AVIRAL
JEE | NEET | FOUNDATIONS

FINAL TEST SERIES XI JEE
TEST-01 ANSWER KEY

Test Date :19-01-2020

[PHYSICS]

1. Answer (2)

$h = \frac{1}{2}gt^2$ ...(1)

$\frac{h}{2} = \frac{1}{2}g(t-1)^2$ ...(2)

Solving, t = 3.41 sec.

2. Answer (3)

For equilibrium,

$F = -\frac{dU}{dx} = 0 = \frac{d}{dx}(x^2 - 6x) = 2x - 6 \Rightarrow x = 3\text{m}$

At x = 3 m, U = 9 – 18 = – 9 joule

$E = K + U$

$11 = K + (-9) \quad \Rightarrow K = 20$ J

3. Answer (2)

$V_{max} = \sqrt{gr\tan(\theta+\lambda)} = \sqrt{gr\frac{(\tan\theta+\tan\lambda)}{(1-\tan\theta.\tan\lambda)}}$

$= \sqrt{gr\frac{(\tan\theta+\mu)}{[1-\tan\theta\times\mu]}} = \sqrt{\frac{10\times 2\left(\frac{3}{4}+\frac{1}{2}\right)}{\left(1-\frac{1}{2}\times\frac{3}{4}\right)}}$

$= \sqrt{200\times\frac{5\times 8}{4\times 5}} = \sqrt{400} = 20\ \text{ms}^{-1}$

4. Answer (4)

$x = 4t^2 - 3t \Rightarrow v = 8t - 3 \Rightarrow a = 8\ \text{ms}^{-2}$

$\Rightarrow \boxed{F = 16\text{N}} \Rightarrow dx = (8t-3)dt$

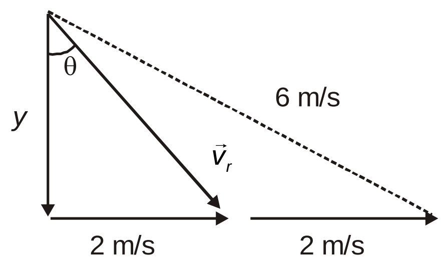
$W = \int dW = \int Fdx = \int_0^t 16(8t-3)dt = 16(4t^2 - 3t)$

$t = \frac{3}{4}\text{s},\ W = 0$

For W to be minimum, $\frac{dW}{dt} = 0 \Rightarrow t = \frac{3}{8}$ s

$\frac{d^2W}{dt^2} = 8, \frac{d^2W}{dt^2} > 0$

5. Answer (4)



$\frac{2}{y} = \tan\theta$

$y = 2\cot\theta$

Now, $\sqrt{y^2+16} = 36 \Rightarrow 4\cot^2\theta + 16 = 36$

$\Rightarrow \cot^2\theta = 5 \Rightarrow \theta = \cot^{-1}(\sqrt{5})$

6. Answer (2)

$3kx_1 = 2kx_2 = kx_3 \Rightarrow 3x_1 = 2x_2 = x_3$ ..(1)

$x = x_1 + x_2 + x_3$

$\Rightarrow x = x_1 + \frac{3}{2}x_1 + 3x_1 \Rightarrow x = \frac{11x_1}{2}$

$\Rightarrow x_1 = \frac{2}{11}x.$

7. Answer (1)

8. Answer (3)

$2T - mg = ma_1 \uparrow$ ...(1)

$Mg - T = Ma_2 \downarrow$ ...(2)

$a_{rel} = a_1 + a_2$ ...(3)

$a_2 = 2a_1$ ...(4)

Solving, $a_1 = \frac{3g}{21}$

Then $a_{rel} = \frac{3g}{21} + \frac{6g}{21} = \frac{9}{21}g = \frac{3g}{7}$

Now, $l = \frac{1}{2}a_{rel}.t^2 \Rightarrow l = \frac{1}{2} \times \frac{3g}{7}.t^2 \Rightarrow t = \sqrt{\frac{14g}{3l}}$

9. Answer (3)

$\vec{v}_{rel} = (v - v\cos\theta)\hat{i} + v\sin\theta\hat{j} \Rightarrow |\overrightarrow{v_{rel}}|$

$= v\sqrt{(1-\cos\theta)^2 + \sin^2\theta} = 2v\sin\frac{\theta}{2}$

$$|\bar{v}_{rel}| = \frac{\int_0^{2\pi} 2v\sin\theta/2 d\theta}{2\pi\int_0 d\theta} = \frac{2v}{2\pi} = \frac{\left(-\cos\frac{\theta}{2}\right)_0^{2\pi}}{\frac{1}{2}}$$

$$= \frac{2v}{\pi}\left[-\cos\frac{\theta}{2}\right]_0^{2\pi} = \frac{4v}{\pi}$$

10. Answer (4)

For no motion between blocks,

$F_{max} = \mu_2(m_1 + m_2)q = 0.4 \times 10 \times 10 = 40$ N

Thus, $F_{max} = 40$ N

As, $F_{max} > F$ applied.

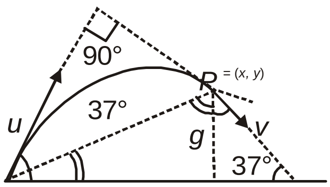
Hence between blocks $a_{rel} = 0$

$\Rightarrow a_{common} = \frac{30}{10} = 3\text{ ms}^{-2}$

Now, for 4 kg

$f = ma = 4 \times 3 = 12$ N.

11. Answer (3)



$\theta = 53$

When $\vec{v} \perp \vec{u}$

$t = \frac{u}{g\sin\theta}$ ...(1)

$v = u\cot\theta$ ...(2)

$\Rightarrow v = u \times \frac{3}{4} = 10 \times \frac{3}{4} = \frac{15}{2}\text{ ms}^{-1}$

At P, $\frac{v^2}{R} = g\cos 37° \Rightarrow R = \frac{v^2}{g\cos 37°}$

$\Rightarrow R = \frac{15}{2} \times \frac{15}{2} \times \frac{5}{10 \times 4}$

$R = \frac{225}{32}$m

12. Answer (4)

F_{upon} due to $B = (m_A + m_B)(g + a)$

$= (2+3)(10+2) = 60\text{N}\downarrow$

Displacement $s = ut + \frac{1}{2}at^2 = -5 \times t = \frac{1}{2} \times 2 \times t^2$

$= -5 \times 2 + \frac{1}{2} \times 2 \times 4 = -10 + 4 = 6\text{ m}\downarrow$

$W = \vec{F}.\vec{S} = 60 \times 6 = 360$ J

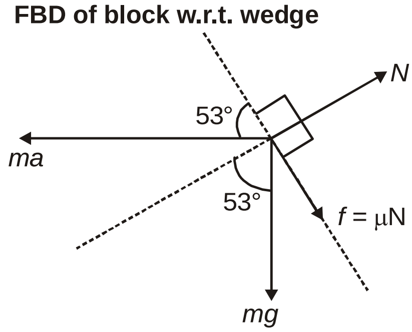
13. Answer (3)

$N = mg\cos 53° + ma.\sin 53°$

$N = mg \times \frac{3}{5} + ma \times \frac{4}{5}$ ...(1)

$\mu N + mg\sin 53° = ma\cos 53°$ ...(2)

FBD of block w.r.t. wedge



$0.1\left[\frac{3}{5}mg + \frac{4}{5}ma\right] + \frac{4}{5}mg = \frac{3}{5}ma$

$\frac{1}{10}[3mg + 4ma] + 4mg = 3ma$

$3mg + 4ma + 40mg = 30\ ma$

$\Rightarrow 43\ mg = 26\ ma$

$\Rightarrow \boxed{a = \frac{43}{26}g}$ ...(3)

Now, $F = (M+m)a = 6 \times \frac{43}{26}g = \frac{129}{13}$ g N

14. Answer (1)

$T - mg = ma$ ...(1)

$Mg - 31T = M \times \frac{a}{31}$ ...(2)

Solving, $a = \frac{31g(M - 31m)}{M + 961m}$

15. Answer (4)

From work-energy theorem,

$W_F + W_{by} mg + W_{by} tr = \Delta K = 0$

$W_F - mgR \sin 60° - \mu mg(R - R\cos 60°) = 0$

$W_F = mgR\frac{\sqrt{3}}{2} + \frac{\mu mgR}{2} = \frac{mgR}{2}\left(\mu + \sqrt{3}\right)$

16. Answer (3)

$F = -\frac{dU}{dx} = -\left[\frac{d}{dx}\left(-\frac{2}{3}x^3 + \frac{3}{2}x^2 + 2x\right)\right]$

$= -\left[-\frac{2}{3} \times 3x^2 + \frac{3}{2} \times 2x + 2\right] = -\left[-2x^2 + 3x + 2\right]$

$F = 2x^2 - 3x - 2$ ..(1)

$F = 0 \Rightarrow 2x^2 - 3x - 2 = 0$

$\Rightarrow 2x^2 - 4x + x - 2 = 0$

$\Rightarrow 2x(x - 2) + 1(x - 2) = 0$

$x = 2$, $x = -\frac{1}{2}$

Now, $\frac{dF}{dx} = 4x - 3$ at $x = 2$,

$\frac{dF}{dx} = 4 \times 2 - 3 = 8 - 3 = 5$

$\frac{dF}{dx} > 0 \Rightarrow \frac{d^2y}{dx^2} < 0$

Thus at $x = 2$, unstable equilibrium.

At $x = -\frac{1}{2}, \frac{dF}{dx} = 4x\left(-\frac{1}{2}\right) - 3x = -5, \frac{dF}{dx} < 0$

$\Rightarrow \frac{d^2y}{dx^2} > 0$

Thus $x = -\frac{1}{2}$, stable equilibrium.

17. Answer (4)

Limiting friction between B and C = 0.5 × 4 × 10 = 20 N

Maximum common acceleration $= \frac{20}{4} = 5 \text{ ms}^{-2}$

Now, $a_{max} = \frac{m_{A\max}.g}{m_A + 3 + 4} \Rightarrow 5 = \frac{m \times 10}{m + 7}$

$10m_A = 5m_A + 35 \Rightarrow m_A = 7$ kg

When $m_A = 5$ kg, $a = \frac{5 \times 10}{5 + 3 + 4} = \frac{50}{12} \text{ms}^{-2}$

$\Rightarrow f = 4 \times \frac{50}{12} = \frac{50}{3}$ N

18. Answer (4)

At A, $T_A - mg = \frac{mv_A^2}{l} \Rightarrow T_A = mg + 6mg = 7\ mg$

At B, $T_B = \frac{mv_B^2}{l} = 4mg, T$ and C ,

$T_C + mg - \frac{mv_C^2}{l} \Rightarrow T_C = m \times \frac{V_C^2}{l} - mg - 2mg - mg$

$\boxed{T_B = 4mg}$ $\boxed{T_A = 7mg}$ $\boxed{T_C = mg}$

19. Answer (4)

For $UCM, \vec{v} \perp \frac{d}{dt}\vec{v}$

For accelerated CM, $\vec{v}.\frac{d}{dt}\vec{v} > 0$

For decelerated $CM, \vec{v}.\frac{d}{dt}\vec{v} < 0$.

20. (b) $\therefore E = \frac{1}{2}mv^2$

$\therefore$ % Error in K.E.

= % error in mass + 2 × % error in velocity

= 2 + 2 × 3 = 8 %

21. $200 - 120 = 12a_1 \Rightarrow a_1 = \frac{80}{12} = \frac{20}{3}\,\text{ms}^{-2} \uparrow$

$200 - 150 = 15a_2 \Rightarrow a_2 = \frac{50}{15} = \frac{10}{3}\,\text{ms}^{-2} \uparrow$

$$a_p = \frac{\frac{20}{3} + \frac{10}{3}}{2} = 5\ \text{ms}^{-2} \uparrow$$

22. Answer (4)

$F = -\frac{dU}{dx} \Rightarrow \frac{dU}{dx} = -F$

$\Rightarrow$ For equilibrium, $F = 0 \Rightarrow \frac{dU}{dx} = 0$

For stable equilibrium,

$$\frac{d^2U}{dx^2} > 0 \Rightarrow \frac{d}{dx}\left(\frac{dU}{dx}\right) > 0 \Rightarrow \frac{d}{dx}(-F) > 0 \Rightarrow -\frac{dF}{dx} > 0$$

$\Rightarrow \frac{dF}{dx} < 0$ for unstable equilibrium, $\frac{dF}{dx} > 1$.

23. Answer (2)

$$\begin{array}{r} 2.221 \\ \times 1.2 \\ \hline 2.6652 = 2.7 \\ \hline \end{array}$$

Now,

$$\begin{array}{r} 238.523 \\ 2.7 \\ \hline 241.2 \end{array}$$

Number of *SF* = 4

24. Answer (2)

$$t = \frac{s_{\text{rel}}}{v_{\text{rel}}} = \frac{l}{v + v\cos 60^\circ} = \frac{2l}{3v}$$

Distance = $v \times t = v \times \frac{2l}{3v} = \frac{2l}{3} = \frac{2}{3} \times 3 = 2\text{ m}$.

25. Answer (4)

$$\mu_s mg = m\sqrt{a_T^2 + \frac{v_m^4}{r^2}}$$

$\Rightarrow \mu^2 g^2 = a_T^2 + \frac{v_m^4}{r^2}$

$\Rightarrow \frac{1}{4} \times 100 = 9 + \frac{v_m^4}{16}$

$\Rightarrow v_m^4 = 16 \times 16$

$\Rightarrow v_m = 4\text{ms}^{-1}$

Now, $a = \frac{vdv}{ds} \Rightarrow vdv = ads$

$$\int_u^v vdv = \int_o^s ads$$

$v^2 = u^2 + 2as$

$(4)^2 = (2)^2 + 2 \times 3 \times s$

$2 \times 6 = 6 \times s \Rightarrow \boxed{s = 2\text{m}}$

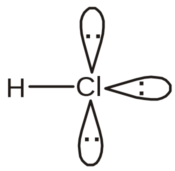
[CHEMISTRY]

26. Answer (1)

Uue (119) → $[\text{Rn}]_{86} 5f^{14} 6d^{10} 7s^2 7p^7$

Hence it belongs to 17th group.

27. Answer (3)



1 bond pair, 3 lone pair.

28. Answer (1)

NO (15) Bond order = 2.5

NO^+ (14) Bond order = 3

NO^- (16) Bond order = 2

Hence, order of bond energy $NO^+ > NO > NO^-$

29. Answer (2)

Let the uncertainty in momentum = x

Uncertainty in position = 4x

$\therefore\ 4x^2 = \frac{h}{4\pi} \Rightarrow x = \frac{1}{4}\sqrt{\frac{h}{\pi}}$

Hence uncertainty in position $= \sqrt{\frac{h}{\pi}}$.

30. Answer (3)

$C_nH_{2n}O_n + nO_2(g) \longrightarrow nCO_2(g) + nH_2O(l)$

1 mL n mL n mL

$\therefore$ Contraction in volume = 1 + n – n = 1 mL.

31. Answer (4)
Fact.

32. Answer (2)
Electronic configuration (56) – $[Xe]_{54}6s^2$

33. Answer (1)
$I_2 + AsO_2^- + 2H_2O \rightarrow AsO_4^{3-} + 2I^- + 3H^+$
m.eq. of $HAsO_2$ (in 50 mL) = m.eq. of I_2 = 35 × 0.05 × 2 = 3.5
$\therefore$ meq of $HAsO_2$ in 250 mL = 17.5

weight of $HAsO_2 = \frac{17.5}{2} \times 108 \times 10^{-3} = 0.945$ g

% of $HAsO_2$ in the sample $= \frac{0.945}{3.78} \times 100 = 25\%$.

34. Answer (3)
Isodiaphers have same (n - p)

35. Answer (4)
$XeOF_4$ is square pyramidal.

36. Answer (2)
C : H : N = 9 : 1 : 3.5
Ratio by moles

$C:H:N = \frac{9}{12}:\frac{1}{1}:\frac{3.5}{14} = \frac{3}{4}:1:1:\frac{1}{4} = 3:4:1$

C_3H_4N is empirical formula.

$n = \frac{108}{54} = 2$

Hence molecular formula $C_6H_8N_2$

37. Answer (3)
Separation energy

$= 13.6 \times \frac{z^2}{n^2} = 13.6 \times \frac{3^2}{2^2} = +30.6$

($\because$ for first excited state n = 2)

38. Answer (3)

39. Answer (2)

$2\pi r_n = n\lambda \Rightarrow 2\pi \times 0.53\frac{n^2}{Z} = n\lambda$

$\Rightarrow \lambda = 2\pi \times 0.53 \times \frac{n}{Z}$

$E_{sep} = 3.4 = 13.6\frac{Z^2}{n^2} \Rightarrow \frac{n}{Z} = 2$

40. Answer (2)

$Fe_2(C_2O_4)_3 + MnO_4^- + H^+ \rightarrow 2Fe^{3+} + 6CO_2 + H_2O$

$FeC_2O_4 + MnO_4^- + H^+ \rightarrow Fe^{3+} + 2CO_2 + H_2O$

Total equivalents of $Fe_2(C_2O_4)_3$ and FeC_2O_4
= equivalents of $KMnO_4$
On solving, x = 0.9 mole.

41. Answer (3)
Limiting agent is Na_2CO_3.
Now 106 g of Na_2CO_3 gives 22.4 L of CO_2

$\therefore$ 5.3 g of Na_2CO_3 gives $\frac{22.4}{106} \times 5.3 = 1.12L$

42. Answer (4)
Fact.

43. Answer (3)

44. Answer (4)

45. Answer (3)

No. of molecules in 1 gm NH_3 is $\frac{1}{17} \times N_A$

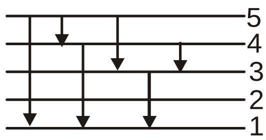
No. of molecules in 1 gm N_2 is $\frac{1}{28} \times N_A$

46. Answer (2)
Radius of n^{th} shell = r_0n^2
$\Rightarrow r_0(n+1)^2 - r_0(n-1)^2 = 2r_0n^2$
$\Rightarrow (n + 1 + n - 1)(n + 1 - n + 1) = 2n^2$
$\Rightarrow 2n \times 2 = 2n^2$
$\Rightarrow \boxed{n = 2}$

47. $\frac{1}{\lambda} = 1.1 \times 10^7 \left[\frac{1}{3^2} - \frac{1}{n_2^2}\right]$

$\Rightarrow \nu = 3 \times 10^8 \times 1.1 \times 10^7 \left[\frac{1}{9} - \frac{1}{n^2}\right]$

Putting the values of *n* from the options only 5 satisfies the equation.
Hence answer is (5).

48.


Total radiations are = 6.

49. Number of spherical nodes = n – *l* – 1.

50.

[MATHEMATICS]

51. Answer (3)

$$=\left(\sin\frac{\pi}{14}.\sin\frac{3\pi}{14}.\sin\frac{5\pi}{14}\right)^2$$

$$=\left(\cos\frac{\pi}{7}.\cos\frac{2\pi}{7}.\cos\frac{4\pi}{7}\right)^2$$

$$=\left(\frac{\sin.\frac{8\pi}{7}}{8\sin\frac{\pi}{7}}\right)^2=\frac{1}{64}$$

52. Answer (4)

$\alpha + \beta + \gamma = 1$

$$\beta=\frac{1}{3}$$

$$\alpha\beta+\beta\gamma+\alpha\gamma=3p \qquad \Rightarrow \beta(\alpha+\gamma)+\alpha\gamma=3p$$

$$3p=\frac{1}{3}\times\frac{2}{3}+\alpha\gamma$$

$$3p=\frac{2}{9}+\left(\frac{1}{3}-d\right)\left(\frac{1}{3}+d\right)=\frac{1}{3}-d^2$$

$$p=\frac{1}{9}-\frac{1}{3}d^2 \qquad \Rightarrow p_{max}=\frac{1}{9}$$

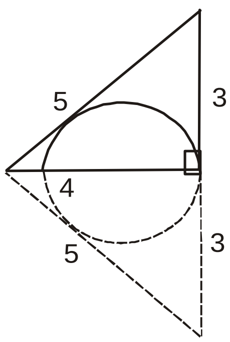
53. Answer (2)

$$\frac{x}{x+6}-\frac{1}{x}\le 0$$

$$\frac{x^2-x-6}{x(x+6)}\le 0 \qquad \Rightarrow \frac{(x-3)(x+2)}{x(x+6)}\le 0$$

$x \in (-6, -2] \cup (0, 3]$

54. Answer (4)



Radius of incircle = $\frac{\Delta}{s}$

$$=\frac{\frac{1}{2}\times 4\times 6}{\frac{1}{2}\times(5+5+6)}=\frac{3}{2}$$

$20r - 23 = 7$

55. Answer (1)

$\sec\theta=m$ and $\tan\theta=n$, then $\frac{1}{m}\left[(m+n)+\frac{1}{(m+n)}\right]$

$$\frac{1}{\sec\theta}\left[(\sec\theta+\tan\theta)+\frac{1}{((\sec\theta)+\tan\theta)}\right]$$

$$\cos\theta\left[\frac{1}{(\sec\theta-\tan\theta)}+\frac{1}{\sec\theta+\tan\theta}\right]$$

$$\cos\theta\left[\frac{\sec\theta+\tan\theta+\sec\theta-\tan\theta}{\sec^2\theta-\tan^2\theta}\right]=2$$

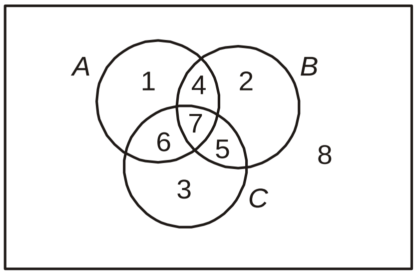
56. Answer (4)

No. of one to one functions

= 6 × 5 × 4 × 3

= 360

57. Answer (4)



$A - B = 1 + 6$

$B - C = 2 + 4$

$C - A = 3 + 5$

$$(A-B)\cup(B-C)\cup(C-A)=1+2+3+4+5+6$$

$$=(A\cup B\cup C)-(A\cap B\cap C)$$

58. $(3\sin\theta + 5\cos\theta)^2 + (5\sin\theta - 3\cos\theta)^2 = 34$

$\Rightarrow 25 + (5\sin\theta - 3\cos\theta)^2 = 34$

$|5\sin\theta - 3\cos\theta| = 3$.

Hence (B) is the correct answer.

59. 2 sinx - cos2x = 2 (sin^{2}x + sinx) - 1

$$= 2\left[\left(\sin x + \frac{1}{2}\right)^2 - \frac{1}{4}\right] - 1$$

$$= 2\left(\sin x + \frac{1}{2}\right)^2 - \frac{3}{2} \geq -\frac{3}{2}$$

$\Rightarrow$ 2 sinx – cos2x $\geq$ - 3/2

Hence (A), are the correct answers.

60. The given equation may be written as $8^{(1+|\cos x|+|\cos^2 x|+|\cos^3 x|+\cdots+\infty)} = 8^2$

$\Rightarrow 1 + |\cos x| + |\cos^2 x| + |\cos^3 x| + \ldots + \infty = 2$

As we have $-\pi < x < \pi$, $x \neq 0$, we have $|\cos x| < 1$

Hence $\frac{1}{1-|\cos x|} = 2$

$\Rightarrow |\cos x| = \frac{1}{2}$

$\therefore$ values of x in $(-\pi, \pi)$ for which $\cos x = \pm\frac{1}{2}$ are $\pm\frac{\pi}{3}, \frac{2\pi}{3}$.

Hence (A) are the correct answer.

61. As the coefficients are real and one root is $2+i$, therefore, another root is $2-i$ (conjugate of $2+i$). Let the third root be α then sum of the roots $= 2+i+2-i+\alpha$

$\Rightarrow -(-5) = 4+\alpha \Rightarrow \alpha = 1$

So, the other two roots are $2-i$ and 1.

62. We have $x^2 + px + (1-p) = 0$ .....(i)

$(1-p)^2 + p(1-p) + (1-p) = 0$

$(1-p)[1-p+p+1] = 0$; $p = 1$

Put $p-1$ in equation (i),

$x^2 + x = 0 \Rightarrow x(x+1) = 0$ *i.e.,* $x = 0 = -1$.

63. $y = \sqrt{\frac{(x+1)(x-3)}{(x-2)}}$

Here x cannot be 2.

$\Rightarrow$ Either both N^r and D^r are positive

$x \geq -1, x \geq 3$ and $x > 2 \Rightarrow x \geq 3$ .....(i)

Or N^r is negative and D^r is negative

$x \geq -1$ and $x < 2 \Rightarrow -1 \leq x < 2$ .....(ii)

From (i) and (ii), $-1 \leq x < 2$ or $x \geq 3$.

64. **C**

65. $\sin\theta = \frac{1}{2} \Rightarrow \theta = \frac{\pi}{6}$

$\cos\phi = \frac{1}{3} \Rightarrow \frac{\pi}{3} < \phi < \frac{\pi}{2}$. Thus, $\frac{\pi}{2} < (\theta+\phi) < \frac{2\pi}{3}$.

66. If $f(x) = \cos\sqrt{x}$, then $f(x)$ is not a periodic function.

67. Given, $(\cos x + \sin x)^2 + k\sin x\cos x - 1 = 0, \forall x$

$\Rightarrow \cos^2 x + \sin^2 x + 2\cos x\sin x + k\sin x\cos x - 1 = 0, \forall x$

$\Rightarrow (k+2)\cos x\sin x = 0, \forall x \Rightarrow k+2 = 0 \Rightarrow k = -2$.

68. **B**

69. **D**

70. $n(P) = 25\%$, $n(C) = 15\%$

$n(P^c \cap C^c) = 65\%$, $n(P\cap C) = 2000$

Since, $n(P^c \cap C^c) = 65\%$

$\therefore n(P\cup C)^c = 65\%$ and $n(P\cup C) = 35\%$

Now, $n(P\cup C) = n(P) + n(C) - n(P\cap C)$

$35 = 25 + 15 - n(P\cap C)$

$\therefore n(P\cap C) = 40 - 35 = 5$. Thus $n(P\cap C) = 5\%$

But $n(P\cap C) = 2000$

$\therefore$ Total number of families $= \frac{2000\times 100}{5} = 40{,}000$

Since, $n(P\cup C) = 35\%$

and total number of families = 40,000

and $n(P\cap C) = 5\%$. $\therefore$ (2) and (3) are correct.

71. Let the roots are α and β

so, $\alpha^3 + \beta^3 = (\alpha+\beta)^3 - 3\alpha\beta(\alpha+\beta)$

$= (a-2)^3 - 3(a-3)(a-2)$

$= a^3 - 9a^2 + 27a - 26 = (a-3)^3 + 1$

It assumes the least value, if $(a-3)^3 = 0$.

$\therefore a = 3$.

72. Given, $\tan x + \sec x = 2\cos x$ .....(i)

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

$\Rightarrow (\sin x + 1) = 2(1 - \sin x)(1 + \sin x)$

$\Rightarrow (1 + \sin x)[2(1 - \sin x) - 1] = 0 \Rightarrow 2(1 - \sin x) - 1 = 0$

[$\because \sin x \neq -1$ otherwise $\cos x = 0$ and $\tan x, \sec x$ will be undefined]

$\Rightarrow \sin x = \frac{1}{2} \Rightarrow x = \frac{\pi}{6}, \frac{5\pi}{6}$ in $(0, 2\pi)$.

73. $\sin^3 x \sin 3x = \frac{1}{4}(3\sin x - \sin 3x)\sin 3x$

$= \frac{3}{8}.2\sin x \sin 3x - \frac{1}{8}.2\sin^2 3x$

$= \frac{3}{8}(\cos 2x - \cos 4x) - \frac{1}{8}(1 - \cos 6x)$

$= -\frac{1}{8} + \frac{3}{8}\cos 2x - \frac{3}{8}\cos 4x + \frac{1}{8}\cos 6x$ .....(i)

and $\sum_{m=0}^{n} c_m \cos mx = c_0 + c_1 \cos x + c_2 \cos 2x$

$+ c_3 \cos 3x + ... + c_n \cos nx$ .....(ii)

Comparing both sides of (i) and (ii), we get $n = 6$.

74. Since $\sin x + \sin^2 x = 1$,

$\Rightarrow \sin x = 1 - \sin^2 x = \cos^2 x$ .....(i)

The given expression is

$= \cos^6 x(\cos^6 x + 3\cos^4 x + 3\cos^2 x + 1) - 1$

$= \cos^6 x(\cos^2 x + 1)^3 - 1$, ($\because \sin x = \cos^2 x$)

$= (\sin^2 x + \sin x)^3 - 1 = 1 - 1 = 0$.

75. Since $A \subseteq B, \therefore A \cap B = A$

$\therefore n(A \cap B) = n(A) = 3$.