INSTITUTE OF ENGINEERING

Model Entrance Exam

(Set-11 Solutions)

Instructions:

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

Date: 2080/04/27
(August-12)

Duration: 2 hours
Time: 8 AM – 10 AM

Section-A (1 marks)

1) d
2) b
3) a
4) d $m = -1$ is not possible for s-orbital ($l = 0$).
5) c
6) a
7) a
8) c
9) d
10) a Mass of 22400 cm^3 of NH_3 at STP = 17 g
Mass of 112 cm^3 of NH_3 at STP $= \frac{17\times112}{22400}$ g $= 0.085$ g
11) a $E_{H_2SO_4} = \frac{98}{2} = 49$
$N = \frac{50\times1000}{49\times50} = 2.04$
12) a
13) d
14) b
15) c
16) a
17) c
18) d
19) d
20) a
21) d
22) c
23) c
24) c $\begin{pmatrix} 0 & k+2 \\ 5 & 0 \end{pmatrix}$ is a skew symmetric matrix if:
$a_{ij} = -a_{ji}$
$k + 2 = -5$
$k = -5 - 2 = -7$
25) d $(A \cap \overline{B}) = \{x: x \in A \text{ and } x \in \overline{B}\} = \{x: x \in A \text{ and } x \notin B\} = A - B$
26) a Put $2x + 1 = t$
$x = \frac{t-1}{2}$
$f(t) = \frac{t-1}{2} + 1 = \frac{t+1}{2}$
$\therefore f(x^2) = \frac{x^2+1}{2}$
27) a Let three numbers in G.P. be $\frac{a}{r}, a, ar$.
As given, $\frac{a}{r} \times a \times ar = 1728$
$a^3 = 1728$
$\therefore a = 12$ (middle term)
28) b Given quadratic equation is:
$4x^2 + 3x + 7 = 0$
$\alpha + \beta = -\frac{3}{4}$
$\alpha\beta = \frac{7}{4}$
$\frac{1}{\alpha} + \frac{1}{\beta} = \frac{\alpha+\beta}{\alpha\beta} = \frac{-\frac{3}{4}}{\frac{7}{4}} = -\frac{3}{7}$
29) a $x + y + z = a + b + a\omega + b\omega^2 + a\omega^2 + b\omega = a(1 + \omega + \omega^2) + b(1 + \omega + \omega^2) = a \times 0 + b \times 0 = 0$

30) b $|\vec{a}+\vec{b}| = |\vec{a}-\vec{b}|$

$|\vec{a}|^2 + 2\vec{a}.\vec{b} + |\vec{b}|^2 = |\vec{a}|^2 - 2\vec{a}.\vec{b} + |\vec{b}|^2$

$\therefore \vec{a}.\vec{b} = 0$

31) c Dr's of line normal to $2x - y + 2z = 0$ are: 2, -1, 2.

Dc's are:

$\frac{2}{\sqrt{4+1+4}}, -\frac{1}{\sqrt{4+1+4}}, \frac{2}{\sqrt{4+1+4}}$

$i.e., \frac{2}{3}, \frac{-1}{3}, \frac{2}{3}$

32) a $ax^2 + 2hxy + by^2 = 0$ represents a pair of perpendicular lines if $a + b = 0$ i.e, $a = -b$

33) c As given, $\frac{2b^2}{a} = b$

$2b = a$

$4b^2 = a^2$

$4a^2(1-e^2) = a^2$

$1 - e^2 = \frac{1}{4}$

$e = \frac{\sqrt{3}}{2}$

34) c Here, $(\vec{a}+\vec{b}+\vec{c})(\vec{a}+\vec{b}+\vec{c}) = 0$

$a^2 + b^2 + c^2 + 2(\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}) = 0$

$3 + 2(\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}) = 0$

$\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a} = -\frac{3}{2}$

35) a On solving parabola,

$(y-1)^2 = \frac{-3}{2}\left(x - \frac{11}{6}\right)$

Vertex (h, k) = $\left(\frac{11}{6}, 1\right)$

Tangent at vertex is:

$x = h = \frac{11}{6}$

$\therefore 6x = 11$

37) c $2\sec 2\alpha = \tan\beta + \cot\beta$

$2\sec 2\alpha = \frac{\sin\beta}{\cos\beta} + \frac{\cos\beta}{\sin\beta}$

$2\sec 2\alpha = \frac{1}{\sin\beta.\cos\beta}$

$2\sec 2\alpha = \frac{2}{2\sin\beta.\cos\beta}$

$2\sec 2\alpha = 2\operatorname{cosec} 2\beta$

$\sin 2\beta = \cos 2\alpha = \sin\left(\frac{\pi}{2} - 2\alpha\right)$

$2\beta = \frac{\pi}{2} - 2\alpha$

$\alpha + \beta = \frac{\pi}{4}$

37) c $a = 2b$

$2R\sin A = 2.2R\sin B$

$\sin 3B = 2\sin B$

$3\sin B - 4\,sin^3 B = 2\sin B$

$\sin B = 4\,sin^3 B$

$1 = 4\,sin^2 B$

$\sin B = \frac{1}{2} = \sin 30^\circ$

$B = 30^\circ$

$\therefore A = 3B = 90^\circ$

38) d $f(x) = 2x + \cos x$

$f'(x) = 2 - \sin x > 0 \qquad (x \in R)$

Hence, f is an increasing function.

39) a $\int_0^1 \frac{1-x}{1+x}dx = \int_0^1 \left(-1+\frac{2}{1+x}\right)dx = |-x+2\log(1+x)|_0^1 = -1+2\log 2 = 2\log 2 - 1$

40) b $\int \tan^{-1}\sqrt{\frac{1-\cos 2x}{1+\cos 2x}}dx = \int \tan^{-1}\sqrt{\frac{2sin^2x}{2cos^2x}}dx = \int \tan^{-1}(\tan x)\,dx = \int x\,dx = \frac{x^2}{2}+c$

41) b $\frac{dy}{dx} = am\cos mx - bm\sin mx$

$\frac{d^2y}{dx^2} = -am^2\sin mx - bm^2\sin mx = -m^2(a\sin mx + b\sin mx) = -m^2y$

42) b $\lim_{x\to\frac{\pi}{4}}\left(\frac{1-\tan x}{1-\sqrt{2}\sin x}\right)$ $\left(\frac{0}{0}\right)$ form

Using L'Hospital rule

$= \lim_{x\to\frac{\pi}{4}}\frac{-sec^2x}{-\sqrt{2}\cos x} = \frac{(\sqrt{2})^2}{\sqrt{2}\left(\frac{1}{\sqrt{2}}\right)} = 2$

43) c $\lim_{x\to 0} f(x) = \lim_{x\to 0}\frac{\sin 3x}{3}.3 = 3$

And $f(0) = \frac{k}{2}$

Since, $f(x)$ is continuous at $x = 0$, then:

$\frac{k}{2} = 3$

$k = 6$

44) c $H = I^2RT$

$H \propto I^2$

45) d

46) a Angular momentum, $L = \frac{nh}{2\pi}$

As $\frac{n}{2\pi}$ is just a number, thus dimensions of Planck's constant is same as that of angular momentum.

47) c Change in momentum, $p = p_f - p_i = -mv - mv = -2mv$

Momentum changes by 2mv in magnitude but kinetic energy remains same.

48) b $x = A\sin\omega t$

The particle is at mean position initially i.e., at $t = 0, x = 0$

At some instant t, the particle is at a position of half amplitude i.e., $x = \frac{A}{2}$

$\frac{A}{2} = A\sin\omega t$

$\sin\omega t = \frac{1}{2}$

$\omega t = \frac{\pi}{6}$

$\frac{2\pi}{T}\times t = \frac{\pi}{6}$

$t = \frac{T}{12}$

49) d $\sigma = \frac{Q}{A} = \frac{1.6\times10^{-19}}{2\times10^{-6}} = 8\times10^{-14}$

50) b An electric dipole when kept in uniform electric field experiences a torque but no force.

51) d

52) b

53) c

54) b The purpose of water proofing agent is to alter the surface of a solid such that it starts repelling water.
Initially, the surface was getting wet by water as water tends to spread on the surface, because contact angle is acute.
If the solid surface (e.g., clothes) are sprayed with waterproofing agent , then it changes the angle of contact from acute to obtuse. Hence, water tends to be repelled from the surface and beads up on the surface and does not easily penetrate the clothing.

55) d $E = NAB\omega\cos\theta$

The induced emf in the coil is maximum when $\cos\theta$ is maximum or $\theta = 0^\circ$.

56) b Friction forces are always parallel to the surfaces in contact, which in this case, are the wall and the cover of the book. This tells us that the friction force is either upwards or downwards. Because the tendency of the book is to fall due to gravity, the friction force must be in upward direction.

57) a

58) d Radioactivity is a nuclear phenomenon. Inside an unstable radioactive nucleus, electron is created as a result of decay of one neutron into a proton inside a nucleus and it is not possible for the electron to stay inside the nucleus; thus, it is spontaneously emitted in the form of beta radiation.

59) c

60) a

<u>Section-B</u> (2 marks)

61) d Photosynthesis produces sugar in a plant, and oxygen is a byproduct. The other choices may be involved in photosynthesis, but they are not byproducts.

62) a The passage states that photosynthesis produces oxygen, which is necessary for life on earth. None of the other choices fit the context.

63) c The passage states that photosynthesis produces sugar, which the plant uses for food.

64) a Paragraph 4 states that photosynthesis produces oxygen; without oxygen, human life could not exist on earth.

65) d

66) b $MX_2(s) \rightleftharpoons M^{2+} + 2X^-$

Let, $[M^{2+}] = x$

$\therefore [X^-] = 2x$

$K_{sp} = [M^{2+}][X^-]^2$

$4 \times 10^{-12} = x(2x)^2$

$4 \times 10^{-12} = 4x^3$

$\therefore x = [M^{2+}] = 1 \times 10^{-4}$ M

67) b The given cell is:

$Fe \mid Fe^{2+} \parallel Fe^{3+} \mid Fe^{2+}$

$E^0 = E^0{}_{Fe^{3+}/Fe^{2+}} - E^0{}_{Fe^{2+}/Fe} = 0.771 - (-0.441) = 1.212$ V

68) c $CaCl_2 \xrightarrow{H_2O} HC \equiv CH \xrightarrow{hot\ iron\ tube} C_6H_6 \xrightarrow{CH_3Cl, AlCl_3} C_6H_5CH_3$

Acetylene Benzene Toluene

69) d Normality $= \frac{\text{Gram equivalents}}{\text{Volume (in mL)}} \times 1000$

Gram equivalents of HCl $= \frac{0.1 \times 100}{1000} = 0.01$

No. of gram equivalents of metal carbonate = No. of gram equivalents of HCl

$\therefore$ Gram equivalents of metal carbonate = 0.01

$\frac{\text{Weight}}{\text{Equivalent weight}} = 0.01$

Equivalent weight $= \frac{2}{0.01} = 200$

70) c The orbitals are: (i) 4p (ii) 4s (iii) 3d (iv) 3p

Increasing order of energies is:

(iv) 3p < (ii) 4s < (iii) 3d < (i) 4p

71) a $MnO_2 + 2HCl \longrightarrow MnCl_2 + \underset{\text{Greenish yellow}}{Cl_2} + 2H_2O$

$NH_3 + 3Cl_2 \longrightarrow NCl_3 + 3HCl$

Oxidation state of N in NH_3 is -3 and in NCl_3 is +3.

72) a $4x^2 - 9xy - 9y^2 = 0$

$(4x + 3y)(x - 3y) = 0$

$x - 3y = 0$ and $4x + 3y = 0$

So, the sides of triangle are:

$x - 2 = 0, x - 3y = 0$ & $4x + 3y = 0$

Solving, we get vertices $A(0,0), B\left(2, -\frac{8}{3}\right)$ and $C\left(2, \frac{2}{3}\right)$

Area (A) $= \frac{1}{2}\begin{vmatrix} x_1 - x_3 & x_2 - x_3 \\ y_1 - y_3 & y_2 - y_3 \end{vmatrix} = \frac{1}{2}\begin{vmatrix} 0 - 2 & 2 - 2 \\ 0 - \frac{2}{3} & -\frac{8}{3} - \frac{2}{3} \end{vmatrix} = \frac{1}{2}\begin{vmatrix} -2 & 0 \\ -\frac{2}{3} & -\frac{10}{3} \end{vmatrix} = \frac{1}{2}\left(\frac{20}{3}\right) = \frac{10}{3}$

73) c Equation of tangent of parabola $yy_1 = 2a(x + x_1)$ and $a = 1$

Coordinates of endpoints of latus rectum are:

A(1, 2) and B(1, -2)
Equation of tangent at A(1, 2) is:
$2y = 2(x + 1)$ --- (i)
Equation of tangent at B(1, -2) is:
$-2y = 2(x + 1)$ --- (ii)
On solving (i) and (ii),
$y = 0; x = -1$
Hence, the point of intersection of tangents at the end points is (-1, 0).

74) c The equation of plane through (x_1, y_1, z_1) and perpendicular to the planes $a_1x + b_1y + c_1z + d_1 = 0$ and $a_2x + b_2y + c_2z + d_2 = 0$ is:

$$\begin{vmatrix} x - x_1 & y - y_1 & z - z_1 \\ a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \end{vmatrix} = 0$$

i.e., $\begin{vmatrix} x - 1 & y + 3 & z + 2 \\ 1 & 2 & 2 \\ 3 & 3 & 2 \end{vmatrix} = 0$

Expanding,
$2x - 4y + 3z - 8 = 0$

75) b $\left|\vec{a} + \vec{b} + \vec{c}\right|^2 = (\vec{a} + \vec{b} + \vec{c}).(\vec{a} + \vec{b} + \vec{c}) = a^2 + b^2 + c^2 + \vec{a}.(\vec{b} + \vec{c}) + \vec{b}.(\vec{a} + \vec{c}) + \vec{c}.(\vec{a} + \vec{b})$
$\left|\vec{a} + \vec{b} + \vec{c}\right|^2 = 9 + 16 + 25 + 0 + 0 + 0$
$\left|\vec{a} + \vec{b} + \vec{c}\right|^2 = 50$
$\left|\vec{a} + \vec{b} + \vec{c}\right| = \sqrt{50}$
$\therefore \left|\vec{a} + \vec{b} + \vec{c}\right| = 5\sqrt{2}$

76) b Centre = Point of intersection of $2x - 3y - 5 = 0$ and $3x - 4y - 7 = 0$
On solving,
Centre = (1, -1)
Area = $\pi r^2 = 49\pi$
$r = 7$
Equation of circle is:
$(x - 1)^2 + (y + 1)^2 = 7^2$
$x^2 + y^2 - 2x + 2y = 47$

77) c $\tan^{-1} x - \tan^{-1} y = 0$
$x = y$
$\cos^{-1} x + \cos^{-1} y = \frac{\pi}{2}$
$2\cos^{-1} x = \frac{\pi}{2}$
$\cos^{-1} x = \frac{\pi}{4}$
$x = \frac{1}{\sqrt{2}}$
$x^2 + xy + y^2 = \frac{1}{2} + \frac{1}{\sqrt{2}}.\frac{1}{\sqrt{2}} + \frac{1}{2} = \frac{1}{2} + \frac{1}{2} + \frac{1}{2} = \frac{3}{2}$

78) c For the function to get defined,
$0 \le x^2 + x + 1 \le 1$
Suppose range of $x^2 + x + 1 = g(x)$
$g(x) = x^2 + x + \frac{1}{4} + \frac{3}{4} = \left(x + \frac{1}{2}\right)^2 + \frac{3}{4}$
$g(x)_{min} = \frac{3}{4}, g(x)_{max} = 1$
$g(x) \in \left[\frac{3}{4}, 1\right]$
$\sqrt{g(x)} \in \left[\frac{\sqrt{3}}{2}, 1\right] \in \left[\frac{\pi}{3}, \frac{\pi}{2}\right]$
$\therefore$ Range of $\sin^{-1}\left(\sqrt{x^2 + x + 1}\right) = \left[\frac{\pi}{3}, \frac{\pi}{2}\right]$

79) c $\begin{vmatrix} x+4 & x & x \\ x & x+4 & x \\ x & x & x+4 \end{vmatrix}$

$R_1 \to R_1 + R_2 + R_3$

$= \begin{vmatrix} 3x+4 & 3x+4 & 3x+4 \\ x & x+4 & x \\ x & x & x+4 \end{vmatrix}$

$= (3x+4)\begin{vmatrix} 1 & 1 & 1 \\ x & x+4 & x \\ x & x & x+4 \end{vmatrix}$

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

$= (3x+4)\begin{vmatrix} 1 & 0 & 0 \\ x & 4 & 0 \\ x & 0 & 4 \end{vmatrix}$

Expanding, we get,

$= (3x+4)\{1(16-0)\}$

$= 16(3x+4)$

80) b $b^2 = ac, x = \frac{a+b}{2}, y = \frac{b+c}{2}$

$\frac{1}{x} + \frac{1}{y} = \frac{2}{a+b} + \frac{2}{b+c} = \frac{2(b+c+a+b)}{(a+b)(b+c)}$

$= \frac{2(a+2b+c)}{ab+ac+b^2+bc}$

$= \frac{2(a+2b+c)}{ab+b^2+b^2+bc} \quad \because b^2 = ac$

$= \frac{2(a+2b+c)}{b(a+2b+c)}$

$= \frac{2}{b}$

81) d Vowels are A, A, E. Even places are second, fourth and sixth.

Their arrangements at these places will be:

$\frac{3!}{2!} = 3$

$\therefore$ Total number of required words $= \frac{4!}{2!} \times 3 = 36$

82) a If we replace $log_e n = x$, then,

Sum $= x + \frac{x^3}{3!} + \frac{x^3}{5!} + \cdots$

$= \frac{1}{2}(e^x - e^{-x}) = \frac{1}{2}(e^{log_e n} - e^{-log_e n}) = \frac{1}{2}\left(n - \frac{1}{n}\right) = \frac{n^2-1}{2n}$

83) d $\lim_{x\to 1} \frac{1-\sqrt{x}}{(\cos^{-1} x)^2} = \lim_{x\to 1} \frac{(1-\sqrt{x})(1+\sqrt{x})}{(\cos^{-1} x)^2(1+\sqrt{x})}$

Put $x = \cos\theta$

$x \to 1 \Rightarrow \cos\theta \to 1 \Rightarrow \theta \to 0$

$= \lim_{\theta\to 0} \frac{1-\cos\theta}{\theta^2(1+\sqrt{\cos\theta})}$

$= \lim_{\theta\to 0} \frac{1-\cos\theta}{\theta^2} \cdot \frac{1}{(1+\sqrt{\cos\theta})}$

$= \lim_{\theta\to 0} \frac{2\, sin^2\frac{\theta}{2}}{4.\frac{\theta^2}{4}} \cdot \frac{1}{(1+\sqrt{\cos\theta})}$

$= \frac{1}{2}\lim_{\theta\to 0} \left(\frac{\sin\frac{\theta}{2}}{\frac{\theta}{2}}\right)^2 \cdot \frac{1}{(1+\sqrt{\cos\theta})}$

$= \frac{1}{2} \times 1 \times \frac{1}{1+1} = \frac{1}{2} \times 1 \times \frac{1}{2} = \frac{1}{4}$

84) a $y = sec(\tan^{-1} x) = \sec\left(\sec^{-1}\sqrt{1+x^2}\right) = \sqrt{1+x^2}$

Differentiating w.r.t x,

$\frac{dy}{dx} = \frac{d\left(\sqrt{1+x^2}\right)}{d(1+x^2)} \cdot \frac{d(1+x^2)}{dx} = \frac{1}{2\sqrt{1+x^2}} \cdot 2x = \frac{x}{\sqrt{1+x^2}}$

$\left(\frac{dy}{dx}\right)_{x=1} = \frac{1}{\sqrt{2}} = \cos\frac{\pi}{4}$

85) a $I = \int \left(\frac{x+2}{x+4}\right)^2 e^x\, dx = \int \frac{x^2+4x+4}{(x+4)^2} e^x\, dx = \int e^x \left[\frac{x(x+4)}{(x+4)^2} + \frac{4}{(x+4)^2}\right] dx = \int e^x \left[\frac{x}{x+4} + \frac{4}{(x+4)^2}\right] dx$

$= e^x\left(\frac{x}{x+4}\right) + c$

86) c Required area $= \int_{-2}^{2} y dx = \int_{-2}^{2} 1\, dx = [x]_{-2}^{2} = 2 - (-2) = 4$ sq. units

87) c Let t_1 be the time taken by the ball to reach the highest point.
Here, $v = 0, u = 20\ ms^{-1}, a = -g = -10\ ms^{-2}, t = t_1$
$v = u + at$
$0 = 20 + (-10)t_1$
$t_1 = 2$ s
Taking vertical downward motion of the ball from the highest point to the ground
$u = 0, a = +g = 10\ ms^{-2}, S = 20 + 25 = 45\ m, t = t_2$
$S = ut + \frac{1}{2}at^2$
$45 = 0 + \frac{1}{2}(10){t_2}^2$
${t_2}^2 = \frac{45\times2}{10} = \frac{90}{10} = 9$
$t_2 = 3$ s

88) b Maximum height, $H = \frac{u^2 sin^2\theta}{2g}$
$sin^2\theta = \frac{H\times2g}{u^2} = \frac{40\times2\times9.8}{56^2} = \frac{1}{4}$
$\sin\theta = \frac{1}{2}$
$\theta = \sin^{-1}\left(\frac{1}{2}\right) = 30°$

89) b Acceleration of a rolling body down an inclined plane is:
$a = \frac{g\sin\theta}{1+\frac{K^2}{R^2}}$
For solid cylinder, $K^2 = \frac{R^2}{2}$
$a = \frac{g\sin\theta}{1+\frac{1}{2}} = \frac{2}{3}g\sin\theta$

90) b Let v be the speed of body when it escapes the gravitational pull of the Earth and u be the speed of projection of the body from the Earth's surface.
According to the law of conservation of mechanical energy,
$\frac{1}{2}mu^2 - \frac{GM_E m}{R_E} = \frac{1}{2}mv^2 - 0$
Where m and m_E be masses of body and Earth respectively and R_E be the radius of the Earth.
$v^2 = u^2 - \frac{2GM_E m}{R_E}$
$v^2 = u^2 - {v_e}^2 \quad \left(\because v_e = \sqrt{\frac{2GM_E m}{R_E}}\right)$
$v = \sqrt{u^2 - {v_e}^2} = \sqrt{(3v_e)^2 - {v_e}^2} = \sqrt{8}v_e = 2\sqrt{2}\times11.2 = 22.4\sqrt{2}\ kms^{-1}$

91) a $P = h\rho g$
$h = \frac{P}{\rho g} = \frac{3\times10^5}{1000\times9.8}$ m
Velocity of efflux, $v = \sqrt{2gh} = \sqrt{\frac{2\times9.8\times3\times10^5}{1000\times9.8}} = \sqrt{600} = 24.5\ ms^{-1}$

92) b Since in an adiabatic process
$T_1{V_1}^{\gamma-1} = T_2{V_2}^{\gamma-1}$
$T_2 = T_1\left(\frac{V_1}{V_2}\right)^{\gamma-1} = 300\left(\frac{2V}{4V}\right)^{\frac{5}{3}-1} = 300\left(\frac{1}{2}\right)^{2/3} = \frac{300}{2^{2/3}} = 189\ K \qquad \left(\because V_1 = 2V, V_2 = 4V, \gamma = \frac{5}{3}\text{(monatomic gas)}\right)$

93) b Frequency of fundamental note, $v = \frac{1}{2L}\sqrt{\frac{T}{m}}$
In first case, $256 = \frac{1}{2L}\sqrt{\frac{T}{m}}$ --- (i)
In second case, $320 = \frac{1}{2(L-10)}\sqrt{\frac{T}{m}}$ --- (ii)

Dividing (ii) by (i), we get,

$\frac{320}{256} = \frac{2L}{2(L-10)}$

$\frac{L}{L-10} = \frac{5}{4}$

$L = 50$ cm

94) b As the capacitors are connected in parallel, potential difference across both the condensers remains the same.

$q_1 = CV, q_2 = \frac{C}{2}V$

Also, $q = q_1 + q_2 = CV + \frac{C}{2}V = \frac{3}{2}CV$

Work done in fully charging both the condensers is:

$W = \frac{1}{2}qV = \frac{1}{2} \times \left(\frac{3}{2}CV\right) \times V = \frac{3}{4}CV^2$

95) d Length of a wire (L) $= 2\pi r = 2\pi \times \frac{10}{100}\ m = \frac{\pi}{5}\ m$

Resistance of wire $= 12 \times \frac{\pi}{5} = \frac{12\pi}{5}$

Resistance of each part $= \frac{\left(\frac{12\pi}{5}\right)}{2} = \frac{6\pi}{5}$

Since upper and lower part of the wire are in parallel connection.

$R_{eqv} = \frac{\frac{6\pi}{5}\times\frac{6\pi}{5}}{\frac{6\pi}{5}+\frac{6\pi}{5}} = \frac{36\pi^2}{25} \times \frac{5}{12\pi} = \frac{15}{25}\pi = 0.6\ \pi\ \Omega$

96) b Here, $n = 500\ turns/m, I = 1\ A, \mu_r = 500$

Magnetic Intensity; $H = nI = 500\ Am^{-1}$

As, $\mu_r = 1 + \chi$

Where, χ is the magnetic susceptibility of the material.

$\chi = \mu_r - 1$

Magnetization, $M = \chi H = (\mu_r - 1)H = (500 - 1) \times 500 = 2.5 \times 10^5\ Am^{-1}$

97) b Current in circuit, $I = \frac{V}{Z} = \frac{220}{44} = 5\ A$

Power dissipated in the circuit, $P = I^2R = 5^2 \times 22 = 550\ W$

98) d Here, $f_0 = 1.5\ cm, f_e = 6.25\ cm, u_0 = -2\ cm, v_e = -25\ cm$

For objective,

$\frac{1}{f_0} = \frac{1}{v_0} - \frac{1}{u_0}$

$\frac{1}{v_0} = \frac{1}{f_0} + \frac{1}{u_0} = \frac{1}{1.5} + \frac{1}{-2} = \frac{2}{3} - \frac{1}{2} = \frac{4-3}{6} = \frac{1}{6}$

$v_0 = 6$ cm

For eye-piece,

$\frac{1}{v_e} - \frac{1}{u_e} = \frac{1}{f_e}$

$\frac{1}{u_e} = \frac{1}{v_e} - \frac{1}{f_e} = -\frac{1}{25} - \frac{1}{6.25} = -\frac{1}{25} - \frac{4}{25} = -\frac{5}{25} = -\frac{1}{5}$

$u_e = -5$ cm

Distance between two lenses $= |v_0| + |u_e| = 6 + 5 = 11$ cm

99) b Angular position of first dark fringe, $\theta_1 = (2 \times 1 - 1)\frac{\lambda}{2d} = \frac{\lambda}{2d} = \frac{5460\times10^{-10}}{2\times0.1\times10^{-3}} = 2730 \times 10^{-6}\ rad = 2730 \times 10^{-6} \times \frac{180^\circ}{\pi}$ $= 0.16^\circ$

100) d Energy, $E_n = -\frac{13.6}{n^2}\ eV$

In ground state, $E_1 = -\frac{13.6}{1^2} = -13.6\ eV$

In first excited state, $E_2 = -\frac{13.6}{2^2} = -3.4\ eV$

Required energy $= E_2 - E_1 = -3.4 - (-13.6) = 10.2\ eV$

Thank You!!!!!!