

SOLUTIONS

PROGRESS TEST-3

GZ-1911-1913 & GZK-1904

JEE MAIN PATTERN

Test Date: 22-07-2017



Corporate Office: Paruslok, Boring Road Crossing, Patna-01
Kankarbagh Office: A-10, 1st Floor, Patrakar Nagar, Patna-20
Bazar Samiti Office : Rainbow Tower, Sai Complex, Rampur Rd.,
Bazar Samiti Patna-06
Call : 9569668800 | 7544015993/4/6/7

PHYSICS

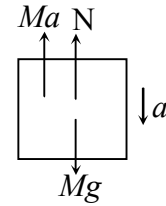
1. (C)

F.B.D. of block is as shown

$$Mg = N + Ma$$

$$Mg = \frac{Mg}{4} + Ma$$

$$a = \frac{3g}{4}$$



2. (D)

$$v = \ln x, a = v \frac{dv}{dx} = \ln x \times \frac{1}{x}$$

$$\text{If } a = 0 \quad \Rightarrow \quad \ln x = 0$$

$$\text{or } x = 1 \text{ m}$$

3. (A)

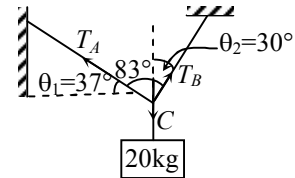
$$mg - \eta mg = ma, \quad a = g(1 - \eta)$$

4. (A)

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

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

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



5. (C)

$$T \sin \theta = R$$

$$T \cos \theta = W$$

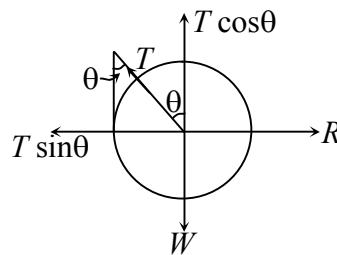
Solving

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

$$R = W \tan \theta$$

Vectorially

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

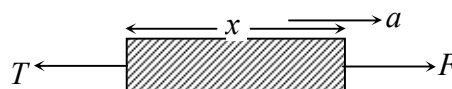


6. (C)

$$\text{Acceleration } a = \frac{F}{M}$$

Drawing F.B.D.

$$F - T = \frac{M}{L}(x)a \Rightarrow T = F\left(1 - \frac{x}{L}\right)$$



7. (A)

8. (C)

$$\text{From constraint relation } v_B = \frac{v}{3}$$

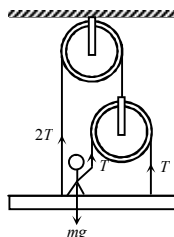
9. (A)

$$N_A = N_B$$

10. (A)

$$4T = mg$$

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



11. (D)

$$(\vec{A} + \vec{B}) \cdot \vec{A} = 0$$

$$A^2 + AB \cos \theta = 0$$

$$A^2 = -AB \cos \theta$$

$$\theta = \cos^{-1}\left(-\frac{A}{B}\right)$$

12. (D)

13. (A)

Let the components of \vec{A} makes angles α, β and γ with x, y and z axis respectively then $\alpha = \beta = \gamma$

$$\cos^2 \alpha + \cos^2 \beta + \cos^2 \gamma = 1$$

$$\Rightarrow 3 \cos^2 \alpha = 1 \Rightarrow \cos \alpha = \frac{1}{\sqrt{3}}$$

$$\therefore A_x = A_y = A_z = A \cos \alpha = \frac{A}{\sqrt{3}}$$

14. (B)

$$\vec{A} = \hat{i} + \hat{j}$$

$$\cos \alpha = \frac{A_x}{|A|} = \frac{1}{\sqrt{2}} = \cos 45^\circ \therefore \alpha = 45^\circ$$

15. (B)

Magnitude of unit vector = 1

$$\Rightarrow \sqrt{(0.5)^2 + (0.8)^2 + c^2} = 1$$

By solving we get $c = \sqrt{0.11}$

16. (B)

Let \hat{n}_1 and \hat{n}_2 are the two unit vectors, then the sum is

$$\begin{aligned} \vec{n}_s &= \hat{n}_1 + \hat{n}_2 \text{ or } n_s^2 = n_1^2 + n_2^2 + 2n_1n_2 \cos \theta \\ &= 1 + 1 + 2 \cos \theta \end{aligned}$$

Since it is given that n_s is also a unit vector, therefore

$$1 = 1 + 1 + 2 \cos \theta \Rightarrow \cos \theta = -\frac{1}{2} \therefore \theta = 120^\circ$$

Now the difference vector is $\hat{n}_d = \hat{n}_1 - \hat{n}_2$ or $n_d^2 = n_1^2 + n_2^2 - 2n_1n_2 \cos \theta = 1 + 1 - 2 \cos(120^\circ)$

$$\therefore n_d^2 = 2 - 2(-1/2) = 2 + 1 = 3 \Rightarrow n_d = \sqrt{3}$$

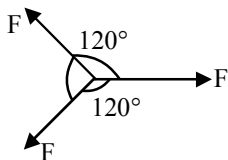
17. (D)

If two vectors A and B are given then Range of their resultant can be written as $(A - B) \leq R \leq (A + B)$.i.e. $R_{\max} = A + B$ and $R_{\min} = A - B$ If $B = 1$ and $A = 4$ then their resultant will lie in between 3N and 5N. It can never be 2N.

18. (A)

In N forces of equal magnitude work on a single point and their resultant is zero then angle between any two forces is given

$$\theta = \frac{360}{N} = \frac{360}{3} = 120^\circ$$



If these three vectors are represented by three sides of a triangle then they form an equilateral triangle

19. (C)

Resultant of two vectors \vec{A} and \vec{B} can be given by $\vec{R} = \vec{A} + \vec{B}$

$$|\vec{R}| = |\vec{A} + \vec{B}| = \sqrt{A^2 + B^2 + 2AB \cos \theta}$$

$$\text{If } \theta = 0^\circ \text{ then } |\vec{R}| = A + B = |\vec{A}| + |\vec{B}|$$

20. (B)

$$\text{Let } \vec{A} \cdot (\vec{B} \times \vec{A}) = \vec{A} \cdot \vec{C}$$

Here $\vec{C} = \vec{B} \times \vec{A}$ is perpendicular to both vector

$$\vec{A} \text{ and } \vec{B} \quad \therefore \vec{A} \cdot \vec{C} = 0$$

21. (D)

$$\vec{\Delta v} = \vec{v}_f - \vec{v}_i$$

$$\vec{\Delta v} = [50(-\hat{i}) - 50(\hat{j})] \text{ km/hr}$$

$$\vec{\Delta v} = (-50\hat{i} - 50\hat{j}) \text{ km/hr}$$

$$|\vec{\Delta v}| = 50\sqrt{2} \text{ km/hr}$$

$$\text{and direction of } \vec{\Delta v} = \frac{\vec{\Delta v}}{|\vec{\Delta v}|} = \frac{-\hat{i} - \hat{j}}{\sqrt{2}}$$

$$\therefore \vec{\Delta v} = 50\sqrt{2} \frac{\text{km}}{\text{hr}} \text{ south-west}$$

22. (A)

$$\text{Given that } \left(\vec{F}_1 + \vec{F}_2 \right) \cdot \vec{F}_1 = 0$$

where $F_1 < F_2$

$$\therefore F_1^2 + F_1 F_2 \cos \theta = 0$$

Given that $F_2 = 2F_1$

$$F_1^2 + 2F_1^2 \cos \theta = 0$$

$$\cos \theta = -\frac{1}{2}$$

$$\therefore \theta = 2\pi/3$$

23. (C)

24. (B)

$$\int (\sin x + \cos x)^2 dx$$

$$= \int (1 + 2 \sin x \cos x) dx$$

$$= \int dx + \int \sin 2x dx = x - \frac{\cos 2x}{2} + c = \frac{1}{2} \left(x + \frac{1}{2} \sin 2x \right) + c$$

25. (B)

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

$$\frac{dy}{dx} = \frac{(x-1) - (x+1)}{(x-1)^2} = -\frac{2}{(x-1)^2}$$

26. (D)

$$\int_0^{\pi} \sin x \, dx = (-\cos x)_0^{\pi} = 1+1=2$$

27. (A)

$$F - 7g = 7a, \quad T - 2g = 2a$$

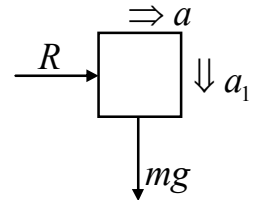
$$\text{On solving} \quad F = 140 \text{ N}$$

28. (B)

$$\text{Acceleration of combined mass } a = \frac{F}{2m} = \frac{2mg}{2m} = g$$

$$\text{so, } R = ma = mg$$

$$\text{Vertical acceleration} = g. \quad \text{so } a_{\text{net}} = \sqrt{2}g$$



29. (A)

$$m_2g - 2T = m_2a$$

$$\text{or} \quad 2T = m_2(g - a) \quad \dots (i)$$

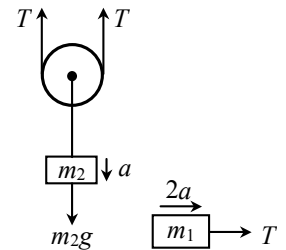
$$\text{Again, } T = m_1(2a)$$

$$\text{or} \quad 2T = 4m_1a \quad \dots (ii)$$

$$\text{Equating (i) and (ii), } m_2g - m_2a = 4m_1a$$

$$\text{or} \quad (4m_1 + m_2)a = m_2g$$

$$a = \frac{m_2g}{4m_1 + m_2}$$



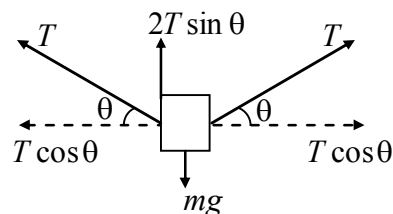
30. (D)

$$2T \sin \theta = mg$$

$$\Rightarrow T = \frac{mg}{2 \sin \theta}$$

$$\text{But } \theta = 0$$

$$\Rightarrow T = \infty$$



CHEMISTRY

31. (D)

$$v_{\text{sol}} = 30 + 20 = 50 \text{ ml}$$

$$w_{\text{HCl}} = \frac{30}{100} \times 12 + \frac{20}{100} \times 18 = 3.6 + 3.6 = 7.2$$

$$\therefore \% w/v = \frac{7.2}{50} \times 100 = 14.4$$

32. (B)

$$v_A = \frac{3}{1.2}, v_B = \frac{2}{1.5}$$

$$\therefore d = \frac{m}{v} = \frac{3+2}{\frac{3}{1.2} + \frac{2}{1.5}} = 1.30 \text{ g/ml}$$

33. (A)

$$\% \text{ of 'B'} = \frac{3B}{2A + 3B} \times 100 = \frac{3 \times (1.5A)}{2A + 3 \times (1.5A)} \times 100 = \frac{4.5}{6.5} \times 100 = 69.2\%$$

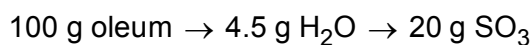
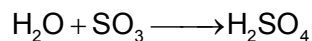
34. (C)

$$v_i = 1 \quad v_f = 1 + \frac{10}{100} \times 1 = 1.1$$

$$\therefore M_i v_i = M_f v_f \Rightarrow M_f = \frac{M_i}{1.1} \therefore \% \Delta M = \frac{|\Delta M|}{M_i} \times 100 = 9.09$$

35. (C)

36. (B)



37. (A)

$$M = \frac{5.6}{11.2} = \frac{1}{2} = \frac{\text{moles}}{v(\ell/t)} = \frac{m/34}{20/1000}$$

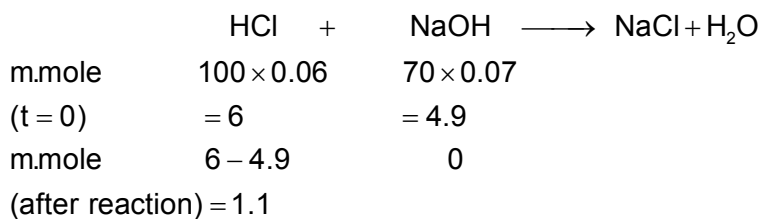
$$\therefore m = \frac{1}{2} \times \frac{20}{1000} \times 34 = 0.34 \text{ g}$$

38. (C)

$$\frac{n_O}{n_B} = \frac{y}{3} = \frac{1}{0.3} \Rightarrow y = 10$$

$$\frac{n_H}{n_A} = \frac{4}{1} = \frac{2y}{x} = \frac{2 \times 10}{x} \Rightarrow x = 5$$

39. (D)



So, m.mole of HCl (left) = 1.1 = M × V (ml)

$$\therefore M = \frac{1.1}{(100 + 70)} = \frac{1.1}{170} = 0.006$$

40. (C)

$$\text{Moles of 'N'} = \frac{0.12}{12} \times 6 = 0.06$$

$$\therefore \text{Moles of NO} = 0.06$$

$$\therefore \text{No. of molecules of NO} = 0.06 \times N_A = 3.6 \times 10^{22}$$

41. (A)

$$n_{\text{NaOH}} = 1.2 \quad m_{\text{H}_2\text{O}} = 1000 \text{ g}$$

$$\therefore m_{\text{NaOH}} = 1.2 \times 40 = 48 \text{ g}$$

$$\text{So, \% of NaOH} = \frac{48}{48 + 1000} \times 100 = 4.6\%$$

42. (B)

$$n_{\text{solute}} = 1.4 \quad m_{\text{solvent}} = 1000 \text{ g}$$

$$\therefore m_{\text{solute}} = 1.4 \times 40 = 56 \text{ So, } m_{\text{solution}} = 1056$$

$$\therefore V_{\text{solution}} = \frac{m}{d} = \frac{1056}{1.2} \text{ ml} = 0.88 \text{ L}$$

$$\therefore \text{molarity} = \frac{1.4}{0.88} = 1.59 \text{ M}$$

43. (D)

$$\text{m.mole of Fe}^{2+} = 5 \times \text{m.mole of MnO}_4^- = 5 \times 0.24 \times 1000$$

$$\Rightarrow \text{m.mole of Fe}^{2+} = 0.20 \times v = 5 \times 0.24 \times 1000$$

$$\therefore V = 6000 \text{ mL} = 6 \text{ L}$$

44. (A)

$$A_3 \rightarrow 3A$$

$$1 - 0.3 \quad 3 \times 0.3$$

$$= 0.7 \quad = 0.9$$

$$\% \text{ change} = \frac{(0.9 + 0.7) - 1}{1} \times 100 = 60\%$$

45. (C)

$$v_{\text{sol}} = \frac{m}{d} = \frac{10}{1.1} \text{ ml} = \frac{10}{1.1 \times 10^3} \text{ L}$$

$$\therefore n_{\text{NaOH}} = M \times v(\text{L}) = 0.8 \times \frac{10}{1.1 \times 10^3} = \frac{8}{1.1} \times 10^{-3}$$

$$\therefore n_{\text{OH}^-} = \frac{8}{1.1} \times 10^{-3} \text{ moles} = \frac{80}{11} \text{ millimoles}$$

46. (D)

$$\frac{1}{2}mv^2 = 3.01 \text{ eV} - 2.1 \text{ eV} = 0.91 \text{ eV}$$

47. (A)

48. (A)

$$\text{S.C on Li}^{2+} = \frac{2e}{7m} ; \text{S.C on He}^+ = \frac{e}{4m}$$

$$\therefore \text{Ratio} = \frac{2e/7m}{e/4m} = \frac{8}{7}$$

49. (B)

$$eV_{\text{S,P}} = 3 \text{ eV} - 2.1 \text{ eV} = 0.9 \text{ eV}$$

50. (D)

$$\text{Energy of a quanta} = \frac{hc}{\lambda} = hc\omega$$

$$\therefore E_{\text{Total}} = 12 \times 3 = n \times (hc\omega)$$

$$\therefore n = \frac{36}{hc\omega}$$

51. (C)

$$\text{Number of moles of SO}_2 = \frac{16}{64} = \frac{1}{4}$$

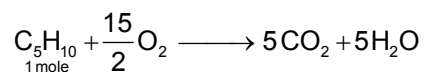
$$\begin{aligned} \therefore \text{Number of molecules of SO}_2 \\ = \frac{1}{4} \times N_A = \frac{1}{4} \times 6.022 \times 10^{23} = 1.5 \times 10^{23} \end{aligned}$$

52. (D)

Element	%	$\frac{\%}{\text{At. weight}}$	$\frac{\text{Value}}{\text{min}^m \text{ Value}}$	Simple ratio
A	75	$\frac{75}{75} = 1$	$\frac{1}{1} = 1$	1
B	25	$\frac{25}{25} = 1$	$\frac{1}{1} = 1$	1

\therefore Formula of the compound will be AB.

53. (B)

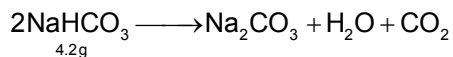


$$\frac{n_{\text{C}_5\text{H}_{10}}}{1} = \frac{n_{\text{O}_2}}{15/2}$$

$$\Rightarrow n_{\text{O}_2} = \frac{15}{2}$$

$$\therefore \text{Volume of O}_2 \text{ gas at NTP} = \frac{15}{2} \times 22.4 = 168\text{L.}$$

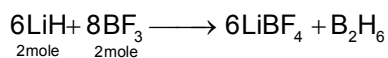
54. (D)



$$\text{Number of moles of NaHCO}_3 = \frac{4.2}{84} = \frac{1}{20}, \text{ No of moles of CO}_2 = \frac{1}{20} \times \frac{1}{2} = \frac{1}{40}$$

$$\text{So, Volume of CO}_2 \text{ formed at NTP} = \frac{1}{40} \times 22.4 = 0.56 \text{ L}$$

55. (A)

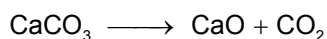


(LR)

↓

$$\frac{1}{8} \times 2 = 0.25 \text{ mole.}$$

56. (A)



1L STP

$$\text{Mole of CO}_2 = \frac{1}{22.7}$$

$$\text{Mole of CaCO}_3 = \frac{1}{22.7}$$

$$\text{gm of CaCO}_3 = \frac{100}{22.7} = 4.405$$

$$\% \text{ Purity of CaCO}_3 = \frac{4.405}{5} \times 100 = 88.1\%$$

57. (D)

$$x_{\text{C}_2\text{H}_5\text{OH}} = 0.25$$

$$x_{\text{H}_2\text{O}} = 0.75$$

$$\frac{x_{\text{C}_2\text{H}_5\text{OH}}}{x_{\text{H}_2\text{O}}} = \frac{1}{3} = \frac{n_{\text{C}_2\text{H}_5\text{OH}}}{n_{\text{H}_2\text{O}}}$$

$$\text{C}_2\text{H}_5\text{OH} = 1 \text{ mole} = 46 \text{ g}$$

$$\text{H}_2\text{O} = 3 \text{ mole} = 54 \text{ g}$$

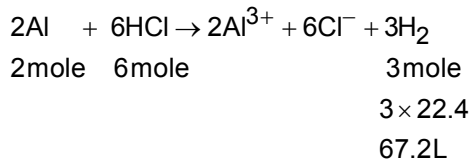
$$\% \text{ C}_2\text{H}_5\text{OH} = \frac{46}{46 + 54} \times 100 = 46\%$$

58. (C)

$$\text{Moles of Na} = 2 \times 4 = 8$$

$$\therefore \text{No. of Na - atom} = 8 N_A$$

59. (B)

1 mole Al = 33.6 L H₂ (NTP only)1 mole HCl = 11.2 L H₂ (NTP)

60. (C)

Let mass of oxygen = 1 g, then mass of nitrogen = 4 g

Mol. wt. of N₂ = 28 g, Mol. wt. of O₂ = 32 g28 g of N₂ = 6.02×10^{23} molecules of nitrogen

$$4 \text{ g of N}_2 = \frac{6.02 \times 10^{23}}{28} \times 4 \text{ molecules of nitrogen}$$

$$\text{and } 1 \text{ g O}_2 = \frac{6.02 \times 10^{23}}{32} \times 1 = \frac{6.02 \times 10^{23}}{32} \text{ molecules of oxygen}$$

Thus, ratio of molecules of oxygen : nitrogen

$$= \frac{6.02 \times 10^{23} / 32}{6.02 \times 10^{23} / 28} = 7 : 32$$

MATHEMATICS

61. (B)

$$a = \log_{10} 2 = \log_{10} \frac{10}{5} = 1 - \log_{10} 5$$

$$\Rightarrow \log_{10} 5 = 1 - a$$

62. (D)

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

$$\Rightarrow \frac{1-x^2}{x} \cdot x \geq 0 \Rightarrow x \in [-1, 1] - \{0\}$$

63. (A)

$$\frac{a}{r} + a + ar = 21 \text{ and } \frac{a^2}{r^2} + a^2 + a^2 r^2 = 189$$

$$\Rightarrow a = 6, r = 2 \text{ or } \frac{1}{2}$$

\therefore G.P. is 3, 6, 12,

64. (C)

We have first term $A = a$ (i)

Second term $A + d = b$ (ii)

and last term $l = 2a$ (iii)

From (i), (ii) and (iii), $d = (b - a)$ and $n = \frac{b}{b - a}$

Then sum

$$S = \frac{n}{2}[a + l] = \frac{b}{2(b - a)}[a + 2a] = \frac{3ab}{2(b - a)}$$

Trick : Let $a = 2, b = 3$ then the sum = 9 which is given by option (c).

65. (C)

Let $S_{\text{Even}} = 2 + 4 + 6 + 8 + \dots \infty$ (i)

and $S_{\text{Odd}} = 1 + 3 + 5 + 7 + 9 + \dots \infty$ (ii)

$$\text{Sum } S_E = \frac{n}{2}[4 + (n - 1)2] = \frac{n}{2}[2n + 2] = \frac{n}{2}2(n + 1)$$

$$\text{and } S_O = \frac{n}{2}[2 + (n - 1)2] = \frac{n}{2}(2n)$$

$$\text{Now } \frac{S_E}{S_O} = \frac{(n + 1)}{n} \text{ or } S_E : S_O = (n + 1) : n.$$

66. (B)

$$\cos 10^\circ + \cos 170^\circ = \cos 20^\circ + \cos 160^\circ = \cos 30^\circ + \cos 150^\circ = \dots = \cos 80^\circ + \cos 100^\circ = 0$$

$$\cos 90^\circ = 0$$

$$\cos 180^\circ = -1$$

\therefore over all sum = -1

67. (B)

$$\sin^4 x + \cos^4 x = (\sin^2 x + \cos^2 x)^2 - 2\sin^2 x \cos^2 x$$

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

Minimum value is $1/2$ at $x = \pi/4$

68. (A)

$$\frac{\cos 15^\circ + \cos 45^\circ + \cos 75^\circ}{\sin 15^\circ + \sin 45^\circ + \sin 75^\circ} = \frac{\cos 15^\circ + \cos 45^\circ + \sin 15^\circ}{\sin 15^\circ + \sin 45^\circ + \cos 15^\circ} = 1$$

69. (A)

70. (C)

71. (B)

72. (C)

73. (A)

74. (B)

$$\log_{1/2}(x^2 - 6x + 12) \geq -2 \quad \dots(i)$$

For log to be defined, $x^2 - 6x + 12 > 0$

$$\Rightarrow (x-3)^2 + 3 > 0, \text{ which is true } \forall x \in \mathbb{R}.$$

$$\text{From (i), } x^2 - 6x + 12 \leq \left(\frac{1}{2}\right)^{-2}$$

$$\Rightarrow x^2 - 6x + 12 \leq 4 \Rightarrow x^2 - 6x + 8 \leq 0$$

$$\Rightarrow (x-2)(x-4) \leq 0 \quad \Rightarrow 2 \leq x \leq 4; \therefore x \in [2, 4].$$

75. (A)

$$\sqrt{2 + \sqrt{2 + \sqrt{2 + 2 \cos 8\theta}}}$$

$$= \sqrt{2 + \sqrt{2 + \sqrt{4 \cos^2 4\theta}}} \quad \left[\because 1 + \cos 8\theta = 2 \cos^2 \frac{8\theta}{2} \right]$$

$$= \sqrt{2 + \sqrt{2 + 2 \cos 4\theta}}$$

$$= \sqrt{2 + \sqrt{2(1 + \cos 4\theta)}}$$

$$= \sqrt{2 + \sqrt{2(2 \cos^2 2\theta)}} \quad [\because 1 + \cos 4\theta = 2 \cos^2 2\theta]$$

$$= \sqrt{2 + 2 \cos 2\theta} = \sqrt{2(1 + \cos 2\theta)} = \sqrt{2(2 \cos^2 \theta)} = 2 \cos \theta$$

76. (A)

Maximum value of $2\sin x + 4\cos x = 2\sqrt{5}$.

Hence the maximum value of $2\sin x + 4\cos x + 3$ is $2\sqrt{5} + 3$.

Hence (a) is the correct answer.

77. (A)

$$\begin{aligned}
 &= 2\cos^4 \frac{\pi}{8} + 2\cos^4 \frac{3\pi}{8} \\
 &= \frac{1}{2} \left\{ \left(1 + \cos \frac{\pi}{4} \right)^2 + \left(1 + \cos \frac{3\pi}{4} \right)^2 \right\} \\
 &= \frac{1}{2} \left\{ \left(1 + \frac{1}{\sqrt{2}} \right)^2 + \left(1 - \frac{1}{\sqrt{2}} \right)^2 \right\} = \frac{3}{2}
 \end{aligned}$$

78. (D)

$$\log_{16} x + \log_4 x + \log_2 x = 14$$

$$\log_{2^4} x + \log_{2^2} x + \log_2 x = 14 \Rightarrow \frac{1}{4} \log_2 x + \frac{1}{2} \log_2 x + \log_2 x = 14$$

$$\Rightarrow \log_2 x \left(\frac{1}{4} + \frac{1}{2} + 1 \right) = 14 \Rightarrow \frac{7}{4} \log_2 x = 14 \Rightarrow \log_2 x = \frac{14 \times 4}{7} = 8$$

$$\Rightarrow \log_2 x = 8 \log_2 2 \Rightarrow x = 2^8$$

79. (C)

$$3^x - 8 = 3^{2-x} \text{ and } 3^x - 8 > 0$$

$$\text{Let } 3^x = y (y > 0)$$

$$\Rightarrow y - 8 = \frac{9}{y}$$

$$\Rightarrow y^2 - 8y = 9$$

$$y = 9, y = -1$$

$$x = 2$$

80. (B)

$$\text{use } x^2 - 5x + 7 < 1 \text{ and } x^2 - 5x + 7 > 0$$

81. (A)

$$\cot(\alpha - \beta) = \frac{\tan \alpha \cdot \tan \beta + 1}{\tan \alpha - \tan \beta} = \frac{\frac{x}{y} + 1}{x} = \frac{x + y}{xy}$$

82. (C)

$\therefore \tan \frac{P}{2}$ and $\tan \frac{Q}{2}$ are the roots of equation $ax^2 + bx + c = 0$

$$\therefore \tan \frac{P}{2} + \tan \frac{Q}{2} = -\frac{b}{a} \text{ and } \tan \frac{P}{2} \tan \frac{Q}{2} = \frac{c}{a}$$

$$\frac{P}{2} + \frac{Q}{2} + \frac{R}{2} = \frac{\pi}{2} \quad (\because P + Q + R = \pi)$$

$$\Rightarrow \frac{P+Q}{2} = \frac{\pi}{2} - \frac{R}{2}$$

$$\Rightarrow \frac{P+Q}{2} = \frac{\pi}{4} \quad (\because \angle R = \frac{\pi}{2})$$

$$\Rightarrow \tan\left(\frac{P+Q}{2}\right) = 1 \quad \Rightarrow \frac{\tan \frac{P}{2} + \tan \frac{Q}{2}}{1 - \tan \frac{P}{2} \cdot \tan \frac{Q}{2}} = 1$$

$$\Rightarrow \frac{-b/a}{1 - c/a} = 1 \quad \Rightarrow c = a + b$$

83. (A)

Use $\tan \theta \tan(60 - \theta) \tan(60 + \theta) = \tan 3\theta$

84. (D)

$$\sin A \sec A \sqrt{\operatorname{cosec}^2 A - 1} = \tan A |\cot A|$$

$$= -1 \quad (\because 90^\circ < A < 180^\circ)$$

85. (D)

$$\text{Let } y = 3^{\log_7 x} \Rightarrow y^2 - 2y + 1 = 0$$

$$\Rightarrow y = 1 \Rightarrow x = 1$$

86. (B)

$$\tan 2B = \tan((A+B) - (A-B)) = \frac{p-q}{1+pq}$$

87. (A)

$$\operatorname{cosec} 10 - 4 \sin 70$$

$$\begin{aligned}
 &= \frac{1}{\sin 10} - 4 \sin 70 \\
 &= \frac{1 - 4 \sin 70 \sin 10}{\sin 10} = \frac{1 - 2(\cos(60) - \cos(80))}{\sin 10} \\
 &= \frac{1 - 2\left(\frac{1}{2} - \cos(80)\right)}{\sin 10} \\
 &= \frac{1 - 1 + 2\cos(80)}{\sin 10} = 2 \frac{\cos(80)}{\sin 10} = 2
 \end{aligned}$$

88. (B)

$$\frac{(\cos 6x + \cos 4x) + 5(\cos 4x + \cos 2x) + 10(1 + \cos 2x)}{\cos 5x + 5 \cos 3x + 10 \cos x} = 2 \cos x$$

89. (B)

We know that

$$\sin \alpha + \sin(\alpha + \beta) + \sin(\alpha + 2\beta) + \dots + \sin\{\alpha + (n-1)\beta\}$$

$$\begin{aligned}
 &= \frac{\sin\left\{\alpha + (n-1)\frac{\beta}{2}\right\} \sin\left(\frac{n\beta}{2}\right)}{\sin\frac{\beta}{2}}
 \end{aligned}$$

$$\therefore \sin \frac{\pi}{n} + \sin \frac{3\pi}{n} + \sin \frac{5\pi}{n} + \dots \text{to } n \text{ terms}$$

$$\begin{aligned}
 &= \frac{\sin\left\{\frac{\pi}{n} + (n-1)\frac{\pi}{n}\right\} \sin\left(\frac{n\pi}{n}\right)}{\sin\frac{\pi}{n}} \quad \left[\text{Here, } \alpha = \frac{\pi}{n} \text{ and } \beta = \frac{2\pi}{n} \right]
 \end{aligned}$$

$$\begin{aligned}
 &= \frac{\sin \pi \sin \pi}{\sin \frac{\pi}{n}} = 0
 \end{aligned}$$

90. (A)

$$3 < |x - 1| < 5$$

$$\Rightarrow x \in (-4, -2) \cup (4, 6)$$