



AVIRAL CLASSES

IIT-JEE | NEET | FOUNDATIONS

ULTIMATE TEST SERIES JEE MAIN -2020

TEST-04 ANSWER KEY

Test Date :07-03-2020

[PHYSICS]

1. C

2. $v = at + \frac{b}{t+c} \Rightarrow [c] = [t] = T$;

$$[v] = [at] \Rightarrow [a] = \frac{[v]}{[t]} = LT^{-2} ;$$

$$[b] = (LT^{-1})T = L$$

3. $PV = \mu RT$ where $\mu = \frac{5}{32}$ moles

4. $\Delta U = \mu C_V \Delta T$ & $0 = W + \Delta U$
 $\Rightarrow \Delta U = -6R$ ($\because W = 6R$)

$$\text{Therefore } -6R = 1 \left(\frac{R}{\gamma - 1} \right) \Delta T = \frac{3}{2} R \Delta T$$

$$\Rightarrow \Delta T = -4 \Rightarrow T_{\text{final}} = (T - 4)K$$

5. Let time of flight be T then $T = \frac{u}{g}$

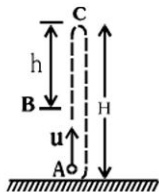
Let h be the distance covered during last 't' second of its ascent

$$\text{Velocity at point B} = v_B = u - g(T - t)$$

$$= u - g \left(\frac{u}{g} - t \right) = gt$$

$$\Rightarrow h = v_B t - \frac{1}{2} gt^2$$

$$\Rightarrow h = gt^2 - \frac{1}{2} gt^2 = \frac{1}{2} gt^2$$



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

$$\Rightarrow A^2 - \vec{A} \cdot \vec{B} + \vec{B} \cdot \vec{A} - B^2 = 0$$

$$\Rightarrow A = B (\because \vec{A} \cdot \vec{B} = \vec{B} \cdot \vec{A})$$

7. Source is stationary $\Rightarrow \lambda = \text{constant}$ & $f = \frac{v + v_s}{v}$

$$f = \left(1 + \frac{v_s}{v} \right) f = \left(1 + \frac{1}{5} \right) f = 1.2f$$

8. Use $\eta = 1 - \frac{T_2}{T_1} = \frac{W}{Q}$

9. B

10. $\frac{mv^2}{r} = \frac{Gmm}{(2r)^2}$ $v^2 = \frac{Gm}{4r}$

$$v = \frac{1}{2} \sqrt{\frac{Gm}{r}}$$

11. $\frac{g_h}{g} = \frac{R^2}{(R+h)^2}$

$$\frac{g/16}{g} = \frac{R^2}{(R+h)^2}$$

$$h = 3R$$

$$12. \quad \frac{1}{K_{eq}} = \frac{1}{K_1} + \frac{1}{K_2}$$

$$= \frac{1}{K} + \frac{1}{2K}$$

$$K_{eq} = \frac{2K}{3}$$

$$n = \frac{1}{2\pi} \sqrt{\frac{2K/3}{M}} = \frac{1}{\pi} \sqrt{\frac{K}{6M}}$$

$$13. \quad n \propto \frac{1}{\ell} \quad \frac{n_1}{n_2} = \frac{\ell_2}{\ell_1}$$

$$\frac{N}{N+5} = \frac{20}{20.5}$$

$$20.5 N = 20 N + 5 \times 20$$

$$0.5 N = 100$$

$$N = \frac{100}{0.5} = 200 \text{ Hz}$$

$$N + 5 \Rightarrow 200 + 5 = 205 \text{ Hz}$$

14. C

$$15. \quad v = \sqrt{\frac{\gamma P}{\rho}} \quad v \propto \frac{1}{\sqrt{\rho}} \quad \frac{v_1}{v_2} = \sqrt{\frac{\rho_2}{\rho_1}} = \sqrt{\frac{1}{2}} = \frac{1}{\sqrt{2}}$$

$$16. \quad \frac{\theta_1 - \theta_2}{t} = K \left[\frac{\theta_1 + \theta_2}{2} - \theta_0 \right]$$

$$\frac{70 - 60}{10} = K \left[\frac{70 + 60}{2} - \theta_0 \right] \dots (i)$$

$$\frac{60 - 54}{10} = K \left[\frac{60 + 54}{2} - \theta_0 \right] \dots (ii)$$

eq (i)/(ii)

$$\frac{10}{6} = \frac{65 - \theta_0}{57 - \theta_0}$$

$$\text{solving it } \theta_0 = 45^\circ\text{C}$$

17. D

18. D

19. A

$$20. \quad a = \frac{dV}{dt}$$

INTEGER

$$21. \quad \text{Power} = Fv = v \left(\frac{m}{t} \right) v = v^2 (\rho Av) \\ = \rho Av^3 = (100)(2)^3 =$$

$$22. \quad \frac{Q}{t} = \frac{kA(T_1 - T_2)}{\ell} \\ \frac{Q'}{t} = \frac{k \left(\frac{A}{4} \right) (T_1 - T_2)}{4\ell} = \frac{1}{16} \frac{kA(T_1 - T_2)}{\ell} \\ \Rightarrow Q' = \frac{Q}{16}$$

$$23. \quad \text{For given conditions } mg = m\omega^2 a = ka \\ \Rightarrow a = \frac{mg}{k} = \frac{2 \times 10}{200} \\ = 0.1 \text{ m} = 10 \text{ cm}$$

$$24. \quad \text{Solar constant} = \frac{\sigma(4\pi r^2)T^4}{(4\pi R^2)} \\ = \frac{\sigma r^2(t + 273)^4}{R^2}$$

$$\therefore x = a \sin \omega t$$

$$\therefore \frac{a}{2} = a \sin \omega t \quad \Rightarrow \omega t = \frac{\pi}{6}$$

$$\Rightarrow \left(\frac{2\pi}{T} \right) t = \frac{\pi}{6} \quad \Rightarrow t = \frac{T}{12}$$

[CHEMISTRY]

26. $(v_{\text{rms}})_{\text{SO}_2} = (v_{\text{rms}})_{\text{O}_2}$

$$\sqrt{\frac{3RT_{\text{SO}_2}}{64}} = \sqrt{\frac{3R \times 303}{32}}$$
27. [Metallic character \propto size]
 28. D
 29. D
 30. D
 31. B
 32. Intermolecular attraction $\propto a$
 33. A
 34. C
 35. A
36. Calculated $\mu = q \times d$
 $= 4.8 \times 10^{-10} \text{ esu} \times 187.5 \times 10^{-10} \text{ cm}$
 $= 9 \times 10^{-18} \text{ esu cm}$
 $= 9 \text{ Debye} (1 \times 10^{-18} \text{ esu cm} = 1 \text{ Debye})$
 Observed $\mu = 0.63 \text{ Debye}$

$$\% \text{ Ionic character} = \frac{\mu_{\text{observed}}}{\mu_{\text{calculated}}} \times 100$$

$$= \frac{0.63}{9} \times 100 = 7\%$$
37. M.P. \propto lattice energy of the crystal $\propto \frac{1}{r^+ + r^-}$
 38. D
 39. D
 40. D
 41. B
 42. A
 43. Option 4th is of weak base remaining all are salts of SAWB which have pH less than seven
 44. D
 45. B

INTEGER

46. 4
 47. 4
 48. 4
 49. Square pyramidal geometry = sp^3d^2 (5 Bond pair + 1 lone pair)
 50. 3

[MATHEMATICS]

51. **Ans. (2)**

$$\frac{1 + i \cos \theta}{1 - 2i \cos \theta} = \frac{(1 + i \cos \theta)(1 + 2i \cos \theta)}{(1 - 2i \cos \theta)(1 + 2i \cos \theta)}$$

$$= \frac{1 - 2 \cos^2 \theta + 3i \cos \theta}{1 + 4 \cos^2 \theta}$$
 is a real number only if $\frac{3 \cos \theta}{1 + 4 \cos^2 \theta} = 0$
 i.e. if $\cos \theta = 0$
 i.e. if $\theta = (2n + 1)\pi/2, n \in I$
 So (b) is correct alternative.
52. **Ans. (3)**

$$m = \sum P_i \cdot x_i = \frac{1}{2} + \frac{1}{2} = 1$$

$$\sigma^2 = \sum P_i (m - x_i)^2 = \frac{1}{3} + \frac{4}{6} = 1$$
53. **Ans. (3)**

$$\frac{4 \sin 9^\circ \sin 21^\circ \sin 39^\circ \sin 51^\circ \sin 69^\circ \sin 81^\circ}{\sin 54^\circ}$$

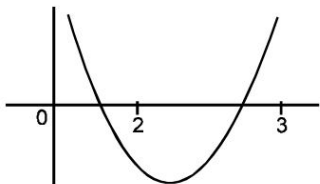
$$= \frac{4 \sin 9^\circ \cos 9^\circ \cdot \sin 39^\circ \cos 39^\circ \sin 21^\circ \cos 21^\circ}{\sin 54^\circ}$$

$$= \frac{\sin 18^\circ \cdot \sin 78^\circ \sin 42^\circ}{2 \sin 54^\circ}$$

$$= \frac{\sin 18^\circ}{4} \cdot \frac{(\cos 36^\circ + \cos 60^\circ)}{\sin 54^\circ} = \frac{1}{8}$$

54 Ans. (1)

$$x^2 - \frac{2p}{p-5}x + \frac{p-4}{p-5} = 0$$



$$f(0) > 0, f(2) < 0, f(3) > 0$$

$$f(0) > 0 \Rightarrow \frac{p-4}{p-5} > 0 \dots (1)$$

$$f(2) < 0 \Rightarrow \frac{p-24}{p-5} < 0 \dots (2)$$

$$f(3) > 0 \Rightarrow \frac{4p-49}{p-5} > 0 \dots (3)$$

Intersection of (1) (2) & (3) gives $(\frac{49}{4}, 24)$

55 Ans. (3)

$${}^nC_1 \cdot 2^1 + {}^nC_2 \cdot 2^2 + {}^nC_3 \cdot 2^3 + \dots + {}^nC_n \cdot 2^n$$

$$(1+2)^n = {}^nC_0 + {}^nC_1 \cdot 2^1 + {}^nC_2 \cdot 2^2 + \dots + {}^nC_n \cdot 2^n$$

$$(3^n - 1) = {}^nC_1 \cdot 2^1 + {}^nC_2 \cdot 2^2 + \dots + {}^nC_n \cdot 2^n$$

56. Ans. (1)

Let d_1 & d_2 are the distance of point (1, 2) from the bisector B_1 & B_2 .

$$d_1 = \frac{|3+8-7|}{5} = \frac{4}{5}$$

$$d_2 = \frac{|4-6-14|}{5} = \frac{16}{5}$$

$$\therefore d_1 < d_2$$

$\therefore B_1$ is an acute angle bisector

57. Ans. (2)

As altitude from A is fixed and orthocentre lies on altitude hence $x + y = 3$ is required locus.

58. Ans. (4)

$$\ln(m \sin x + 4) \geq 0 \Rightarrow m \sin x + 4 \geq 1$$

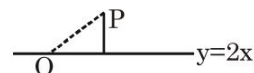
$$m \sin x \geq -3 \Rightarrow m \in [-3, 3]$$

7 possible integral values.

59. Ans. (2)

$P(x, y)$

$$OP = 3PM$$



$$\sqrt{x^2 + y^2} = 3 \frac{|2x - y|}{\sqrt{5}}$$

$$\Rightarrow 5(x^2 + y^2) = 9(4x^2 + y^2 - 4xy)$$

$$31x^2 + 4y^2 - 36xy = 0 \text{ pair of st. line}$$

Aliter focus is (0,0) and $y = 2x$ directrix,

$$e = 3$$

focus lies on directrix therefore locus is pair of st. line.

60. Ans. (2)

$$\frac{24}{7} > -\frac{3}{4} > -3$$

$$\tan A = \frac{\frac{24}{7} + \frac{3}{4}}{1 - \frac{24}{7} \cdot \frac{3}{4}} = -\frac{117}{51}$$

$$\tan B = \frac{-\frac{3}{4} + 3}{1 + \frac{9}{4}} = \frac{9}{13}$$

$$\tan C = \frac{-3 - \frac{24}{7}}{1 - 3 \cdot \frac{24}{7}} = \frac{45}{65} = \frac{9}{13}$$

61. Ans. (3)

$$\frac{bc}{(-b^3)(-c^3)} + \frac{ac}{(-a^3)(-c^3)} + \frac{ab}{(-a^3)(-b^3)}$$

$$= \frac{a^2 + b^2 + c^2}{a^2b^2c^2} = \frac{(a + b + c)^2 - 2\sum ab}{(abc)^2}$$

$$= \frac{0 - 16}{(-1)^2} = -16$$

62. Ans. (3)


$$\left(\frac{11}{7}\right)^2 + \left(\frac{12}{7}\right)^2 + \left(\frac{13}{7}\right)^2 + \dots$$

$$= \frac{1}{7^2} [(11)^2 + (12)^2 + \dots + (21)^2]$$

$$= \frac{1}{7^2} \left[\frac{21 \cdot 22 \cdot 43}{6} - \frac{10 \cdot 11 \cdot 21}{6} \right]$$

$$\frac{1}{49} \cdot \frac{21}{6} \cdot 11(86 - 10) = \frac{11}{14} \cdot 76 = \frac{11}{7} \cdot 38$$

63. Ans. (2)

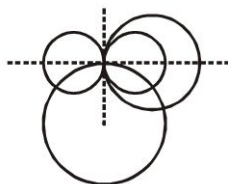
$$x^2 + 5x + \frac{17}{8} = -x^2 + 4x + 2$$


$$\Rightarrow 2x^2 + x + \frac{1}{8} = 0 \Rightarrow x = -\frac{1}{4}$$

$\Rightarrow P_1$ and P_2 touches each other

64. Ans. (2)

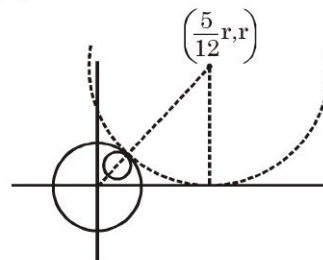
$$2x + 3y = 26$$



65. Ans. (1)

$a - 2, a + 2$
 $a - 2 < 1$ & $a + 2 > 6$
 $a < 3$ & $a > 4$ not possible

66. Ans. (4)



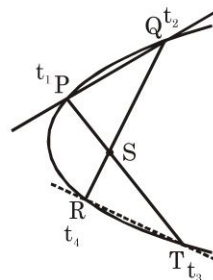
$$\frac{13}{12}r - r = 20 \Rightarrow r = 240$$

67. Ans. (3)

$$\left(\frac{3x + 4y}{\sqrt{3^2 + 4^2}}\right)^2 = \frac{1}{5} \left(\frac{4x - 3y}{\sqrt{4^2 + 3^2}}\right)^2$$

$$LR = \frac{1}{5}$$

68. Ans. (3)



$$t_1 t_3 = t_2 t_4 = -1$$

$$PQ : y(t_1 + t_2) = 2x + 4t_1 t_2$$

$$3(t_1 + t_2) = -4 + 4t_1 t_2 \dots\dots(1)$$

$$TR : y(t_3 + t_4) = 2x + 4t_3 t_4 \dots\dots(2)$$

$$\text{from (1) } -3\left(\frac{1}{t_3} + \frac{1}{t_4}\right) = -4 + \frac{4}{t_3 t_4}$$

$$\Rightarrow 3(t_3 + t_4) = 4t_3 t_4 - 4 \dots\dots(3)$$

using (2) and (3) we can say that TR passes through $(-2, 3)$

69. Ans. (3)

$$X^2 = 4Y, X^2 + \frac{Y^2}{2} = 1$$

$$y = mx - m^2$$

$$y = mx - \sqrt{m^2 + 2}$$

$$m^2 = \sqrt{m^2 + 2}$$

$$\Rightarrow m^4 - m^2 - 2 = 0$$

$$m^2 = 2, -1 \Rightarrow m$$

$$m_1^2 + m_2^2 = 4$$

70. Ans. (3)

$$y = x^2, z = y^3 \Rightarrow z = x^6$$

$$\log_x z = 6$$

INTEGER

71.

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

72.

Ellipse and circle touches each other at (2,0)

\therefore Length of common chord = 0

73.

$$f(a^2) - 3f(a) = 0$$

$$\Rightarrow (a^4 + a^2 + 1) - 3(a^2 + a + 1) = 0$$

$$\Rightarrow (a^2 + a + 1)(a^2 - a + 1) - 3(a^2 + a + 1) = 0$$

$$\Rightarrow (a^2 + a + 1)(a^2 - a - 2) = 0$$

74.

$f(x) = 2$ has 3 solutions $x = -3, 1/2, \alpha$ where $(2 < \alpha < 3)$.

Now $f(x) = -3$ has no solution

$f(x) = 1/2$ has 2 solutions

$f(x) = \alpha$ has 2 solutions

So, $f(f(x)) = 2$ has 4 solutions

75.

$f(x)$ is symmetrical about the line $x = 7$.

Let x_1, x_2, x_3, x_4 and x_5 are the real and distinct

roots of $f(x) = 0$. Then $x_3 = 7, \frac{x_1 + x_5}{2} = 7,$

$$\frac{x_2 + x_4}{2} = 7.$$

$$S = x_1 + x_2 + x_3 + x_4 + x_5 = 35$$

$$S/7 = 5$$