation of >C=C< \propto α -hydrogen

43. (A)

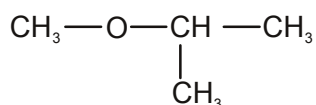
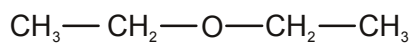
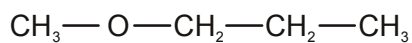
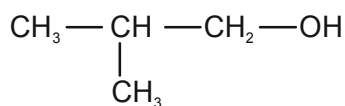
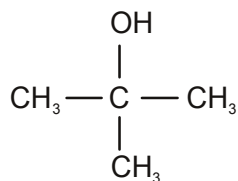
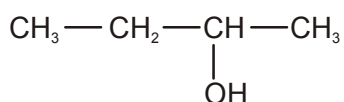
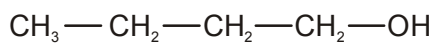
Resonance increases dipolemoment.



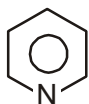
Resonance

due to SIR
no resonance

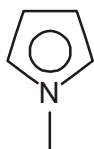
44. (C)



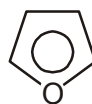
45. (C)



28 Kcal/mole

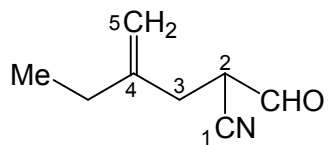


22 Kcal/mole



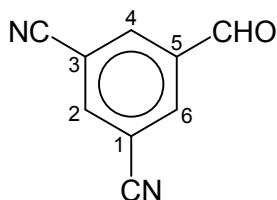
16 Kcal/mole

46. (D)



2-Formyl-4-ethyl pent-4-ene-1-nitrile

47. (B)



5-Formyl benzene-1,3-dicarbonitrile

48. (A)

Because both the oxygen make $p\pi - p\pi$ backbonding with carbon.

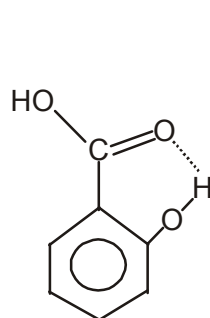
49. (C)

Acidic strength \propto Stability of conjugate base \propto Stability of A^\ominus

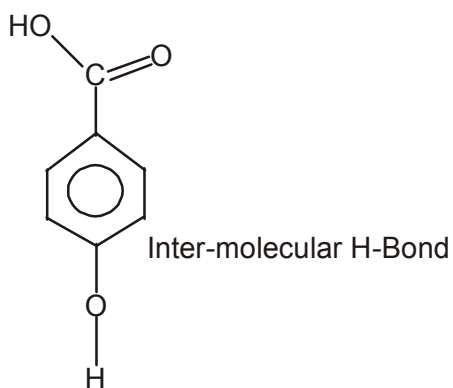
50. (C)

Rectangular shape so (a) and (b) are not equal.

51. (D)



Intramolecular H-Bond



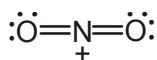
Inter-molecular H-Bond

Solubility = II > I

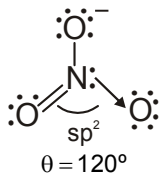
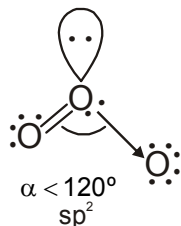
52. (C)

(i) & (ii) \Rightarrow Bond order increases.

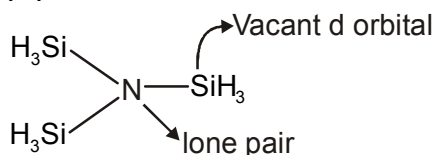
53. (C)



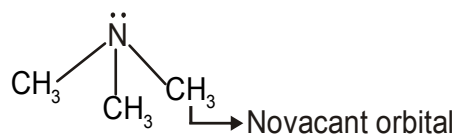
$$\theta = 180^\circ$$



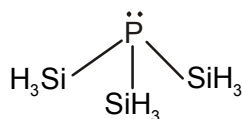
54. (B)



(due to Back Bonding)



(No back bonding)

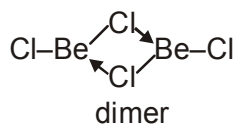


(No back bonding due to large size of atoms)

55. (D)

As electronegativity of halogen attached with sulphur increases, sulphur becomes more electron deficient and hence its tendency of get electrons from oxygen through $p\pi - d\pi$ bonding also increases i.e. extent of $p\pi - d\pi$ bonding increases and hence, bond order also increases.

56. (A)

Temperature $> 1200\text{K}$ 

57. (D)

Among B_2 , C_2 , N_2 σ^b orbitals filled before σ^b , indicating s-p intermixing.

58. (A)

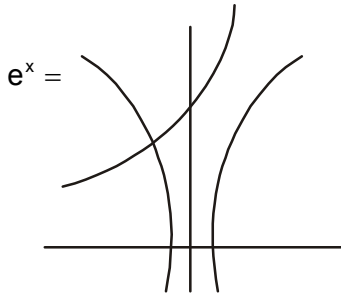


59. (D)

60. (B)

MATHEMATICS

61. (B)



62. (D)

$$f(x) = \frac{\pi}{2} + \cot^{-1}\{-x\}; f(x) \in \left(\frac{3\pi}{4}, \pi\right]$$

63. (A)

$$b^2 - 3b + 10 = 8 \quad b = 1, 2$$

64. (C)

$$\lim_{x \rightarrow 0} \frac{\cos^2 x - 1}{x^2(x+1)\cos x} = -1$$

65. (A)

$$\ln y = \lim_{x \rightarrow \frac{\pi}{2}} \frac{\ln \cos x}{\sec x} = 0$$

66. (C)

$$\lim_{x \rightarrow 0} \frac{a \sin bx}{x \cos x} = e^{ab}$$

67. (A)

$$-2 \sin y \frac{dy}{dx} = -\cos \operatorname{cosec} x \cot x; \frac{dy}{dx} = 1$$

$$2 \sin y \frac{dy^2}{dx^2} + 2 \cos y \left(\frac{dy}{dx}\right)^2 = -\cos \operatorname{cosec} x \cot x - \operatorname{cosec}^3 x$$

68. (B)

$$1 = \frac{dx}{dy} + e^x \cdot \frac{dx}{dy}$$

$$0 = \frac{d^2x}{dy^2} + e^x \cdot \frac{d^2x}{dy^2} + e^x \left(\frac{dx}{dy} \right)^2$$

69. (C)

$$g'(-4) = \frac{1}{(3x^2 + 8x + 6)_{\text{at } x=-2}} = \frac{1}{2}$$

70. (D)

Obvious

71. (D)

$$\lim_{h \rightarrow 0} \frac{\frac{2hf'(2+h^2)}{f(2+h^2)} + \frac{2hf'(2-h^2)}{f(2-h^2)}}{2h}$$

72. (C)

$$h'(x) = f'(2xg(x) + \cos \pi x - 3) \cdot (2g(x) + 2xg'(x) - \pi \sin \pi x)$$

73. (A)

$$x \in \mathbb{Q} \quad f(x) = x$$

$$x \notin \mathbb{Q} \quad f(1-x) = x$$

74. (A)

75. (C)

$$18y \frac{dy}{dx} = 3x^2; \quad \frac{dy}{dx} = \frac{x^2}{6y}$$

$$-\frac{6y}{x^2} = -1; \quad x^2 = 6y.$$

76. (B)

$$3x^2 + 12x + a = 0; \quad \text{is equivalent to } x^2 + 4x + 3 = 0 \quad a = 9$$

77. (B)

$$3x^2 + 2(a+2)x + 3a \geq 0 \quad \forall x \in \mathbb{R}$$

$$4(a+2)^2 - 4 \times 9a \leq 0; \quad a^2 + 4a + 4 - 9a \leq 0$$

$$a^2 - 5a + 4 \leq 0 \quad (a-1)(a-4) \leq 0$$

78. (C)

$$\frac{dy}{dx} = -\sin x$$

$$y - \cos x = (-\sin x)(x - x)$$

$$\cos x = \sin x \times x; \quad y = x \sin x$$

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

79. (C)

80. (C)

81. (B)

82. (D)

83. (C)

84. (B)

85. (C)

86. (A)

$$x^2 + y^2 = 16 + b^2 = (10/2)^2$$

87. (D)

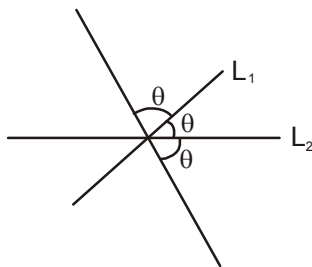
$$T = S$$

$$p = q = 0$$

88. (C)

89. (A)

$$\theta = 60^\circ$$



90. (D)

$$\text{Clearly ; } a = \frac{|12-8|}{\sqrt{1+1}} = \frac{4}{\sqrt{2}}$$

$$\therefore \text{ Length of latus rectum} = 4a = 4 \times \frac{4}{\sqrt{2}} = 8\sqrt{2}$$