

SOLUTIONS

PROGRESS TEST-1

RB-1815 & RBS-1804

JEE MAIN PATTERN

Test Date: 16-09-2017

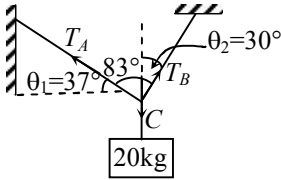


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PHYSICS

1. (A)

$$T_A \cos \theta_1 = T_B \sin \theta_2$$



$$T_A \cos 37^\circ = T_B \sin 30^\circ$$

$$T_A \times \frac{4}{5} = T_B \times \frac{1}{2}; \quad \frac{T_A}{T_B} = \frac{5}{8}$$

2. (C)

$$T \sin \theta = R$$

$$T \cos \theta = W$$

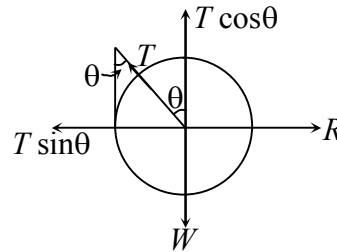
Solving

$$T^2 = R^2 + W^2$$

$$R = W \tan \theta$$

Vectorially

$$\vec{R} + \vec{T} + \vec{W} = \vec{0}$$



3. (D)

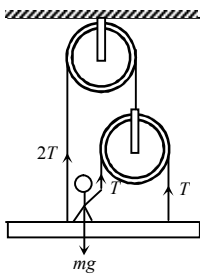
Here $T_1 \cos (90 - \theta) + T_2 \cos \theta = 100$ and $T_1 \cos \theta = T_2 \cos (90 - \theta)$. Solving, $T_1 = 80$ N.

4. (A)

$$N_A = N_B$$

5. (A)

$$4T = mg$$

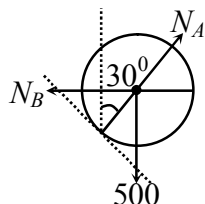


$$\therefore T = \frac{60 \times 10}{4} = 150 \text{ N}$$

6. (C)

$$N_A \cos 30^\circ = 500$$

$$N_A \sin 30^\circ = N_B$$



$$\sqrt{3} = \frac{500}{N_B}$$

$$N_B = \frac{500}{\sqrt{3}} \text{ N}$$

7. (D)

Let F be the force exerted by clamp on pulley

For equilibrium of block $T = Mg$

Hence

$$F = \sqrt{g^2(M+m)^2 + M^2g^2} = g\sqrt{(M+m)^2 + M^2}$$

8. (B)

9. (D)

10. (A)

11. (D)

12. (B)

13. (A)

14. (A)

15. Applying Snell's law between the points O and P , we have

$$2 \times \sin 60^\circ = (\sin 90^\circ) \times \frac{2}{(1+H^2)}, 2 \times \frac{\sqrt{3}}{2} = 1 \times \frac{2}{(1+H^2)}$$

$$(1+H^2) = \frac{2}{\sqrt{3}}, \quad H = \sqrt{\left(\frac{2}{\sqrt{3}} - 1\right)}$$

(A)

16. If angle made by the incident ray with the normal (i.e. y axis) is θ . Then

$$\tan \theta = \frac{1}{2} \Rightarrow \sin \theta = \frac{1}{\sqrt{5}}$$

If the refracted ray makes angle θ' with y-axis then from Snell's Law

$$2 \times \frac{1}{\sqrt{5}} = \frac{\sqrt{5}}{2} \times \sin \theta' \Rightarrow \sin \theta' = \frac{4}{5}$$

The unit vector along with the refracted ray moves is given by

$$-1 \times \sin \theta' \hat{i} - 1 \times \cos \theta' \hat{j} = -\frac{4}{5} \hat{i} - \frac{3}{5} \hat{j}$$

\therefore (B)

17. $\mu = \frac{\text{Real depth}}{\text{Apparent depth}} = \frac{120}{120 - 40} = 1.5$

\therefore (A)

18. $\vec{v}_{om} = (3i + 4k)$

$$\vec{v}_{lm} = (-3i + 4k)$$

$$\Rightarrow v_{lo} = \vec{v}_{lm} - \vec{v}_{om} = -6i$$

\Rightarrow negative x-axis

\therefore (A)

19. x is distance of object from surface.

$$\text{Apparent depth of object from surface} = \frac{x}{\mu}$$

$$\text{Apparent depth of image from surface} = \frac{x + 2h}{\mu}$$

$$\text{Distance between the apparent depths of object and image} = \frac{2h}{\mu}$$

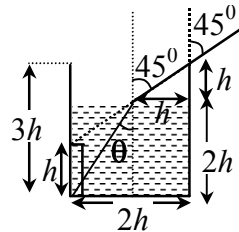
\therefore (B)

20. $\mu \sin \theta = \sin 45^\circ$

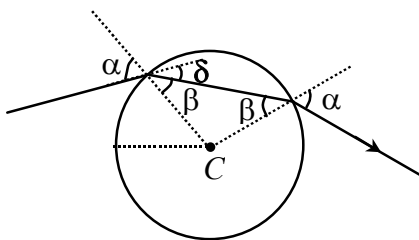
$$\frac{\mu h}{h\sqrt{5}} = \frac{1}{\sqrt{2}}$$

$$\mu = \sqrt{\frac{5}{2}}$$

\therefore (B)



21. Total angle of deviation = $2(\alpha - \beta)$



\therefore (B)

22. At maximum depth the ray graze the surface (i.e. the angle made by the ray with normal will become 90°)

$$\text{Applying Snell's law } 1 \times \sin 45^\circ = \left(\sqrt{2} - \frac{1}{\sqrt{2}} x \right) \sin 90^\circ$$

$$\Rightarrow \sqrt{2} - \frac{1}{\sqrt{2}} x = \frac{1}{\sqrt{2}} \text{ or } x = 1 \text{ m}$$

\therefore (D)

23. $u = -20 \text{ cm}$, $f = +10 \text{ cm}$ also $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$$\Rightarrow \frac{1}{+10} = \frac{1}{v} + \frac{1}{(-20)}$$

$$\Rightarrow v = \frac{20}{3} \text{ cm; virtual image.}$$

\therefore (C)

24. $\frac{\mu_2}{\mu_1} = \frac{v_1}{v_2} = \frac{1}{2} \Rightarrow \frac{\mu_1}{\mu_2} = 2 (\mu_1 > \mu_2)$

For total internal reflection

$${}_2\mu_1 = \frac{1}{\sin C} = 2 \Rightarrow C = 30^\circ$$

\therefore (A)

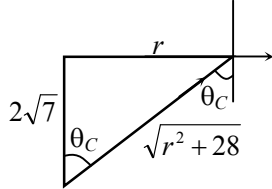
25. Erect and enlarged image can be produced by concave mirror

$$\frac{I}{O} = \frac{f}{f-u} \Rightarrow \frac{+3}{+1} = \frac{f}{f-(-4)}$$

$\Rightarrow f = -6 \text{ cm} \quad \Rightarrow R = 12 \text{ cm}$

\therefore (B)

26. $\sin \theta_c = \frac{1}{\mu} = \frac{r}{\sqrt{r^2 + 28}}$



$\mu = \frac{4}{3} \Rightarrow r = 6 \text{ m}$

\therefore (B)

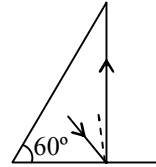
27. (A)

Occurs two time So

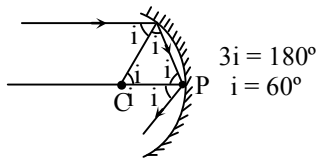
$\delta_1 = 180 - 2 \times 15 = 150^\circ$ (Anticlockwise)

$\delta_2 = 180 - 2 \times 55 = 70^\circ$ (clockwise)

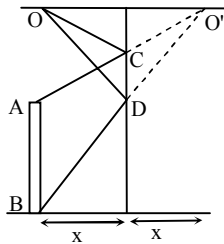
$\delta_{ml} = 150 - 70 = 80^\circ$ (Anticlockwise)



28. (C)



29. (A)



Clearly $CD = \frac{AB}{2}$

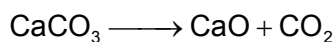
30. (B) Time difference

$\Delta t = t_1 - t_2 = \frac{h}{v_{\text{glass}}} - \frac{h}{v_{\text{water}}}$

$= \frac{h}{c/\mu_{\text{glass}}} - \frac{h}{c/\mu_{\text{water}}} = \frac{h}{c} \left(\frac{3}{2} - \frac{4}{3} \right) = \frac{h}{6c}$

CHEMISTRY

31. (D)



$$200 \times \frac{95}{100} \text{ kg pure CaCO}_3$$

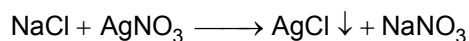
190 kg pure CaCO₃

$$\text{no. of mole of CaO} = \frac{190 \times 100}{100} \times 56$$

$$\text{Mass of CaO} = 1900 \times 56 = 106.4 \text{ kg.}$$

32. (A)

The reaction that takes place is



∴ 143.5 g of AgCl is produced from 58.5 g NaCl

∴ 14g of AgCl will produce from

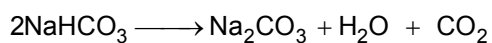
$$\frac{58.5 \times 14}{143.5} = 5.70 \text{ g}$$

This is the amount of NaCl in common salt;

$$\% \text{ purity} = \frac{5.70}{6} \times 100 = 95\%$$

33. (C)

Let x gm of NaHCO₃ in mixture



$$\left(\frac{x}{84}\right) \text{ mole} \qquad \qquad \qquad \left(\frac{x}{84 \times 2}\right) \text{ mole}$$

$$\frac{x}{84 \times 2} \times 22400 = 560$$

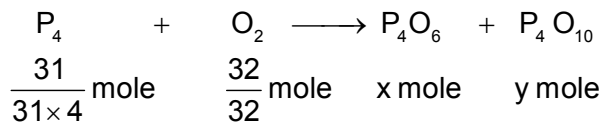
$$x = \frac{84 \times 2}{40} = 4.2 \text{ gm}$$

$$\% \text{ NaHCO}_3 = \frac{4.2}{5} \times 100 = 84\%$$

34. (A)

$$\frac{n(\text{O}_2)}{3} = \frac{n(\text{Fe}_2\text{O}_3)}{2} \Rightarrow \frac{n(\text{O}_2)}{3} = \frac{5}{2} \Rightarrow n(\text{O}_2) = 7.5 \text{ mole}$$

35. (B)



POAC for 'p'

$$4 \times \frac{1}{4} = 4x + 4y$$

$$0.25 = x + y \quad \dots\dots\dots(i)$$

POAC for 'O'

$$2 \times 1 = 6x + 10y$$

$$1 = 3x + 5y \quad \dots\dots\dots(ii)$$

For equation (i) and (ii)

$$3x + 3y = 0.75$$

$$3x + 5y = 1$$

$$\hline -2y = -0.25$$

$$y = \frac{0.25}{2} \text{ mole}$$

$$x = \frac{0.25}{2} \text{ mole}$$

Mass of P_4O_6

$$= \frac{0.25}{2} \times 220 = 27.5 \text{ gm}$$

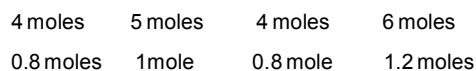
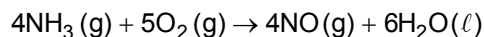
Mass of P_4O_{10}

$$= \frac{0.25}{2} \times 284$$

$$= 35.5 \text{ gm}$$

36. (C)

According to stoichiometry they should react as follows

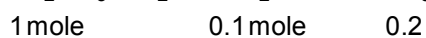
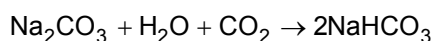


Thus for 1 mole O_2 only 0.8 mole of NH_3 is consumed.

So O_2 is consumed completely.

37. (B)

10g i.e., 0.1 mole CaCO_3 is decomposed to 0.1 mole CO_2 and 0.1 mole CaO .



Because here limiting reagent is CO_2 . NaHCO_3 is twice the number of moles of CO_2 .

38. (B)

Mass of nitrogen = $162 \times 0.1728 = 27.99$

No. of nitrogen atoms per molecule = $\frac{28}{14} = 2$

39. (A)

44.1 g of anhydrous Na_2SO_4 are associated with $\text{H}_2\text{O} = 55.9$ g

Molar mass of anhydrous Na_2SO_4

$$= 2 \times 23 + 32 + 4 \times 16 = 142 \text{ g}$$

So, 142 g of anhydrous Na_2SO_4 will be associated with H_2O

$$= \frac{55.9}{44.1} \times 142 \text{ g} = 180 \text{ g}$$

$$= 10 \text{ moles of } \text{H}_2\text{O}$$

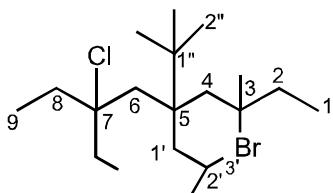
40. (C)

$$\% \text{ M} = \frac{2x}{2x+48} \times 100$$

$$\frac{53}{100} = \frac{2x}{2x+48}$$

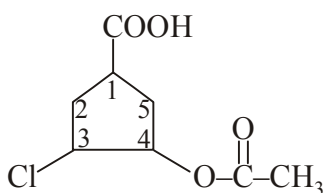
$$\therefore x = 27$$

41. (B)

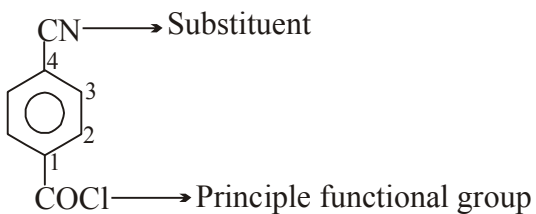


3-Bromo-7-chloro-5-(1,1-dimethylethyl)-7-ethyl-3-methyl-5-(2-methylpropyl)nonane).

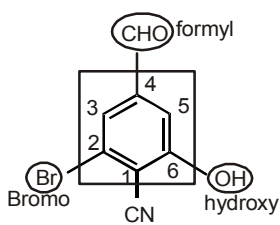
42. (C)



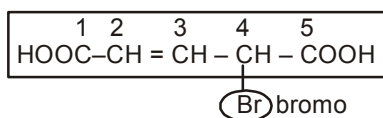
43. (B)



44. (B)

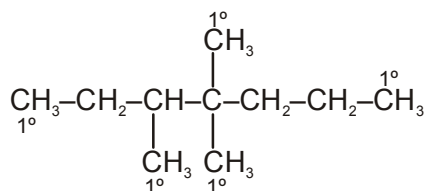


45. (D)

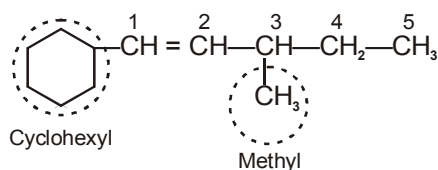


46. (D)

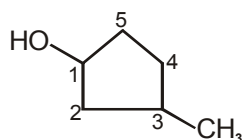
47. (C)



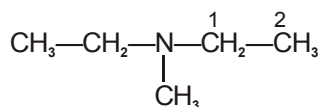
48. (A)



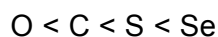
49. (A)



50. (C)



51. (B)



52. (C)

Sudden jump between 1st, 2nd ionization energy.

53. (C)

O⁻ ion will resist the addition of another electron due to inter-electronic repulsion.

54. (D)

A Gives aqueous solution [PH < 7]

B Reacts with strong acid and alkali respectively.

C Gives an aqueous solution which is strongly alkaline

A - Acidic – P(OH)₃ or H₃PO₄B - Amphoteric – Al(OH)₃, H₃AlO₃

C - Basic – NaOH

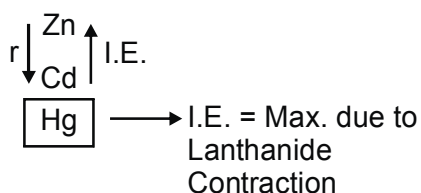
x = Phosphorous – Non metal

y = Aluminium - Metal

c = Sodium - Metal

55. (C)

56. (D)



$$\text{I.E.} = \text{Hg} > \text{Zn} > \text{Cd}$$

57. (D)

Ge

 $\left. \begin{array}{l} \text{Sn} \\ \text{Pb} \end{array} \right\}$ (Exception) Lanthanide Contraction

$$\text{I.E.}_1 = \text{Ge} > \text{Pb} > \text{Sn}$$

58. (D)

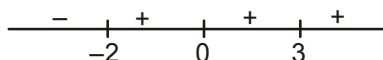
59. (A)

60. (B)

MATHEMATICS

61. (D)

62. (C)



63. (A)

$$3x - 1 = 2x; \quad x \geq \frac{1}{3}$$

$$1 - 3x = 2x; \quad x < \frac{1}{3}$$

64. (C)

$$2^{2 \log_2(2x)} = 36; 4x^2 = 36; x = \pm 3$$

65. (A)

$$\sin \theta = \operatorname{cosec} \theta = 1.$$

66. (A)

$$\left(a \cdot \frac{1 - \tan^2 \theta}{1 + \tan^2 \theta} + b \cdot \frac{2 \tan \theta}{1 + \tan^2 \theta} \right) = a$$

67. (D)

68. (B)

$$x^2 - 5x + 7 < 1 \quad ; \quad x^2 - 5x + 6 < 0 \quad (x-2)(x-3) < 0$$

69. (B)

$$(a+b)^2 = 9ab \quad ; \quad \left(\frac{a+b}{3}\right)^2 = ab.$$

Taking logarithm both side.

70. (D)

$$|\sqrt{x-1}-2| + |\sqrt{x-1}-3| = 1$$

$$t = \sqrt{x-1}; \quad |3-t| + |t-2| = 1$$

$$2 \leq t \leq 3 \quad 4 \leq x-1 \leq 9$$

$$x \in [5, 10]$$

71. (D)

$$\sin x \cos x = \frac{1}{10}; \quad \log_{10}(1+2\sin x \cos x) = \log_{10} \frac{n}{10}$$

$$1+2 \times \frac{1}{10} = \frac{n}{10}; \quad 1+\frac{1}{5} = \frac{n}{10}$$

$$n = 12$$

72. (D)

$$\text{We have, } \tan \theta = \frac{1}{2}$$

$$\therefore \tan 2\theta = \frac{2 \tan \theta}{1 - \tan^2 \theta} = \frac{4}{3}$$

$$\text{Now, } \tan(2\theta + \phi) = \frac{\tan 2\theta + \tan \phi}{1 - \tan 2\theta \tan \phi} = \frac{\frac{4}{3} + \frac{1}{3}}{1 - \frac{4}{3} \times \frac{1}{3}} = 3$$

73. (D)

We have, $\tan A - \tan B = x$

$$\Rightarrow \frac{1}{\cot A} - \frac{1}{\cot B} = x$$

$$\Rightarrow \frac{\cot B - \cot A}{\cot A \cot B} = x$$

$$\Rightarrow \cot A \cot B = \frac{y}{x}$$

$$\text{Now, } \cot(A-B) = \frac{\cot A \cdot \cot B + 1}{\cot B - \cot A}$$

$$= \frac{\frac{y}{x} + 1}{\frac{y}{x}} = \frac{x+y}{xy} = \frac{1}{x} + \frac{1}{y}$$

74. (D)

$$e^{\sin x} = t; \quad t^2 - 4t - 1 = 0$$

75. (B)

$$\sin x + \cos x = \sqrt{2}$$

76. (A)

$$\frac{\tan(\theta + 15)}{\tan(\theta - 15)} = \frac{3}{1}$$

Componendo and dividendo $\sin 2\theta = 1$

$$\theta = n\pi + \frac{\pi}{4}$$

77. (D)

$$(a_1 + \frac{a_3}{2}) + (a_2 - \frac{a_3}{2}) \cos 2x = 0$$

78. (A)

$$-3 + 3 - 1 + 1 = 0$$

79. (C)

$$\sin x \geq 0 \text{ and } \cos x \geq 0 \quad x \in \left[0, \frac{\pi}{2}\right].$$

$$f(x) = \left| 4 \frac{\cos x - \sin x}{\cos x + \sin x} \right| = \left| 4 \tan \left(\frac{\pi}{4} - x \right) \right| \in [0, 4]$$

80. (D)

$$\frac{2 \sin 2\theta}{\cos 2\theta - \cos 4\theta} = \frac{\sin \{(2n+1)\theta - (2n-1)\theta\}}{\sin(2n+1)\theta \sin(2n-1)\theta}$$

$$= \cot(2n-1)\theta - \cot(2n+1)\theta$$

$$f_n(\theta) = \cot \theta - \cot(2n+1)\theta$$

$$f_5\left(\frac{\pi}{8}\right) = \cot \frac{\pi}{8} - \tan \frac{\pi}{8} = 2$$

81. (B)

82. (B)

83. (B)

$$R_1 = \{(1,1), (2,2), (3,3), (1,2), (2,1)\}$$

$$R_2 = \text{Universal Relation}$$

84. (A)

$$\cos(\ln x + \ln y) + \cos(\ln x - \ln y) - 2 \cos(\ln x) \cos(\ln y) = \text{zero}$$

85. (C)

$$a = \frac{\log_5(175)}{\log_5(245)} = \frac{2 + \log_5 7}{1 + 2\log_5 7}; \log_5 7 = \frac{a-2}{1-2a}$$

$$b = \frac{3 + \log_5 7}{1 + 3\log_5 7}; \log_5 7 = \frac{b-3}{1-3b}$$

86. (D)

$$\sqrt{2x}(\ln 2x) = 2x \ln \sqrt{2x}$$

$$x = 0, \frac{1}{2}, 2 \text{ but } x = 0 \text{ not satisfy}$$

87. (A)

$$\text{RHS} = +\text{Ve}, \text{LHS} = +\text{ve};$$

$$f(x) \geq 0 \quad x^2 \geq 4$$

88. (B)

$$x = \pm 1; x = 1, 2$$

89. (D)

$$\text{LHS} \geq |x - 1 + y - x + 2010 - y| \geq 2009$$

90. (C)

$$\sin 2 = \sin(\pi - 2)$$

$$\sin 3 = \sin(\pi - 3)$$

$$\sin 2 > \sin 1 > \sin 3.$$

