BEATS ENGINEERING

INSTITUTE OF ENGINEERING

MODEL ENTRANCE EXAM

(SET – 10)
Solutions

Instructions:

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

Date : 2081/04/12
(July 24)

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

SECTION – A (1 marks) (1*60 = 60)

1) d
2) a
3) c
4) b
5) c
6) d
7) a
8) b
9) b
10) b
11) a
12) b
13) c
14) b This is in the form $xy = c^2$, where $c = 2$.
Length of latus rectum $= 2\sqrt{2}c = 4\sqrt{2}$
15) d $\sec^{-1}\frac{\sqrt{5}}{2} = \tan^{-1}\frac{1}{2} = \tan^{-1}\frac{y}{x}$
$x : y = 2 : 1$
This point lies on 2nd quadrant. So, option 'd' is suitable.
16) c $log_3 x = log_3 a \times log_a x = \frac{log_a x}{log_a 3} = \frac{0.3}{0.4} = \frac{3}{4}$
17) c The following orders are possible:
$16 \times 1, 1 \times 16, 2 \times 8, 8 \times 2, 4 \times 4$
18) c In the case of garland, clockwise and anticlockwise arrangements are same.
So, number of permutation $= \frac{1}{2}\ (n-1)!$
19) c $y = 2\sin^{-1} x$
$\frac{dy}{dx} = \frac{2}{\sqrt{1-x^2}}$
20) a $\frac{dy}{dx} = \frac{1}{1+x^2}$
$\frac{dy}{dx}(at\ x = 1) = \frac{1}{2}$
21) d $\left|\vec{a} + \vec{b}\right|^2 = |\vec{a}|^2 + \left|\vec{b}\right|^2 + 2\vec{a}.\vec{b}$
$\vec{a}.\vec{b} = 0$
$\vec{a} \perp \vec{b}$
22) a If $A + B + C = \pi$, then
$\tan A + \tan B + \tan C = \tan A . \tan B . \tan C = 9$
23) c $\mathrm{e} - \mathrm{c} = 2 \times \text{common difference} = 2(\mathrm{d} - \mathrm{e})$
24) c $x^2 = -\frac{b}{a}$
Roots are real and distinct if $\frac{b}{a} < 0$.
So, $ab < 0$.
25) b $ab.\frac{b^2+a^2-c^2}{2ab} - ac.\frac{a^2+c^2-b^2}{2ac} = \frac{2b^2-2c^2}{2} = b^2 - c^2$
26) d Events are independent.
i.e., $P(B_1 \cap B_2 \cap B_3) = P(B_1).(B_2).(B_3) = \frac{1}{2}.\frac{1}{2}.\frac{1}{2} = \frac{1}{8}$
27) c Family of concurrent lines.

28) a $g^2 = f^2 = c$. So, touches both axis.

29) b $\lim_{n\to\infty} 5\left[1 + \left(\frac{4}{n}\right)^n\right]^{1/n} = 5.1 = 5$

30) b $y = e^{log_e x^5} = x^5$

$\frac{dy}{dx} = 5x^4$

31) c $\sqrt{x} = t$

$\frac{1}{\sqrt{x}} dx = 2dt$

$\int e^x .2dt = 2e^x + c = 2e^{\sqrt{x}} + c$

32) d Distance $= \frac{3-\frac{5}{2}}{\sqrt{1+1+1}} = \frac{1}{2\sqrt{3}}$

33) b $a = \frac{F_a}{m} = \frac{\sqrt{10^2+2\times10\times10\cos 60^\circ+10^2}}{10} = \frac{10\sqrt{3}}{10} = \sqrt{3}\ m/s^2$

34) b $F = \frac{mv^2}{r}$

If r is made double, then

$F' = \frac{mv^2}{2r} = \frac{F}{2}$ (i.e. halve)

35) c Heat flows from one part to another part, then temperature must be different. i.e., temperature gradient.

36) a $E = \frac{\sigma}{E}$ in oil.

If oil is drained, then $E = \frac{\sigma}{\varepsilon_0}$. Here, electric field intensity increases.

37) b Power will be maximum if load resistance is equal to total resistance i.e., $R = \frac{r}{2}$.

38) d $E = \frac{1}{r^2}$

$\frac{\Delta E}{E} = -\frac{2\Delta r}{r} = - \times 1\% = -2\%$

2% decreases.

39) c Cut off potential is independent to distance but depends only on energy of photon.

40) b Weight of body at equator $= mg - mR\omega^2$.

When w increases, then weight decreases.

41) b In case of weightlessness, water rises to top of cube.

42) d $\frac{I_{max}}{I_{min}} = \frac{1+2\sqrt{I\times4I}+4I}{1-2\sqrt{I\times4I}+4I} = 9:1$

43) c $Q = CV = 4\pi\varepsilon_0 RV$

So, charge depends on radius and potential.

44) b The material suitable for fuse is high resistance and low melting point.

45) b $\frac{1}{\lambda} = R\left[\frac{1}{4}\right]$

$\lambda = \frac{4}{R} = \frac{4}{1.097\times10^7} = 364\times10^{-9}\ m = 364\ nm$

46) d 1120 mL = 1120 gm

No. of mole $= \frac{1120}{18} = 62.22$ mole

No. of molecules = $62.22 \times N_A$

47) a Orbital angular momentum $= \frac{h}{2\pi}\sqrt{l(l+1)}$

For d-orbital, $l = 2$

So, angular momentum $= \frac{h}{2\pi}\sqrt{2(2+1)} = \frac{\sqrt{6}h}{2\pi}$

48) b In hcp, coordination number is 12.

49) c Dry ice → CO_2 (g); ΔH = +ve and ΔS = +ve

50) b There are two main reasons for showing variable valency:

i) Inert pair effect in p-block elements.
ii) Small energy difference between ns and (n-1)d sub shells in transition elements and ns and (n-2) sub shells in inner transition elements.

51) d Calcium hydroxide is used in Clarke's method to soften water (lime). It removes temporary hardness.
52) c Mg does not give flame test because of absence of d-orbital's and high excitation energy.
53) b In open Hearth process, Fe_2O_3 is used as O.A.
54) a Metamerism : Structural isomer in which there is a difference in the relative position of alkyl group areound polyvalent atom / funtional groups.
55) d PCC is a mild oxidizing agent. It oxidizes primary alcohols to aldehydes only. The further oxidation to carboxylic acid does not occur.
56) d $2AgCl + Na_2CO_3 \xrightarrow{\text{fuse}} 2Ag \downarrow + 2NaCl + CO_2 + \frac{1}{2}O_2$
57) c $P_4O_6 + 6H_2O \rightarrow 4H_3PO_3$
58) b Steel is an alloy of C (a non metal) and mainly Fe (metal).
59) c
60) c

SECTION – B (2 marks) (2*40=80)

61) b
62) d
63) d
64) a
65) a $\frac{dy}{dx} + \frac{y}{x} = \sin x$ (linear differential equation) --- (i)

I.F. $= \int e^{\frac{1}{x}dx} = e^{log_e x} = x$

Multiplying (i) by I.F.

$d(y.x) = x \sin x$

Integrating:

$yx = \int x \sin x \, dx$

$yx = -x \cos x + \sin x + c$

$x(y + \cos x) = \sin x + c$

66) b $\vec{a} = 3\vec{i} + \vec{j} - 2\vec{k}, \vec{b} = \vec{i} - 3\vec{j} + 4\vec{k}$

$\vec{a} \times \vec{b} = -2\vec{i} - 14\vec{j} - 10\vec{k}$

$|\vec{a} \times \vec{b}| = 10\sqrt{3}$

Area $= \frac{1}{2}|\vec{a} \times \vec{b}| = 5\sqrt{3}$

67) d Number of solution of $7 \sin x = x$ is the point of intersection of $y = \sin x$ and $y = \frac{x}{7}$.

From graph, number of solution = 3.

68) b $m_1 + m_2 = -2h$

$\frac{1}{\sqrt{3}} + \sqrt{3} = -2h$

$\frac{4}{\sqrt{3}} = -2h$

$h = -\frac{2}{\sqrt{3}}$

69) b $t_n = \frac{n+1-1}{(n+1)!} = \frac{1}{n!} - \frac{1}{(n+1)!}$

$t_1 = 1 - \frac{1}{2!}$
$t_2 = \frac{1}{2!} - \frac{1}{3!}$
....
$t_{20} = \frac{1}{20!} - \frac{1}{21!}$
Adding all, we get,
$\sum_{n=1}^{20} t_n = 1 - \frac{1}{21!} = \frac{21!-1}{21!}$

70) c $1 + 2 + \cdots + 7 = \frac{7}{2}\,(1 + 7) = 28$

71) c $\int e^x[f(x) - f'(x)]dx = \phi(x)$ (i)
$\int e^x[f(x) - f'(x)]dx = e^x(x)$ (ii)
Adding (i) and (ii),
$2\int e^x f(x)dx = \frac{1}{2}\phi(x) + e^x f(x)$

72) b $A = xy = (12 - 3y)y = 12y - 3y^2$
$\frac{dA}{dy} = 12 - 6y$
$\frac{d^2A}{dy^2} = -6$ (max)
$\frac{dA}{dy} = 0$
$y = 2$
$A_{max} = 24 - 12 = 12$

73) c $P(A \cup B) = \frac{3}{5}; P(A \cap B) = \frac{1}{5}$
$P(A \cup B) = P(A) + P(B) - P(A \cap B)$
$\frac{3}{5} = P(A) + P(B) - \frac{1}{5}$
$\frac{4}{5} = 1 - P(\bar{A}) + 1 - P(\bar{B})$
$P(\bar{A}) + P(\bar{B}) = \frac{6}{5}$

74) a $x^2 = ky - 3 = k\left(y - \frac{3}{k}\right)$
Focus = $\left(0, \frac{3}{k} + \frac{k}{4}\right)$
$\therefore \frac{3}{k} + \frac{k}{4} = 2$ ($k = 2$ satisfies this)

75) b $\alpha = \frac{2+\sqrt{4-16}}{2} = 1 + i\sqrt{3} = 2(\cos 60^\circ + i \sin 60^\circ)$
$\alpha^6 = 2^6(\cos 360^\circ + i \sin 360^\circ) = 64$
$\beta^6 = 2^6(\cos 360^\circ - i \sin 360^\circ) = 64$
$\alpha^6 + \beta^6 = 128$

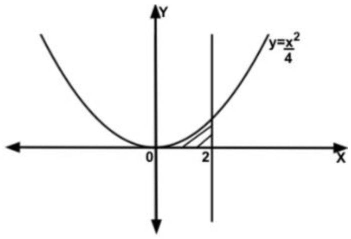
76) b $A.M. = \frac{\sum X}{n} = \frac{330}{10} = 33$

X	$\lvert X - \bar{X}\rvert = \lvert d\rvert$
20	13
22	11
27	6
30	3
31	2
32	2
35	2
40	7

45	12
48	15
	$\Sigma\|d\| = 72$

Mean deviation from mean $= \frac{\Sigma|d|}{n} = \frac{72}{10} = 7.2$

77) b



Area $= \int_0^2 y\,dx = \int_0^2 \frac{x^2}{4}dx = \left[\frac{x^3}{12}\right]_0^2 = \frac{8}{12} = \frac{2}{3}$

78) c $\cot^{-1} 3 + \operatorname{cosec}^{-1}\sqrt{5} = \tan^{-1}\frac{1}{3} + \tan^{-1}\frac{1}{2} = \tan^{-1} 1 = \frac{\pi}{4}$

79) d $lx + my + nz = 2$

The co-ordinates of A, B and C are respectively:

$\left(\frac{2}{l}, 0, 0\right), \left(0, \frac{2}{m}, 0\right), \left(0, 0, \frac{2}{n}\right)$

$\frac{2}{3l} = x, \frac{2}{3m} = y, \frac{2}{3n} = z$

$\frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{z^2} = k$

$\Longrightarrow \frac{9}{4}l^2 + \frac{9}{4}m^2 + \frac{9}{4}n^2 = k$

$k = \frac{9}{4}$

80) b $x = 40 + 12t - t^3$

$\frac{dx}{dt} = v = 12 - 3t^2$

If $v = 0$, then: $t = 2$ sec

$dx = vdt$

$x = \int_0^2 dx = \int_0^2 vdt = \int_0^2 (12 - 3t^2)\,dt = 12(t)_0^2 - 3\left(\frac{t^3}{3}\right)_0^2 = 16$ m

81) a $d = v_r t = (45 + 36) \times \frac{5}{60} = 6.75$ km

82) a $T_{max} - mg = ma$

$a = \frac{T}{m} - g = \frac{250}{20} - 10 = 2.5\ m/s^2$

83) a $\frac{\left(\frac{d\theta}{dt}\right)_1}{\left(\frac{d\theta}{dt}\right)_2} = \frac{\theta_1 - \theta_0}{\theta_2 - \theta_0}$

$\frac{10/10}{8/10} = \frac{55 - \theta_0}{46 - \theta_0}$

$\theta_0 = 10^\circ C$

84) b $dQ = nC_p dT$

$C_p = \frac{175}{5\times 5} = 7$ cal/mol − K

$dU = nC_v dT = 5(C_p - R)(35 - 30)$

$= 5\left(7 - \frac{8.31}{4.2}\right) \times 5 = 125$ cal

85) d $f_s = f_t$ $\quad l = 65$ cm

$f_s' = f_t + 8$ $\quad l' = 64$ cm

$\frac{f_s}{f_s'} = \frac{l'}{l}$

$\frac{f_t}{f_t+8} = \frac{64}{65}$
$f_t = 512$ Hz

86) b $E = V/d$
$V = Ed = \frac{2\times10^3}{10^{-3}} \times 50 \times 10^{-6} = 100$ V

87) a

88) d $\mathrm{E} = -\frac{\mathrm{d}\phi}{\mathrm{dt}} = -\frac{\phi_2-\phi_1}{\mathrm{t}} = -\frac{(0-\mathrm{BAN})}{\mathrm{t}} = \frac{\mathrm{BAN}}{\mathrm{t}} = \frac{20\times10^{=2}\times100}{2\times10^{-3}} = 10{,}000$ V $= 10$ kV

89) c $V = \sqrt{{V_R}^2 + (V_L - V_C)^2} = \sqrt{10^2 + (18-8)^2} = \sqrt{100+100} = 10\sqrt{2}\,V$

90) b $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$
$d\left(\frac{1}{f}\right) = d(u^{-1}) + (v^{-1})$
$0 = -\frac{du}{u^2} - \frac{dv}{v^2}$
$\frac{dv}{du} = -\left(\frac{v}{u}\right)^2$
$dv = -\left(\frac{f}{u-f}\right)^2 du$
$\therefore dI = \left(\frac{f}{u-f}\right)^2 . b$

91) c $N_0 = \frac{6.023\times10^{23}\times0.1}{226} = 2.66 \times 10^{20}$
$A = \lambda N_0 = \frac{0.693}{T_{1/2}} \times N_0 = 3.6 \times 10^9$ disintegration/s

92) a $\frac{hc}{\lambda} = \phi + KE$
$\frac{hc}{\lambda} = \phi + \frac{1}{2}mv^2$
$v = \sqrt{\frac{2}{m}\left(\frac{hc}{\lambda} - \phi\right)} = 5.2 \times 10^5$ m/s
$Bev = \frac{mv^2}{r}$
$B = \frac{mv}{er} = 1.5 \times 10^{-5}$ T

93) c In alkaline medium $KMnO_4$ is reduced to K_2MnO_4.
$KI + H_2O \rightarrow HI + KOH$
$2KMnO_4 + 2KOH \rightarrow 2K_2MnO_4 + H_2O + [O]$
So, 1 mole of $KMnO_4$ is reduced by one mole of KI.

94) c SiF_4 has symmetrical tetrahedral structure, while CO_2 has linear symmetrical structure. Hence, both of these have zero dipole moment, leaving only option (c) whose both members have definite dipole moments.

95) d

A	+	B	$\rightleftharpoons$	C	+	D
1		1		0		0
$1-\frac{1}{3}$		$1-\frac{1}{3}$		$\frac{1}{3}$		$\frac{1}{3}$

$K = \frac{(1/3)^2}{(2/3)^2} = \frac{1}{4} = 0.25$

96) c $W_H = Z_H it$ --- (i)
$W_0 = Z_0 it$ --- (ii)
Dividing (i) by (ii),
$\frac{W_H}{W_0} = \frac{Z_H}{Z_0}$
$\frac{0.504}{W_0} = \frac{1/96500}{8/96500}$

$W_0 = 4.032$ g

97) b In this solution, zinc exists as zincate ion $(ZnO_2{}^{2-})$.

$Zn^{2+} + 2NaOH \rightarrow Zn(OH)_2 \downarrow + 2Na^+$

$Zn(OH)_2 + 2NaOH \rightarrow Na_2ZnO_2(aq) + 2H_2O$

98) a Since, chlorine is more electronegative than Bromine, it will displace bromine from an aqueous solution containing bromide ions.

99) a Smaller the size of nucleophile (CH_3O^-), lesser is the steric hindrance and more reactive is the nucleophile.

100) c

$$C_6H_5NH_2 + 3KOH + CHCl_3 \rightarrow \underset{\text{foul-smelling}}{C_6H_5NC}$$

$$\underset{(Z)}{C_2H_5OH} + Cl_2 \xrightarrow{Ca(OH)_2\text{(slaked lime)}} \underset{Acetaldehyde}{CH_3CHO} \xrightarrow{Cl_2} \underset{chloral}{CCl_3CHO}$$

$$\xrightarrow{Ca(OH)_2} \underset{Chloroform}{CHCl_3}$$

Z is ethanol.

❖❖❖❖ Thank You!!! ❖❖❖❖