BEATS ENGINEERING

INSTITUTE OF ENGINEERING

MODEL ENTRANCE EXAM

(Beats Test Series – Day 5)
Solutions

Instructions:

There are 100 multiple-choice questions, each having four choices of which only one choice is correct.

Date : 2081/05/06
(August 22)

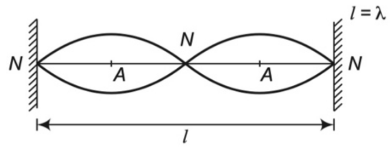
Duration : 2 hours
Time : 8 A.M. – 10 A.M.

SECTION – A (1 marks) (1*60 = 60)

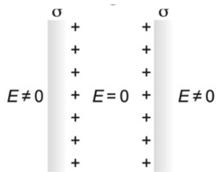
1) a
2) a
3) d
4) a
5) a
6) a
7) d
8) b
9) b
10) c
11) c
12) b
13) c
14) d $\Delta x \times \Delta p = \frac{h}{4\pi}$
$\Delta p = \frac{h}{4\pi\Delta x} = \frac{h}{4\pi\times 0} = \infty$
15) a Due to resonance, there is partial double bond character in O_3. So, it lies between single bond and double bond.
16) b For spontaneous reaction: $\Delta H < 0; \Delta S > 0$.
17) c In BF_3, central atom B has incomplete octet. So, it can accept a pair of electrons and electron pair acceptors are Lewis acid.
18) b
19) c $Na_6P_6O_{18}$ or $Na_2[Na_4(PO_3)_6]$ called as Calgon, is used for softening of hard water.
20) a Basic character of hydroxide of alkaline earth metals increases down the group.
21) d Melting point decreases as the strength of metallic bonding decreases with the increase in size of atom.
22) a
23) d Coinage metals are copper, silver and gold.
24) d
25) d Extraction of oils from flowers is done with the help of steam distillation.
26) b Reduction of carbonyl compounds with Zn-Hg in presence of conc. HCl is called Clemmensen's reduction.
27) a Young's modulus and pressure have the same dimensions.
28) c $Mg - N = ma$ or $N = m(g - a)$
29) a $K = \sqrt{\frac{I}{M}} = \sqrt{\frac{(mL^2/12)}{m}} = \frac{L}{2\sqrt{3}}$
30) c $P = \frac{2T}{r} \propto r^{-1}$
31) c $\frac{C-0}{100} = \frac{F-32}{180}$
$-\frac{273}{100} = \frac{F-32}{180} \Rightarrow F = -460\ ^\circ F$

32) b In adiabatic change, $\Delta Q = 0$. So, $\Delta W = -\Delta U$ $\because (\Delta Q = \Delta U + \Delta W)$

33) c



34) c



Electric field between sheets $= \frac{2}{2\varepsilon_0}(\sigma - \sigma) = 0$

35) a Some peculiar properties of ferromagnetic materials are commonly displayed by curve of B against H which is called B -H curve or hysteresis in B loop. Dia and para do not show these properties.

36) d Self-inductance of coil, $|e| = L\frac{dI}{dt}$

$10 = L \times \frac{10}{1}$

$L = 1$ H

37) a Apparent depth $= \frac{\text{Real depth}}{\text{Refractive Index}} = \frac{\text{h}}{\mu}$

Also, $\mu < \frac{1}{\lambda}$

$\lambda_r > \lambda_y > \lambda_g > \lambda_v$

$\mu_v > \mu_g > \mu_y > \mu_r$

So, apparent depth for red will be minimum. So, it will appear to be raised minimum.

38) d

39) c Energy, $E = eV = hv_{max} = \frac{hc}{\lambda_{min}}$

$\lambda_{min} = \frac{hc}{eV}$

40) d

41) c For asinx + bcosx,

Maximum value = $\sqrt{a^2 + b^2}$, Minimum value = $-\sqrt{a^2 + b^2}$

$\therefore \sin x + \cos x = \sqrt{1^2 + 1^2} = \sqrt{2}$

42) b Given, $\sin^{-1} x = \frac{\pi}{5}$

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

$\Rightarrow \cos^{-1} x = \frac{\pi}{2} - \frac{\pi}{5} = \frac{3\pi}{10}$

43) c $\cos^2 x = \frac{1}{4}$

or, $\cos^2 x = \left(\frac{1}{2}\right)^2$

or, $\cos^2 x = \cos^2\left(\frac{\pi}{3}\right)$

$\therefore x = n\pi \pm \frac{\pi}{3}$

44) b $\vec{b} = -4\vec{a}$

$\therefore \vec{a} \,||\, \vec{b}$

45) a $\lim_{x\to 0} \frac{\sin ax}{\sin bx} = \frac{a}{b}$

$\therefore \lim_{x\to 0} \frac{\sin 7x}{\sin 5x} = \frac{7}{5}$

46) d $\frac{dy}{dz} = \frac{\frac{dy}{dx}}{\frac{dz}{dx}} = \frac{\frac{d\tan^{-1}x}{dx}}{\frac{d\cot^{-1}x}{dx}} = \frac{\frac{1}{1+x^2}}{-\frac{1}{1+x^2}} = -1$

47) b $\int \frac{1}{x\log x} dx = \int \frac{\frac{1}{x}}{\log x} dx = \log\log x + c$

48) d $y = f(x) = x^3 + 3x^2 - 9x + 25$
$f'(x) = 3x^2 + 6x - 9$
$f''(x) = 6x + 6$
For point of inflection. $f''(x) = 0$
$\Longrightarrow 6x + 6 = 0$
$\Longrightarrow x = -1$

49) c Given, ax+4y=5
$\Longrightarrow \frac{x}{5/a} + \frac{y}{5/4} = 1$
Since, X-intercept = 3
$\Longrightarrow \frac{5}{a} = 3$
$\therefore a = \frac{5}{3}$

50) d Two lines are coincident if
$h^2 = ab$
$\Rightarrow \left(\frac{-k}{2}\right)^2 = (1).(4)$
$\Rightarrow k^2 = 16$
$\Rightarrow k = 4$

51) d Given equation of circle is:
$x^2 + y^2 - 2\lambda x - 2\lambda y + \lambda^2 = 0$
Comparing with, $x^2 + y^2 + 2gx + 2fy + c = 0$
$g = \lambda$, $f = \lambda$, $c = \lambda^2$
Here, $g^2 = f^2 = c$
$\therefore$ Circle touches both the axes.

52) d Eccentricity of the parabola is always 1.

53) c $\sin^2\alpha + \sin^2\beta + \sin^2\gamma = (1 - \cos^2\alpha) + (1 - \cos^2\beta) + (1 - \cos^2\gamma)$
$= 3 - (\cos^2\alpha + \cos^2\beta + \cos^2\gamma) = 3 - 1 = 2$

54) a $\sigma = \sqrt{\frac{250}{10}} = 5$
Coefficient of variance $= \frac{\sigma}{\bar{X}} \times 100 = \frac{5}{50} \times 100 = 10$

55) d $A - (B \cap C) = \{x: x \in A \text{ and } x \notin (B \cap C)\}$
$= \{x: x \in A \text{ and } x \notin B \text{ or } x \in A \text{ and } x \notin C\}$
$= (A - B) \cup (A - C)$

56) b f(x) is defined for all values except x = 1
So, domain of f = R – {1}

57) b $\frac{1+2i}{1-i} = \frac{1+2i}{1-i} \times \frac{1+i}{1+i} = \frac{1+i+2i+2i^2}{1-i^2} = \frac{1+3i+2(-1)}{1-(-1)} = \frac{-1+3i}{2} = -\frac{1}{2} + \frac{3}{2}i$
$\left(-\frac{1}{2}, \frac{3}{2}\right)$ lies in second quadrant.

58) a Let three numbers in G.P. be $\frac{a}{r}, a, ar$.
Product = 1728
i.e., $\frac{a}{r}.a.ar = 1728$

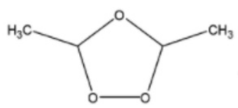
or, $a^3 = 1728$
$\therefore a = 12$ (middle term)

59) c Here, all elements below the leading diagonal are zero.
Hence, it is an upper triangular matrix.

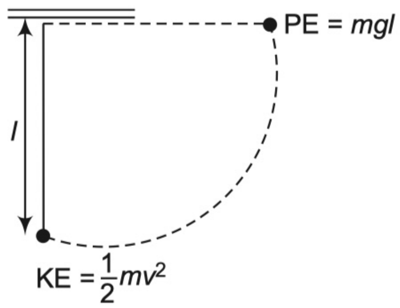
60) b We know, $\alpha + \beta = -\frac{b}{a}$
or, $\alpha - \alpha = -\frac{b}{a}$
or, $0 = -\frac{b}{a}$
$\therefore b = 0$

SECTION – B (2 marks) (2*40=80)

61) b
62) b
63) a
64) d
65) c 96500 C of electricity deposit silver = 108 g
965 C of electricity deposit silver = $\frac{108\times965}{96500} = 1.08$ g
66) a Let the rate law be; $r = k[A]^x[B]^y$
$2 = k[0.2]^x[0.2]^y$ (1)
$4 = k[0.2]^x[0.4]^y$ (2)
$36 = k[0.6]^x[0.4]^y$ (3)
Dividing (2) by (1),
$2 = 2^y \Rightarrow y = 1$
Dividing (3) by (2),
$9 = 3^x \Rightarrow x = 2$
Hence, Rate equation, $R = [A]^2[B]$.
67) c $M_1V_1 + M_2V_2 = M_3V_3$
$1 \times 2.5 + 0.5 \times 3 = M_3 \times 5.5$
$M_3 = 0.73$ M
68) c F always has -1 oxidation state.
69) c Ionization energy usually increases from left to right in periodic table. But N has greater IE than O due to stable half filled electronic configuration.
70) c Bond dissociation energy of F_2 is less than that of Cl_2.
71) b $CH_3 - CH = CH - CH_3 \xrightarrow{O_3}$ Butene ozonide $\xrightarrow[Zn]{H_2O} CH_3CHO \xrightarrow{dil.NaOH} CH_3 - CH(OH) - CH_2 - CHO$



72) c Amines (RNH_2) and Benzylamine ($C_6H_5CH_2NH_2$) are more basic due to +I effect, while, aniline is less basic due to resonance.
73) a $s = s_1 + s_2 + s_3$
$= \frac{1}{2} \times 2 \times 10^2 + 2 \times 10 \times 30 + \frac{1}{2} \times 4 \times 5^2 = 100 + 600 + 50 = 750$ m
74) d Kinetic energy given to a sphere at lowest point = potential energy at the height of suspension



$\frac{1}{2}mv^2 = mgl$

$v = \sqrt{2gl}$

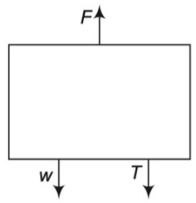
75) b $\frac{1}{2}m\left(\frac{v_e}{2}\right)^2 = \frac{mgh}{1+\frac{h}{R}}$

$\frac{{v_e}^2}{8} = \frac{gh}{1+\frac{h}{R}}$

$\frac{2gR}{8} = \frac{gh}{1+\frac{h}{R}}$

$h = \frac{R}{3}$

76) d Upthrust F = w + T



$T = F - w = V\rho_w g - V\rho_b g = (\rho_w - \rho_b)Vg$

$= (1000 - 800)\left(\frac{8}{800}\right)(10) = 20\text{ N}$

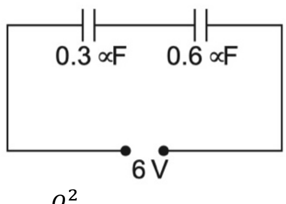
77) d $\frac{T_2}{T_1} = \left(\frac{P_2}{P_1}\right)^{\frac{\gamma-1}{\gamma}} = (8)^{\frac{\frac{3}{2}-1}{3/2}} = 2$

$T_2 = 2T_1 = 2(273+27) = 600\text{ K} = 327\text{ °C}$

78) d Temperature of mixture, $\theta_{mix} = \frac{m_1c_1\theta_1 + m_2c_2\theta_2}{m_1c_1 + m_2c_2} = \frac{m\times c\times 2T + \frac{m}{2}\times(2c)\times T}{m\times c + \frac{m}{2}(2c)} = \frac{3}{2}T$

79) b The phase difference, $\Delta\phi = \frac{2\pi}{\lambda}.\Delta x = k.\Delta x = \pi \times 0.01 \times 25 = \frac{\pi}{4}$

80) b In series, charge remains same on both capacitors.



$U = \frac{Q^2}{2C}$

$U \propto \frac{1}{C}$

$\frac{U_1}{U_2} = \frac{C_2}{C_1} = \frac{0.6}{0.3}$

$U_1 : U_2 = 2:1$

81) d $\frac{2R}{2+R} = \frac{6}{5}$

$R = 3\ \Omega$

82) a $X_C = X_L = R$

$V = \sqrt{{V_R}^2 + (V_L - V_C)^2}$

But, $V_L = V_C$

$\therefore V = V_R = 10$

When capacitor is short circuited, $V_C = 0$

And $V_R = V_L$

$V = \sqrt{{V_R}^2 + {V_L}^2}$

$10 = \sqrt{2}V_L$

$V_L = \frac{10}{\sqrt{2}}$ V

83) d Keep the object at a distance 2f from the lens.

Hence, d = 2f = 2 × 15 = 30 cm

The distance between the object and screen = 30 + 30 = 60 cm

84) d $n_1\lambda_1 = n_2\lambda_2$

$n_2 = \frac{n_1\lambda_1}{\lambda_2} = \frac{60\times5461\times10^{-9}}{5890\times10^{-9}} = 55$

85) c $\frac{1}{2}m{v^2}_{max} = eV_0$

$v_{max} = \sqrt{\frac{2eV_0}{m}} = \sqrt{2\times1.8\times10^{11}\times9} = 1.8\times10^6$ m/s

86) c $\alpha^3 + \beta^3 = (\alpha+\beta)^3 - 3\alpha\beta(\alpha+\beta)$

$= \left(\frac{-b}{a}\right)^3 - \frac{3c}{a}\left(\frac{-b}{a}\right) = \frac{3abc - b^3}{a^3}$

87) c $\frac{(1+x+x^2)}{e^x} = (1+x+x^2).e^{-x}$

$= (1+x+x^2).\left\{1 - \frac{x}{1!} + \frac{x^2}{2!} - \frac{x^3}{3!} + \cdots\right\}$

Coefficient of $x^2 = 1.\frac{1}{2!} + 1\left(\frac{-1}{1!}\right) + 1.1 = \frac{1}{2}$

88) b Here, $P(Q) = \frac{4}{52}$

Since, one card is already picked,

$p(J) = \frac{4}{51}$

$\therefore P(Q\ and\ J) = \frac{4}{52}\times\frac{4}{51} = \frac{4}{663}$

89) b $\begin{vmatrix} b+c & c+a & a+b \\ q+r & r+p & p+q \\ y+z & z+x & x+y \end{vmatrix}$

Applying $C_1 \to C_1 - (C_2 + C_3)$, we get,

$= \begin{vmatrix} -2a & c+a & a+b \\ -2p & r+p & p+q \\ -2x & z+x & x+y \end{vmatrix}$

$= -2\begin{vmatrix} a & c+a & a+b \\ p & r+p & p+q \\ x & z+x & x+y \end{vmatrix}$

Operate $C_2 \to C_2 - C_1$ and $C_3 \to C_3 - C_2$

$= -2\begin{vmatrix} a & c & b \\ p & r & q \\ x & z & y \end{vmatrix} = 2\begin{vmatrix} a & b & c \\ p & q & r \\ x & y & z \end{vmatrix}$

90) b

Players	Defenders	Non-defenders	Selection

(14)	(5)	(9)	
	4	7	${}^5C_4 \times {}^9C_7 = 180$
	5	6	${}^5C5 \times {}^9C_6 = 84$

Total number of ways = 180 + 84 = 264

91) b $\tan\left(\frac{\pi}{4}+\theta\right)+\tan\left(\frac{\pi}{4}-\theta\right)=4$

$\Rightarrow \frac{\tan\frac{\pi}{4}+\tan\theta}{1-\tan\frac{\pi}{4}.\tan\theta}+\frac{\tan\frac{\pi}{4}-\tan\theta}{1+\tan\frac{\pi}{4}.\tan\theta}=4$

$\Rightarrow \frac{1+\tan\theta}{1-\tan\theta}+\frac{1-\tan\theta}{1+\tan\theta}=4$

$\Rightarrow \frac{(1+\tan\theta)^2+(1-\tan\theta)^2}{1-\tan^2\theta}=4$

$\Rightarrow \frac{1+2\tan\theta+\tan^2\theta+1-2\tan\theta+\tan^2\theta}{1-\tan^2\theta}=4$

$\Rightarrow 2+2\tan^2\theta=4-4\tan^2\theta$

$\Rightarrow 6\tan^2\theta=2$

$\Rightarrow \tan^2\theta=\frac{2}{6}=\frac{1}{3}$

$\Rightarrow \theta=n\pi\pm\frac{\pi}{6}$

92) d Let m_1 and m_2 be the slopes of the lines represented by $4x^2+2hxy-7y^2=0$

$m_1+m_2=-\frac{2h}{b}=\frac{2h}{7}$

$m_1m_2=\frac{a}{b}=-\frac{4}{7}$

As given, $\frac{2h}{7}=-\frac{4}{7}$

$\Rightarrow h=-2$

93) d Solving the line $y=x+a\sqrt{2}$ and the circle $x^2+y^2=a^2$, we get,

$x^2+(x+a\sqrt{2})^2=a^2$

$\Rightarrow x^2+x^2+2ax\sqrt{2}+2a^2=a^2$

$\Rightarrow 2x^2+2ax\sqrt{2}+a^2=0$

$\Rightarrow \left(\sqrt{2}x\right)^2+2\left(\sqrt{2}x\right)a+a^2=0$

$\Rightarrow \left(\sqrt{2}x+a\right)^2=0$

$\Rightarrow x=-\frac{a}{\sqrt{2}}$

$\therefore y=-\frac{a}{\sqrt{2}}+a\sqrt{2}=\frac{a}{\sqrt{2}}$

Hence, point of contact $=\left(-\frac{a}{\sqrt{2}},\frac{a}{\sqrt{2}}\right)$

94) b As given, $2b=8\Rightarrow b=4$ and $e=\frac{\sqrt{5}}{3}$

$\because e^2=1-\frac{b^2}{a^2}$

$\Rightarrow \frac{5}{9}=1-\frac{16}{a^2}$

$\Rightarrow a=6$

$\therefore$ major axis $=2a=2\times 6=12$

95) a The line $y=4x$ meets $y=x^3$ at $4x=x^3$.

$\therefore x=0,2,-2\Rightarrow y=0,8,-8$

$\Rightarrow A=\int_0^2(4x-x^3)=\left(2x^2-\frac{x^4}{4}\right)_0^2=4$ sq. units

96) d $f(x)+f(1-x)-2=0$

or, $f(x)-1+f(1-x)-1=0$

or, $g(x)+g(1-x)=0$

Replacing x by $x+\frac{1}{2}$, we get,

$g\left(\frac{1}{2}+x\right)+g\left(\frac{1}{2}-x\right)=0$

So, it is symmetrical about $\left(\frac{1}{2},0\right)$.

97) b $\lim_{x\to1}\frac{1-x^2}{\sin 2\pi x}=-\lim_{x\to1}\frac{2\pi\,(1-x)(1+x)}{2\pi\ \sin(2\pi-2\pi x)}\lim_{x\to1}\frac{(2\pi-2\pi x)}{\sin(2\pi-2\pi x)}\frac{1+x}{2\pi}=-\frac{1}{\pi}$

98) a $(\sin x)(\cos y)=1/2$

$\frac{dy}{dx}[(\sin x)(\cos y)]=\frac{dy}{dx}\left(\frac{1}{2}\right)$

or, $\cos x.\cos y\frac{dy}{dx}-\sin y.\sin x\frac{dy}{dx}=0$

or, $\frac{dy}{dx}=(\cot x)(\cot y)$

or, $\frac{d^2y}{dx^2}=-\text{coesc}^2x.\cot y\frac{dy}{dx}-\text{cosec}^2y.\cot x\frac{dy}{dx}$

Now, $\left(\frac{dy}{dx}\right)_{(\pi/4,\pi/4)}=\cot\left(\frac{\pi}{4}\right).\cot\left(\frac{\pi}{4}\right)=1.1=1$

$\left(\frac{d^2y}{dx^2}\right)_{(\pi/4,\pi/4)}=-(2).(1).(1)-(2).(1).(1)=-2-2=-4$

99) c $f(x)=\frac{t+3x-x^2}{x-4}$

$f'(x)=\frac{(x-4)(3-2x)-(t+3x-x^2)}{(x-4)^2}$

For maximum or minimum, $f'(x)=0$

or, $-2x^2+11x-12-t-3x+x^2=0$

or, $-x^2+8x-(12+t)=0$

For one maxima and minima, $D>0$

or, $64-4(12+t)>0$

or, $16-12-t>0$

or, $4>t$

or, $t<4$

Hence, range of t is: $(-\infty,4)$

100) c $\int\frac{e^x}{\sqrt{4-e^{2x}}}dx=\int\frac{e^x}{\sqrt{2^2-(e^x)^2}}dx$

Let $e^x=t$

or, $e^xdx=dt$

$\therefore I=\int\frac{dt}{\sqrt{4-t^2}}dx=\int\frac{dt}{\sqrt{2^2-(t)^2}}dx=\sin^{-1}\left(\frac{t}{2}\right)+c=\sin^{-1}\left(\frac{e^x}{2}\right)+c$

❖❖❖❖ Thank You!!! ❖❖❖❖