AVIRAL CLASSES
CREATING SCHOLARS

JEE (ADVANCED), PMT & FOUNDATIONS

MOCK TEST JEE-2020
TEST-01 SOLUTION

Test Date :20-03-2020

[PHYSICS]

1.

Ans. (2)
If L is initial length mass

$a = L + \frac{4L}{\pi r^2 y}$ ....(i)

$b = L + \frac{5L}{\pi r^2 y}$ ...(ii)

Then $x = L + \frac{9L}{\pi r^2 y}$ ...(iii)

From (i), (ii) & (iii)
x = 5b – 4a Ans.

2.

Ans. (3)

$\rho = \frac{m}{ne^2\tau}$

$\tau = \frac{9\times10^{-31}}{0.9\times10^{28}\times\left(1.6\times10^{-19}\right)^2\times1.7\times10^{-8}}$

$= 2.3 \times 10^{-13}$

3.

Ans. (3)

$\tan 30 = \frac{v}{H+B}$ & $\tan 60 = \frac{v}{H-B}$

on solving $B = \frac{H}{2} = \frac{3\times10^{-5}}{2}T$

$B = \frac{\mu_0 NI}{2r}$ so I = 0.075 A

4.

Ans. (2)

Current sensitivity $C = \frac{BAN}{R}$

I = same K = same

so $B \propto \frac{C}{AN}$

5.

EM Wave propagates in the direction parallel to $(\vec{E}\times\vec{B})$

6.

Ans. (3)
By applying wet
$KE_f - KE_1 = w_g$

$\frac{1}{2}I\omega^2 = \frac{mg(\ell+\ell/2)}{2}$

$\omega = \sqrt{\frac{9g}{2\ell}}$

$\omega = 3\sqrt{10}$

7.

Ans. (1)
At t = 0, when switch was just closed, capcitor act as no resistance path, so all current will go through it.
At t = ∞, capacitor acts as ∞ resistance path, so, no current will flow through it.

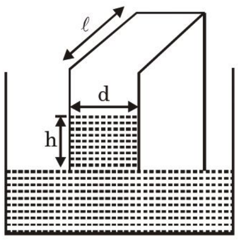
8. (2)
9.

Ans. (4)

$\vec{a} = \frac{d^2\vec{r}}{dt^2}$

10. (1)
11.

Ans. (2)



Force due to surface tension
= weigh of liquid
$20\ell = \rho(d\ell h)\, g$

$h = \dfrac{2\sigma}{\rho d g}$

12. (2)

13.

Ans. (4)

$T = 2\pi\sqrt{\dfrac{I}{mgd}}$; $d = 7r$

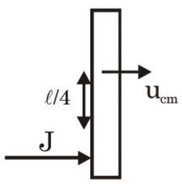
$I = \dfrac{2}{5}m(5r)^2 + m(7r)^2$

$= 59mr^2$

14.

Ans. (3)

Impulse momentum theorem



$J = M\vec{V}_{cm} - M\vec{u}$

$\vec{V}_{cm} - \vec{u}_{cm} = \dfrac{J}{M}$ ....(i)

By angular impulse momentum theorem

$\dfrac{JL}{4} = \dfrac{ML^2}{12}\omega$

$\omega = \dfrac{3J}{ML}$ ....(ii)

$\vec{V}_P = \vec{V}_{cm} + \omega R$

By (i) & (ii)

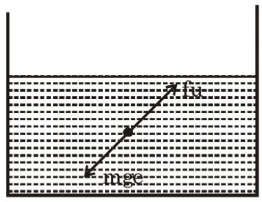
$2u = \dfrac{J}{M} + u + \dfrac{3J}{ML} \times \dfrac{L}{4}$

$u = \dfrac{7J}{4M} \Rightarrow \dfrac{J}{M} = \dfrac{4}{7}u$

$\vec{V}_{cm} = u_{cm} + \dfrac{J}{M} = \dfrac{11}{7}u$

15.

Ans. (3)



For terminal velocity
Net force must be zero
$\therefore f_g = fv$ [$f_B = 0$ due to negligible size]

$m\sqrt{g^2 + a^2} = 6\pi\eta r v$

$v = \dfrac{m\sqrt{g^2 + a^2}}{6\pi r \eta}$

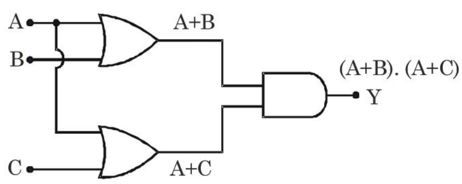
16.

Ans. (3)

Equation for $\vec{E}$ gives directions of propagation of EM wave, which it + z axis and direction of propagation is parallel to $(\vec{E} \times \vec{B})$. So $\hat{k} = (\hat{E} \times \hat{B})$

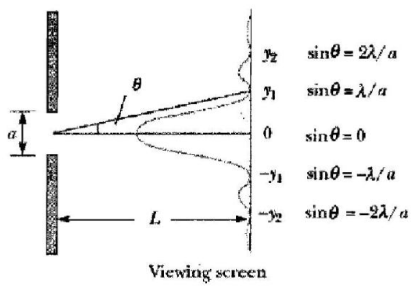
17.

Ans. (3)



18.

Ans. (1)



Single slit difrection

from ques

$\dfrac{2\lambda L}{a} = \dfrac{10\lambda D}{d}$

$a = \dfrac{2d}{10} = 0.2\text{mm}$

19.

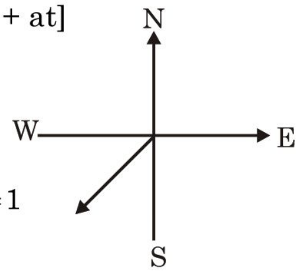
Ans. (1)

$V_{wind} = -\vec{V}\hat{i}$

$V_{Man} = +\vec{V}_m\hat{j}$ $[V_m = u + at]$

$= at\hat{j}$

$V_{wind\,Man} = V\hat{i} - at\hat{j}$



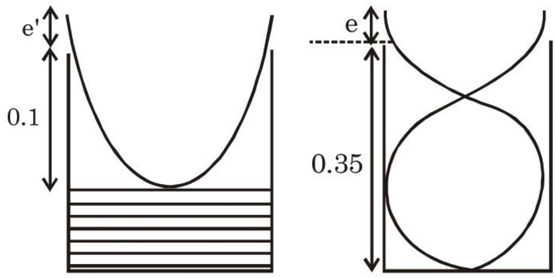
$\Rightarrow \frac{V}{at} = \tan\theta \Rightarrow \frac{V}{at} = 1$

$\theta = 45$

$t = \frac{v}{a}$

20.

Ans. (2)



$\frac{\lambda}{4} = 0.1 + e$

$\lambda = 0.4 + 4e$ ....(i)

$\frac{3\lambda}{4} = 0.35 + e$

$3\lambda = 1.4 + 4e$ ....(ii)

From (i) and (ii)

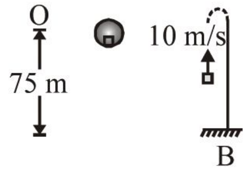
$1.2 + 12e = 1.4 + 4e$

$8e = \mathbf{0.2}$

$e = \frac{0.2}{8} = \mathbf{0.025}$

21. Taking O as origin.

O to B : displacement = – 75m



$h = ut - \frac{1}{2}gr^2$

$-75 = 10t - 5t^2$

$t^2 - 2t - 15 = 0$

$(t - 5)(t + 3) = 0$

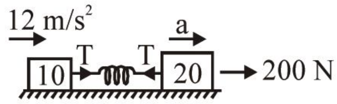
$t = 5$ s

$t = -3$ s, not possible

22. $v_{A/B} = 20 + 30 = 50$ m/s

$t = \frac{l_A + l_B}{50} = \frac{120 + 130}{50} = 5$ s

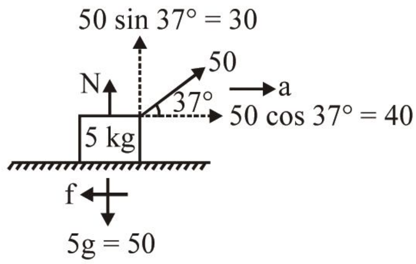
23.



$T = 10 \times 12 = 120$

$200 - T = 20a \Rightarrow a = 4$ m/s²

24.

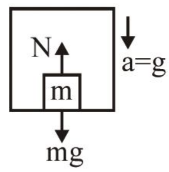


$\uparrow$: $N + 30 = 50 \Rightarrow N = 20$

$f_{max} = \mu N = \frac{1}{2} \times 20 = 10$

$\rightarrow$: $40 - 10 = 5a \Rightarrow a = 6$ m/s²

25. The lift is falling freely (a=g)



N = 0

f = 0

[CHEMISTRY]

26. (4)
27. (2)
28.

Ans (3)

$N_2O_5 + H_2O \rightarrow 2HNO_3$

Meq of $HNO_3 = 10 \times 0.1 \times 2 \times 10 = 20$, mmole of $N_2O_5 = 10$

$\therefore V_{N_2O_5} = 10 \times 10^{-3} \times 22400 = 224$ ml

$\therefore$ % by volume $= \frac{224}{250} \times 100$

29. (3)
30. (1)
31.

Ans (4)

A = 3 , B = 4 , C = 6

32.

Ans (1)

$$\begin{array}{ccccc} 2M & 1M & & 7M & 3M \\ 2A(g) & +\ B(g) & \rightleftharpoons & C(g)\ + & D(g)\ ;\ K_C = 10^{12} \\ 2-2X & 1-X & & 8M & 4M \end{array}$$

$10^{12} = \frac{8 \times 4}{B(2B)^2}$, $[B] = 2 \times 10^{-4}M$,

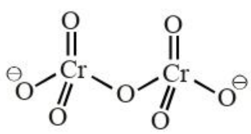
$[A] = 2 \times [B] = 4 \times 10^{-4}M$

33. (3)
34. (3)
35.

Ans (2)

$\Delta H^0 = T\Delta S^0 = 273 \times 20 = 5460J$

36. (2)
37. (3)
38. (1)
39. (3)
40. (1)
41. (4)
42. (4)
43. (1)
44. (2)
45. (4)
46. 4
47. 9
48. 3
49. $Cr_2O_7^{-2}$



50. 7

[MATHEMATICS]

51.

Ans. (2)

$f(x) = \prod_{r=1}^{100} (x - r)^{r.(101-r)}$

$\ell n f(x) = \sum_{r=1}^{100} r(101 - r)\ell n(x - r)$

differentiate

$\frac{f'(x)}{f(x)} = \sum_{r=1}^{100} \frac{r(101-r)}{x-r} \Rightarrow \frac{f'(101)}{f(101)} = \sum_{r=1}^{100} r = 5050$

52.

Ans. (3)

$F(x) - 2017 + x = x(x - 1)(x - 2)....(x - 2017)$

$\therefore F(2018) = 1.2.3.....2018 - 1$

$= 2018! - 1$

53.

Ans. (4)

$f(n) = \sum_{r=1}^{n} (r+1)(r+\omega)(r+\omega^2) = \sum_{r=1}^{n} r^3 + 1$

$f(n) = \frac{x^2(x+1)^2}{4} + n \Rightarrow f(19) = \frac{19^2(20)^2}{4} + 19$

$= 36119$

54.

Ans. (3)

Let $z = x + iy$

Given equation is $x^2 + y^2 + 4x - 5 = 0$.

It is a circle with center (–2,0) and r = 3.

Now let $x + iy + 3 + 2i = h + ik$

(h,k) will lie on circle with center (1,2) and radius 3.

55.

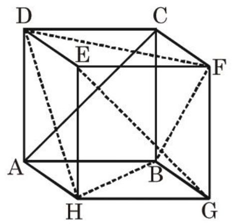
Ans. (4)

$f'(f(x)).f'(x) = \underbrace{\lambda\left[7x^6 + 2\right]}_{\substack{\text{either +veor –ve} \\ \text{depending on } \lambda.}}$

$\therefore f(x)$ has to be either $\uparrow$ or $\downarrow$

56.

Ans. (1)



Consider AC as a fixed face diagonal.

As shown, DH,DF,BH,BF and EG will be face diagonals skew to it (FH will be parallel)

Corresponding to each of 12 face diagonals, we have 5 skew line pairs

$\therefore$ Reqd value = $\frac{12\times 5}{2}$

{$\because$ each pair is counted twice}

57.

Ans. (3)

$p\to(p\vee q)$ and $q\to(p\to q)$ are both tautologies.

58.

Ans. (2)

variance = $3^2 = 9$.

$\therefore\ 9 = \frac{\Sigma x_i^2}{n} - \bar{x}^2 = \frac{\Sigma x_i^2}{200} - 48^2$

$\Rightarrow \Sigma x_i^2 = 462600$

59.

Ans. (4)

$\frac{x^2}{18} - \frac{y^2}{9} = 1$ $\qquad y = -x + k$

$\therefore\ m = -1.$

for tangent : $k^2 = 18(-1)^2 - 9 \Rightarrow k^2 = 9$

$\Rightarrow$ sum of squares of possible values = 18.

60.

Ans. (1)

$h'(x) = 2f(x).f'(x) + 2f'(x).f''(x)$

put $f''(x) = -f(x) - x.g(x).f'(x)$

$\therefore\ h'(x) = -2x.g(x).(f'(x))^2$

61.

Ans. (3)

$\alpha + \sin\beta = 2018$

$\alpha + 2018\cos\beta = 2017$

$\therefore\ \sin\beta = 1 + 2018\cos\beta \Rightarrow \beta = \frac{\pi}{2}$ (only)

$\therefore\ \alpha = 2017.$

$\therefore\ [\alpha + \beta] = \left[2017 + \frac{\pi}{2}\right] = 2018$

62.

Ans. (2)

$\frac{x^2}{8/9} - \frac{y^2}{8/9} = 1$

$y = mx \pm \sqrt{\frac{8}{9}m^2 - \frac{8}{9}}$

$y = mx + \frac{8}{m}$

comparing : $\frac{8}{m} = \pm\sqrt{\frac{8}{9}m^2 - \frac{8}{9}}$

$\Rightarrow m = 3,-3$

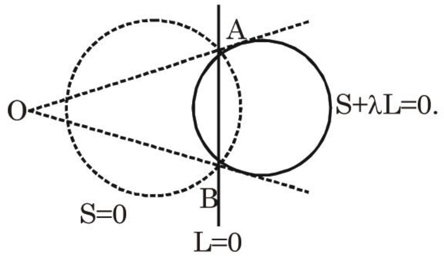
$y = 3x + \frac{8}{3}; y = -3x - \frac{8}{3}$

at $y = 0$: $x = -\frac{8}{9}$

63.

Ans. (4)

$$\underbrace{x^2+y^2+8x+8y+16}_{S}+\lambda\underbrace{(x+y+12)}_{L}=0$$



AB is COC of required circle which is same as L = 0.

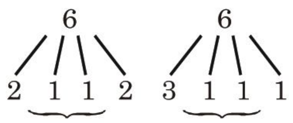
$$\text{COC}:\left(\frac{8+\lambda}{2}\right)x+\left(\frac{8+\lambda}{2}\right)y+16+12\lambda=0$$

L : x + y + 12 = 0.

comparing, we get $\lambda=\frac{16}{3}$

64.

Ans. (4)



(1,1,1,3) selection of boxes in $^3C_1.2$ ways

(1,1,2,2) selection of boxes in $^3C_2.^3C_2$ ways

Total number of selections = 6 + 9 = 15

Total reqd. arrangements = 15 × 6! = 10800.

65.

Ans. (2)

P(A wins) = $\frac{9}{14}$; P(B wins) = $\frac{5}{14}$

$$P(\text{req.})=\frac{9}{14}\left(\frac{2}{6}\right)+\frac{5}{14}\left(\frac{2}{4}\right)=\frac{11}{28}.$$

66.

Ans. (4)

$$V_1=\left[\vec{\alpha}\ \vec{\beta}\ \vec{\gamma}\right]$$

$$V_1=\left[\vec{a}-4\vec{b}+2\vec{c}\quad \vec{a}+\vec{b}-2\vec{c}\quad 3\vec{a}-2\vec{b}+\vec{c}\right]$$

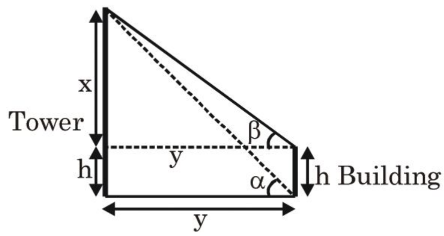
$$\Rightarrow V_1=\begin{vmatrix}1&-4&-2\\1&1&-2\\3&2&1\end{vmatrix}\left[\vec{a}\ \ \vec{b}\ \ \vec{c}\right]$$

$$\Rightarrow V_1=35\left[\vec{a}\ \ \vec{b}\ \ \vec{c}\right]$$

$$V_2=\frac{1}{6}\left[\vec{a}\ \ \vec{b}\ \ \vec{c}\right]\Rightarrow\therefore\frac{V_1}{V_2}=210$$

67.

Ans. (2)



$$\tan\beta=\frac{x}{y}$$

$$\tan\alpha=\frac{x+h}{y}$$

$$\Rightarrow\tan\alpha=\frac{x+h}{x\cot\beta}$$

$$\Rightarrow x=\frac{h\cot\alpha}{\cot\beta-\cot\alpha}$$

$$\therefore\ h+x=\frac{h\cot\beta}{\cot\beta-\cot\alpha}$$

68.

Ans. (1)

$$\frac{x-1}{2}=\frac{y-2}{3}=\frac{z-3}{4}=a\qquad\text{...(i)}$$

$$\frac{x-4}{1}=\frac{y-6}{2}=\frac{z+\lambda}{2}=b\qquad\text{...(ii)}$$

by (i) and (ii) : a = 2; b = 1 ⇒ 4a + 3 = 2b – λ

⇒ λ = –9

69.

Ans. (3)

$\lim_{x\to 1} x^{\log_x e} = e$

70.

Ans. (1)

$6\cot\theta = \cot(\theta + \alpha) + \cot(\theta - \alpha)$

$\Rightarrow \frac{6\cos\theta}{\sin\theta} = \frac{\sin 2\theta}{\sin(\theta+\alpha).\sin(\theta-\alpha)}$

$\Rightarrow \frac{6\cos\theta}{\sin\theta} = \frac{2\sin\theta\cos\theta}{\sin^2\theta - \sin^2\alpha}$

$\Rightarrow 3\sin^2\theta - 3\sin^2\alpha = \sin^2\theta$

$\Rightarrow 2\sin^2\theta = 3\sin^2\alpha$

71. Both $\cot^{-1}2x$ and $\cos^{-1}x$ are always non negative, hence no solution.

72.

$AA^T = \begin{bmatrix} x & y & z \\ y & z & x \\ z & x & y \end{bmatrix}\begin{bmatrix} x & y & z \\ y & z & x \\ z & x & y \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

$\Rightarrow x^2 + y^2 + z^2 = 1; xy + yz + zx = 0.$

$\because (x + y + z)^2 = x^2 + y^2 + z^2 + 2(xy + yz + zx)$

$\Rightarrow x + y + z = 1$ or -1(reject)

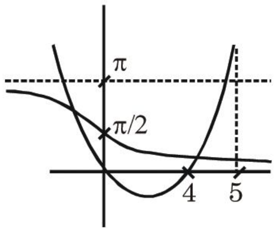
$\therefore x + y + z = 1$

$\therefore x^3 + y^3 + z^3$

$= (x + y + z)(x^2 + y^2 + z^2 - xy - yz - zx) + 3xyz$

$= 1(1 - 0) + 3.1 = 4.$

73.



at $x = 5 : 25 - 4(5) = 5$

(more than $\frac{\pi}{2}$)

74.

$f(x) = \begin{cases} \sin x & x \in \left[0, \frac{\pi}{2}\right] \\ 2 - \sin x & x \in \left(\frac{\pi}{2}, \pi\right] \\ 2 + \sin x & x \in \left(\pi, \frac{3\pi}{2}\right] \\ -\sin x & x \in \left(\frac{3\pi}{2}, 2\pi\right) \end{cases}$

continuous $\forall$ x, non derivable at $x = \pi$.

75.

$(1 - 2x + 5x^2 + 10x^3)(C_0 + C_1x + C_2x^2 + ...)$

$a_1 = n - 2; a_2 = C_2 - 2C_1 + 5C_0 ; a_0 = 1.$

$= \frac{n(n-1)}{2} - 2n + 5$

$\because a_1^2 = 2a_2 \Rightarrow n = 6.$