SOLUTIONS

PROGRESS TEST-5

RB-1801-1805

RBK-1801-1803

JEE MAIN PATTERN

Test Date: 15-10-2017

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PHYSICS

1. Potential at this point, $V = \dfrac{q}{4\pi\varepsilon_0 r} = rE = 2E$

Work done = $qV = 4E$ joules.

$\therefore$ **(B)**

2. **(A)**

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

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

$\therefore$ **(D)**

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

$\therefore$ **(A)**

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

$\Rightarrow \quad \dfrac{r_1}{r_2} = 2$ and $r_1 + r_2 = 30$

Hence, r_1 = 20 cm

$\therefore$ **(B)**

6. $U_i = \dfrac{(q)(-2q) + (q)(-2q) + (-2q)(-2q)}{4\pi\varepsilon_0 a}$ = 0

$U_f = \dfrac{(q)(-2q) + (q)(-2q) + (-2q)(-2q)}{4\pi\varepsilon_0 (2a)} = 0$

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

$\therefore$ **(D)**

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

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

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

$\therefore$ **(D)**

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

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

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

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

$\Rightarrow \quad (\mu - 1)t = \frac{\lambda}{4}$ 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.

$\therefore$ **(D)**

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

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

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

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

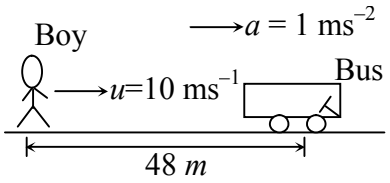
$$t^2 - 20t + 96 = 0\ s$$

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

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

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

$\therefore$ **(A)**

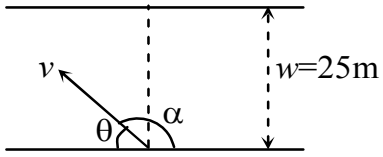


18. $t = \frac{w}{v\sin\theta} \Rightarrow 10 = \frac{25}{5\sin\theta}$

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

$\therefore \alpha$ = 180° – θ = 150°

$\therefore$ **(A)**



19. Horizontal component of velocity of *A* is 10 cos 60° 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 $h = \frac{2u^2\sin^2\theta}{g}$

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

$\therefore$ **(C)**

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

$x = 4\sin 2\pi t$

$y = 4\cos 2\pi t$

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

$x^2 + y^2 = 16$

$\therefore$ **(C)**

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

$\therefore$ **(A)**

22. **(A)**

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

$\therefore$ $a_r = 8$ and $a_t = 6$

$r\omega^2 = 8$ and $r\alpha = 6$

23. **(B)**

24. **(B)**

25. **(C)**

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

$\therefore$ **(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.

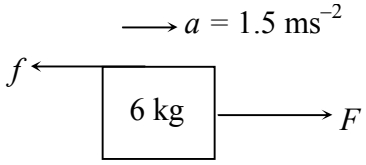
$\therefore$ **(C)**

28. $f = 0.4 \times 2 \times 10 = 8$N

$F - 8 = 6 \times 1.5$

$F = 17$N

$\therefore$ **(A)**



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

$\therefore$ **(C)**

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

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

$\therefore$ **(B)**

CHEMISTRY

31. (A)

Output of CO_2 per hour = 44 g = 22.4 litre at S.T.P.

Reduction of CO_2 per hour = 550 × 60 mL = 33 L

Fraction of time the converter has to be operated = $\frac{CO_2 \text{ output rate}}{CO_2 \text{ reduction rate}} = \frac{22.4}{33} = 0.68$

32. (A)

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

33. (B)

Volume of H_2 = Volume of Cylinder

$= 0.025 \times 1 = 0.025\ m^3 = 25\ L$

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

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

$w_{H_2} = 2.032\ g$

Reaction : $Fe(s) + 2HCl(aq.) \longrightarrow FeCl_2(aq.) + H_2$

$56\ g \qquad\qquad 2g$

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

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

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

34. (D)

Mass of $H_2SO_4 = \frac{50 \times 1.3 \times 40}{100} = 26\ g$

Reaction : $Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$

$1\ mol \quad 1\ mol \qquad\qquad 22.4\ L$ at STP

$98\ g$

Volume of H_2 produced = $\frac{22.4}{98} \times 26 = 5.94\ L$

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. (C)

$$\Delta H = \Delta U + P_2 V_2 - P_1 V_1$$

$$= 30 + 4 \times 5 - 2 \times 3$$

= 44 L atm

38. (C)

q = – W = Net area bounded by the circle

39. (C)

Work done = Area bounded by the circle

$$= \pi \frac{(P_2 - P_1)}{2} \frac{(V_2 - V_1)}{2} = \frac{\pi}{4} (P_2 - P_1)(V_2 - V_1)$$

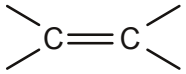
40. (A)

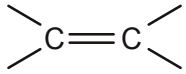
41. (A)

Phenol and Alcohol are functional group isomer of each other

42. (C)

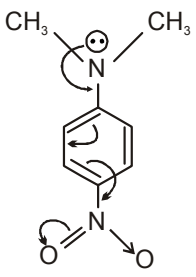
$$B.L \alpha \frac{1}{B.O}$$

as delocalisation of  bond increases B.O decreases B.L, increases

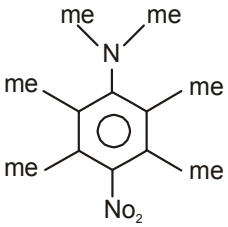
Delocalisation of  $\propto$ α -hydrogen

43. (A)

Resonance increases dipolemoment.

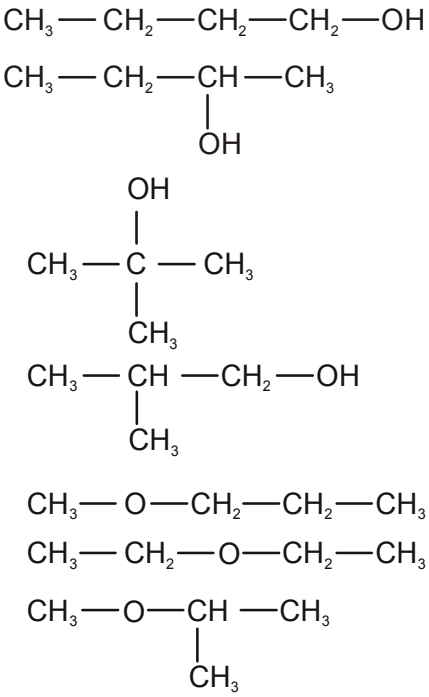


Resonance

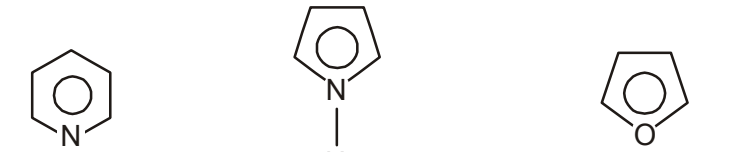


due to SIR
no resonance

44. (C)

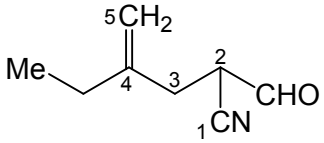


45. (C)



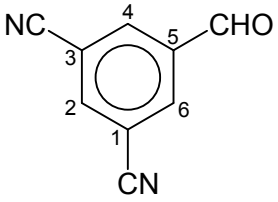
28 Kcal/mole 22 Kcal/mole 16 Kcal/mole

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)

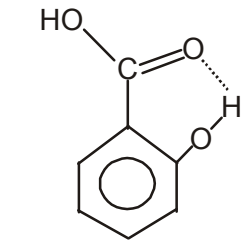
Acidic strength $\propto$ Stability of conjugate base

$\propto$ Stability of A^{Θ}

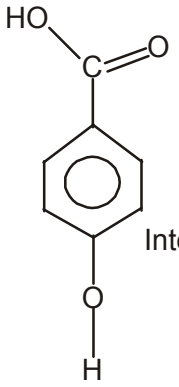
50. (C)

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

51. (D)



Intramolecular H-Bond



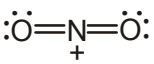
Inter-molecular H-Bond

Solubility = II > I

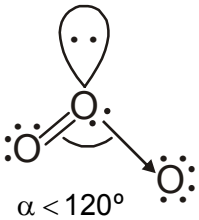
52. (C)

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

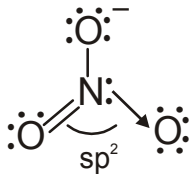
53. (C)



$\theta = 180^{\circ}$

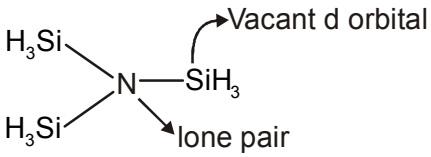


$\alpha < 120^{\circ}$
sp^2

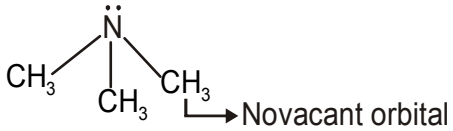


sp^2
$\theta = 120^{\circ}$

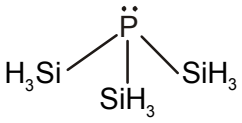
54. (B)



(due to Back Bonding)



(No back bonding)



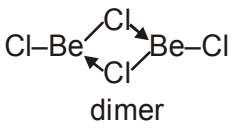
(No back bonding due to large size of atoms)

55. (D)

As electronegativity of halogen attached with sulphur increases, suphur 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 > 1200K



dimer

57. (D)

Among B_2, C_2, N_2 $^{b}_{\pi}$ orbitals filled before $^{b}_{\sigma}$, indicating s–p intermixing.

58. (A)

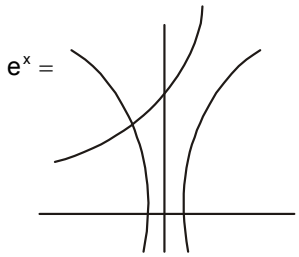
$IF \rightarrow IF_5 + I_2$

59. (D)

60. (B)

MATHEMATICS

61. (B)



62. (D)

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

63. (A)

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

64. (C)

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

65. (A)

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

66. (C)

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

67. (A)

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

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

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)

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

72. (C)

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

73. (A)

$x \in Q \quad f(x) = x$

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

74. (A)

75. (C)

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

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

76. (B)

$3x^2 + 12x + a = 0;$ is equivalent to x2 + 4x + 3 = 0 a = 9

77. (B)

$3x^2 + 2(a+2)x + 3a \geq 0 \; \forall \; x \in R$

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

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

78. (C)

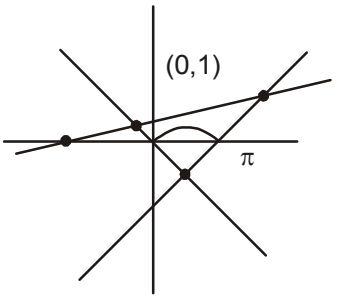
$$\frac{dy}{dx} = -\sin x$$

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

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

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

79. (C)



80. (C)

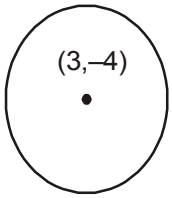
$$\frac{-2h}{b} = 4 \cdot \frac{a}{b};\quad h = -2a$$

$$(-c) = -2 \times 1$$

81. (B)

$$6(1) + 14(-4) + \ell + m = 0$$

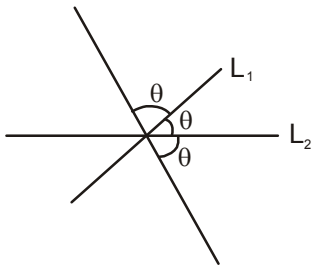
82. (D)



$$\frac{42}{5} - 5 = \frac{7}{5}$$

83. (A)

$\theta = 60°$



84. (D)

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

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

85. (C)

$K^2 + 2K + 5 < K + 11$

$K^2 + K - 6 < 0$

86. (A)

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

87. (D)

T = S,

p = q = 0

88. (C)

$t t_1^3 = -1$

89. (A)

$P\left(h, \frac{\sqrt{3}}{2}\sqrt{h^2-4}\right)$; $P'\left(h, -\frac{\sqrt{3}}{2}\sqrt{h^2-4}\right)$

$PQ\,PQ' = 3$

90. (B)

Normal at $(2\sec\theta, \tan\theta)$

$2x\cos\theta + y\cot\theta = 5$

$\sin\theta = \frac{1}{2}$