AVIRAL CLASSES
CREATING SCHOLARS
JEE (ADVANCED), PMT & FOUNDATIONS

MOCK TEST JEE-2020
TEST-04 SOLUTION
Test Date :07-01-2020

[PHYSICS]

1.

Ans. (2)

$$I = \frac{I_0}{2} \times \cos^2 30° \times \cos^2 30°$$

$$= \frac{9I_0}{32}$$

2. (2)
3.

Ans. (1)

$$b = \frac{F}{v} = \frac{120}{1}, \; r = \frac{b}{2m} = \frac{60}{7000 \times 2}$$

$$\omega = \sqrt{\omega_0^2 - r^2}$$

$$kx = F$$

$$k = \frac{450}{2} = 225 = \sqrt{\frac{225}{700} - \frac{60^2}{700^2}}$$

$$= \sqrt{\frac{225 \times 700 - 3600}{700^2}} = 0.56 \text{ rad/s}$$

4.

Ans. (3)

$$\lambda = \frac{1}{\sqrt{2}\pi\sigma^2 n *}$$

$$\lambda^2 = \lambda_x{}^2 + \lambda_y{}^2 + \lambda_z{}^2$$

$$\lambda_x = \frac{\lambda}{\sqrt{3}}$$

5. (3)
6. (3)
7.

Ans. (2)

$\Delta f = 1.5$ MHz

$f_{modulating} = 750$ kHz

8. (4)
9.

Minimum magnifying power $\Rightarrow$ Image is at ∞

$$m = \frac{D}{f} = \frac{\theta}{\theta_0}$$

for microscope $d_{min} = \dfrac{0.61\lambda}{\sin\alpha}$

$$\frac{d_{min}}{D} = \theta_0 = \frac{0.61\lambda}{D\sin\alpha}$$

for eye, $\theta_{min} = \dfrac{1.22\lambda}{d} = \theta$

$$m_{min} = \frac{\frac{1.22\lambda}{d}}{\frac{0.61\lambda}{D\sin\alpha}} = \frac{2D\sin\alpha}{d} = 30$$

10.

Ans. (2)

$$\omega = \frac{1}{\sqrt{LC}}$$

$$= \frac{1}{\sqrt{\mu_0 n^2 A\ell \times \frac{\epsilon_0 A_1}{d}}} = \frac{1}{\sqrt{\frac{\mu_0 N^2}{\ell} A \times \frac{\epsilon_0 A_1}{d}}}$$

$$\Rightarrow \omega = \frac{\omega_0}{2}$$

11.

Ans. (3)

$$\frac{1}{2f\sqrt{\mu}} = 8\times10^{-3}$$

$$\frac{1}{2\times10^{-2}\times8\times10^{-3}} = f$$

$$f = \frac{10^5}{16} = \frac{100\times100\times10}{4\times4}$$

$= 6250$ Hz

$$\frac{\Delta f}{f} = \frac{1}{2}\frac{\Delta\mu}{\mu} + \frac{\Delta \text{slope}}{\text{slope}}$$

$$= \frac{1}{10} + \frac{0.3}{80} = \frac{11}{80}$$

$$\Delta f = 6250\times\frac{11}{80} = 859.8\text{Hz}$$

12.

Ans. (2)

$Mg - B = Mf$

$B - (M - CM)g = (M - CM)f$

$CMg = (2M - CM)f$

$Cg + Cf = 2f$

$$C = \frac{2f}{g+f}$$

13.

Ans. (3)

$0 = 40\ S_A + 40S_P$

$S_A = -S_P = 60$ cm

$S_P = -60$ cm.

14.

Ans. (1)

$$v = \sqrt{\frac{B}{\rho}}$$

$B = \rho v^2 = 5.4^2 \times 10^6 \times 2.7 \times 10^3$

$= 7.9 \times 10^{10}$ Pa

15. (3)

16.

Ans. (1)

$$f = C \times 1^2\left(\frac{1}{1^2} - \frac{1}{9}\right) = \frac{8}{9}C$$

$$f' = C \times 3^2\left(\frac{1}{1^2} - \frac{1}{2^2}\right) = \frac{27}{4}C = \frac{27}{4}\times\frac{9f}{8}$$

17. (1)

18.

Ans. (3)

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$\mu_v > \mu_R$

$\Rightarrow f_v < f_R$

19.

Ans. (4)

$$v = -\frac{kQ^2}{a}\times5 + \frac{kQ^2}{a}\times7$$

$$-\frac{kQ^2}{\sqrt{2}a}\times7 + \frac{kQ^2}{\sqrt{2}a}\times5 + \frac{2kQq}{\frac{\sqrt{3}a}{2}}$$

$$= \frac{2kQ^2}{a} - \frac{2kQ^2}{\sqrt{2}a} + \frac{4kQq}{\sqrt{3}a}$$

20.

Ans. (2)

$$R_1 = \frac{2\ell}{kA}$$

$$R_2 = \frac{3\ell}{kA}$$

heat goes in inverse ratio of resistance

$$i_1 = \frac{T_A - T_C}{R_1} = \frac{T_B - T_C}{R}$$

$$i_2 = \frac{T_A - T_C}{R_2} = \frac{T_D - T_C}{R}$$

dividing, $\dfrac{R_2}{R_1} = \dfrac{T_B - T_C}{T_D - T_C}$

$3T_D - 3T_C = 2T_B - 2T_C$

$T_C = 3T_D - 2T_B$

21. **5**
22. **3**
23. **2** $i_E \approx i_C = 10^{-3}$ A

$v_{R_1} = 2.5V$

$v_{R_2} = 5V$

24. **4**
25. **3**

[CHEMISTRY]

26.

Ans (4)

$$U_{avg.} = \sqrt{\frac{8\times\pi\times10\times10^5\times8}{2\times\pi\times32\times10^{-3}}} = \sqrt{10^9} \text{ m/sec.}$$

27.

Ans. (3)

$$(\Delta S_r)_{T_2} - (\Delta S_r)_{T_1} = (\Delta C_p)_r \ \ln\frac{T_2}{T_1}$$

(A) It depends on $(\Delta C_p)_r$

(B) It depends on $(\Delta C_p)_r$

(C) $k = 4e^{-Ea/RT}$

(D) Activation energy is independent of temperature

28. (1)
29.

Ans. (3)

A	B	C	D
1	3	3	8

30.

Ans. (4)

contribution due to water can not be neglected

$H_2O \rightarrow \quad H^+ \quad + \quad OH^-$

$\qquad\qquad x \qquad\qquad 2\times10^{-7} + x$

$10^{-14} = x\,[2\times10^{-7} + x]$

$x^2 + 2\times10^{-7}x + 10^{-14} = 0$

$$x = \frac{-2\times10^{-7} + \sqrt{4\times10^{-14} + 4\times10^{-14}}}{2}$$

$= \left(\sqrt{2}-1\right)\times10^{-7}$

$= 0.414\times10^{-7}$

$[OH^-] = 2\times10^{-7} + 0.414\times10^{-7}$

$= 2.414\times10^{-7}$

$Ksp = [B^+]\,[OH^-]^2$

$= [10^{-7}]\,(2.414\times10^{-7})^2$

$= 5.82\times10^{-21}$

31. (3)

Angular part $= \left(\frac{15}{4\pi}\right)^{1/2} \sin\theta\cos\theta\sin\phi$

where θ = angle from z – axis

so, l(angular) = ?

here, in angular node θ lie in XY and XZ plane due to head to head overlaping situation of orbitals by sidewise axis of Z

32.

Ans.(1)

Moles of $C_6H_{12}O_6$ required $= \frac{75000\times10\times10}{180}$

Moles of CO_2 required

$= \frac{75000\times10\times10}{180}\times6 = 2500\times100 = 2.5\times10^5$ mol.

33.

Ans. (1)

In alkalimetals down the group hardness decreases due to decrease in metallic bond strength.

34.

Ans. (3)

In $[Ni(CO)_3(PMe_3)]$ extent of synergic bonding towards CO will be maximum. So C–O bond order will be minimum hence C–O bond length will be maximum.

35.

Ans. (4)

Due to poor metallic bonding in Zn enthalpy of atomisation is lowest.

36.

Ans. (1)

$\overset{+5}{VO_2^{\oplus}}$, $\overset{+6}{Cr_2O_7^{2-}}$, $\overset{+7}{MnO_4^{\ominus}}$

37.

Ans.(1)

(1) Monds process

38.

Ans.(4)

All are soluble in aqua regia

39.

Ans. (1)

$Mn(OH)_2 + H_2O_2 \rightarrow MnO(OH)_2 + H_2O$

40.

Ans.(2)

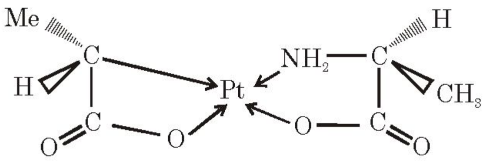
$K_4\left[\overset{+2}{Fe}(CN)_5(O_2)\right]$ is paramagnetic due to $O_2^{\ominus}$

$[NiF_6]^{2-} \rightarrow d^2sp^3$ hybridisation, diamagnetic

$[Fe(H_2O)_5(NO)]^{+2} \rightarrow$ paramagnetic

41.

Ans.(2)



is optically active due to absence of P.O.S.

42.

Ans.(1)

$H_2O \rightarrow sp^3$ hybridisation, V-shape

$NH_3 \rightarrow sp^3$ hybridisation, pyramidal shpae

$Ni(CO)_4$, $[Ni(CN)_4]^{4-}$ both are sp^3 hybridised, tetrahedral in shape

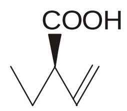
$XeF_4 \rightarrow sp^3d^2$ hybridization square planar shape, $[Fe(CO)_4]^{2-} \rightarrow sp^3$ hybridization, tetrahedral slape

$SF_4 \rightarrow sp^3d$ hybridization sea saw shape, $CF_4 \rightarrow$ tetrahedral, sp^3 hybridisation

43. (4)
In rest options on sp^2c has same group

44. (3)
Fact

45. (4)
Due to π-bond shifting α carbon can stabilize which approach to decarboxylate the carboxylic group



46. (1)

$\because$ W = ZQ

So, $W = \dfrac{EQ}{F}$

$d \times V = \dfrac{E \times Q}{F}$

$\therefore$ Q = 6F

47.7

48. $K = \dfrac{1}{t_{20}} \ln \dfrac{100}{80} = \dfrac{1}{t_{60}} \ln \dfrac{100}{40}$

$\dfrac{t_{60}}{t_{20}} = \dfrac{\ln 5/2}{\ln 5/4} = \dfrac{\log 5/2}{\log 5/4} = \dfrac{0.3979}{0.09691} = 4$

49. $$BOH + HCl \longrightarrow B^+Cl^- + H_2O$$
0.1 M 0.1 M 0.1 M

$B^+ Cl^-$: Salt of weak base strong acid.

50. 5

[MATHEMATICS]

51.

Ans. (2)

Given : $\dfrac{\cos^4\alpha}{\cos^2\beta}+\dfrac{\sin^4\alpha}{\sin^2\beta}=1$

Let : $\dfrac{\cos^2\alpha}{\cos\beta}=\cos\theta$ $\qquad \dfrac{\sin^2\alpha}{\sin\beta}=\sin\theta$

$\cos^2\alpha = \cos\beta\cos\theta \qquad \sin^2\alpha = \sin\beta\sin\theta$

$1 = \cos(\beta-\theta) \quad \Rightarrow \quad \beta = \theta + 2n\pi$

$\therefore \quad \cos^2\alpha = \cos^2\beta \quad \& \quad \sin^2\alpha = \sin^2\beta$

$$\therefore \quad \frac{\cos^4\beta}{\cos^2\alpha}+\frac{\sin^4\beta}{\sin^2\alpha}=\cos^2\beta+\sin^2\beta=1$$

52.

Ans. (4)

$$I=\int\frac{\text{cosec}^2x}{(\text{cosec}x+\cot x)^{9/2}}dx$$

Put cosecx + cotx = z

$$\text{cosec}x-\cot x=\frac{1}{z}.$$

$$-2\text{cosec}^2x dx=\left(1+\frac{1}{z^2}\right)dz$$

$$\therefore \quad I=-\frac{1}{2}\int\frac{1+\frac{1}{z^2}}{z^{9/2}}dz=-\frac{1}{2}\left[\int z^{-9/2}dz+\int z^{\frac{-13}{2}}dz\right]$$

$$=-\frac{1}{2}\left[\frac{z^{-7/2}}{(-7)}2+\frac{z^{-11/2}}{(-11)}2\right]+C$$

$$=z^{\frac{-7}{2}}\left[\frac{1}{7}+\frac{z^{-3}}{11}\right]+C$$

$$=(\text{cosec}x-\cot x)^{\frac{7}{2}}\left(\frac{1}{7}+\frac{(\text{cosec}x-\cot x)^2}{11}\right)+C$$

53.

Ans. (2)

$E\to 2,\ A\to 2,\ R\to 1$

$T\to 1,\ H\to 1,\ Q\to 1,\ U\to 1,\ K\to 1$

$\boxed{RAHU}\,EEATQK$

$$\frac{7!}{2!}$$

54.

Ans. (1)

$(1+t^2)^{10}(1+t^{10}+t^{20}+t^{30})$

$=(1+{}^{10}C_1t^2+{}^{10}C_2t^4+.....+{}^{10}C_{10}t^{20})$
$(1+t^{10}+t^{20}+t^{30})$

$\therefore$ Coefficient $={}^{10}C_{10}+{}^{10}C_5+{}^{10}C_0=2+{}^{10}C_5$

55.

Ans. (4)

$P(z)=\dfrac{1}{6} \qquad P(\bar{z})=\dfrac{5}{6}$

$\therefore$ P(2comes in even trial)

$=P(\bar{z}z \text{ or } \bar{z}\bar{z}\bar{z}z \text{ or } ....\infty)$

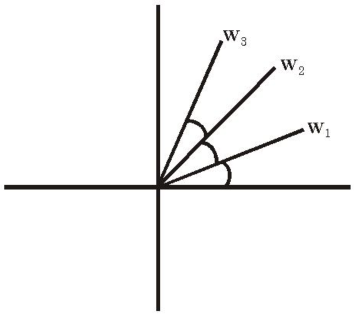
$$=\frac{5}{6}\times\frac{1}{6}+\left(\frac{5}{6}\right)^3.\frac{1}{6}+......\infty$$

$$=\frac{\frac{5}{6}\times\frac{1}{6}}{1-\left(\frac{5}{6}\right)^2}=\frac{5}{11}$$

56.

Ans. (2)

$$\frac{|w_3 - w_2| + |w_5 - w_4| + |w_7 - w_6| + ... + |w_{17} - w_{16}|}{|w_2 - w_1| + |w_5 - w_9| + |w_8 - w_7| + |w_{11} - w_{10}|}$$



$\therefore \quad |w_1 - w_2| = |w_2 - w_3| = ... = a$

$\therefore \quad \text{Ratio} = \dfrac{8a}{4a} = 2$

57.

Ans. (3)

$$\sum_{n=2}^{\infty} \frac{n}{1 + n^4 - 2n^2} = \frac{1}{4} \sum_{n=2}^{\infty} \frac{(n+1)^2 - (n-1)^2}{(n+1)^2 \times (n-1)^2}$$

$$= \frac{1}{4} \sum_{n=2}^{\infty} \left(\frac{1}{(n-1)^2} - \frac{1}{(n+1)^2} \right) = \frac{5}{16}$$

58.

Ans. (2)

Use A.M. $\geq$ G.M.

$$\frac{x^{2017} + y^{2017} + z^{2017} + \underbrace{1 + 1 + ... + 1}_{2014 \text{ times}}}{2017}$$

$$\geq \left(z^{2017}.y^{2017}.z^{2017}.1.1....1\right)^{\frac{1}{2017}}$$

$\therefore \quad E \geq -2014$

59.

Ans. (4)

Since $A^2 = A \;\Rightarrow\; A^3 = A \;\Rightarrow\; A^4 = A$

$\therefore \quad (I + A)^4$

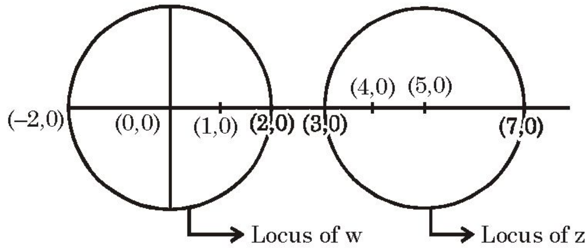
$= {}^4C_0 I^4 + {}^4C_1 A + {}^4C_2 A^2 + {}^4C_3 A^3 + {}^4C_4 A^4$

$= I + 15A$

60.

Ans. (3)

$\left|\dfrac{z-1}{z-4}\right| = 2$ and $\left|\dfrac{w-4}{w-1}\right| = 2$



$\therefore \quad |z - w|_{max} = 9, \quad |z - w|_{min} = 1$

61.

Ans. (4)

sinAcosBcosC + sinBcosCcosA + sinCcosAcosB

= cosAcosBcosC(tanA + tanB + tanC)

= cosAcosBcosC . tanA tanB tanC

= sinAsinBsinC

62.

Ans. (3)

Clearly $\sin^{-1}\sqrt{x} \;\Rightarrow\; x \in [0, 1]$

Also $\cos^{-1}\sqrt{x^2 - 1} \Rightarrow 0 \leq x^2 - 1 \leq 1$

$x^2 \in [1, 2]$

$\therefore$ Possible value of $x = 1$

$\therefore$ Equation becomes $\dfrac{\pi}{2} + \dfrac{\pi}{2} + \tan^{-1}\tan y = a$

$\therefore$ for solution $a \in \left(\dfrac{\pi}{2}, \dfrac{3\pi}{2}\right)$

$\therefore$ integral values are 2, 3, 4

63.

Ans. (2)

Line AB $\frac{x-\sqrt{3}}{\cos 60°} = \frac{y}{\sin 60°} = r$

$x = \sqrt{3} + \frac{r}{2},\ y = \frac{r\sqrt{3}}{2}$

$\therefore$ Point $\left(\sqrt{3} + \frac{r}{2}, \frac{r\sqrt{3}}{2}\right)$ lies on $2y^2 = 2x + 3$

$\therefore \frac{3r^2}{2} = 2\sqrt{3} + r + 3$

$\Rightarrow 3r^2 - 2r - \left(6 + 4\sqrt{3}\right) = 0$

PA and –PB are roots

$\therefore$ $PA - PB = \frac{2}{3}$

$PA.PB = \frac{6+4\sqrt{3}}{3}$

64.

Ans. (4)

Point P lie on director circle of given ellipse

$\frac{x^2}{16} + \frac{y^2}{9} = 1$

$\therefore$ angle between tangents is $\frac{\pi}{2}$

65.

Ans. (1)

Given curve is $(x - 5)(y - 7) = 35$

$\therefore$ Length of LR $= 2\sqrt{(2)(35)} = \sqrt{280}$

66.

Ans. (3)

Symmetric and transitive but not reflexive

67.

Ans. (4)

Use : $\sigma^2 \geq 0 \Rightarrow \frac{\sum x_i^2}{n} - \left(\frac{\sum x_i}{n}\right)^2 \geq 0$

$\Rightarrow \frac{400}{n} - \frac{10000}{n^2} \geq 0 \Rightarrow n \geq 25$

68.

Ans. (4)

$A^2 = \begin{bmatrix}1 & 0\\1 & 1\end{bmatrix}\begin{bmatrix}1 & 0\\1 & 1\end{bmatrix} = \begin{bmatrix}1 & 0\\2 & 1\end{bmatrix}$

it satisfies only option (4)

69.

Ans. (2)

use $\sim(p \Rightarrow q) \equiv p \wedge (-q)$

Option (2) is correct.

70.

Ans. (3)

$\lim_{x\to 1} \frac{(x-1)(x+1)}{\sin^2 x - \sin^2 1}$

$\lim_{x\to 1} \frac{(x-1)(x+1)}{\sin(x-1)\sin(x+1)}$

$\frac{2}{\sin 2}$

71.

Using $\int_0^1 f(x)dx = \int_0^1 f(1-x)dx$

$I = \int_0^1 \sqrt[3]{x^2(2x-3) + (1-x)}\,dx$

$= \int_0^1 \sqrt[3]{(1-x)^2(-1-2x) + x}\,dx$

$= -\int_0^1 \sqrt[3]{(x^2-2x+1)(1+2x) - x}\,dx$

$= -\int_0^1 \sqrt{2x^3 - 3x^2 - x + 1}\,dx = -I$

$2I = 0 \quad \therefore \quad I = 0$

72.

Given $I = \prod_{r=1}^{59}\left(1 - \frac{\cos(60° + r°)}{\cos r°}\right)$

$= \prod_{r=1}^{59}\frac{\sin(30° + r°)}{\cos r°}$

$= \frac{\sin 31°.\sin 32°......\sin 89°}{\cos 1°.\cos 2.......\cos 59°} = 1$

73.

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

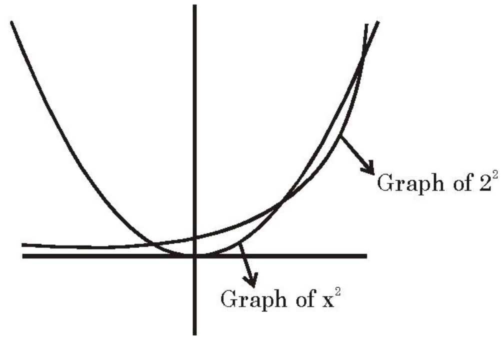
$= \frac{(2\sin x - 1)(\sin x - 1)}{\sin x}$

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

$\Downarrow$ $\quad\ge 0 \quad \le 0$

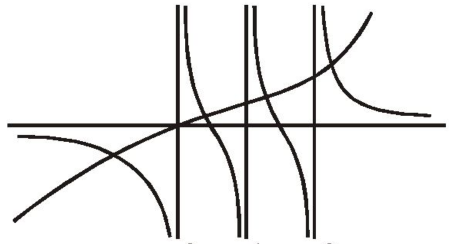
4 solutions Hence no solution

74.



75.

Make graphs



Clearly graphs intersects at 4 points