INSTITUTE OF ENGINEERING

Model Entrance Exam

(Set-5 Solutions)

Instructions:

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

Date: 2080/03/16
(July-01)

Duration: 2 hours
Time: 8 AM – 10 AM

Section-A (1 marks)

1) a
2) d
3) b
4) d
5) d
6) c
7) a
8) d
9) a
10) a
11) a
12) d
13) d $Pressure\ gradient = \frac{Pressure}{distance} = \frac{Nm^{-2}}{m} = Nm^{-3}$
14) b Free fall of an object in vacuum is a case of motion with uniform acceleration.
15) c In inelastic collision between two bodies, total linear momentum is always conserved.
16) d According to Hooke's law, within the elastic limit, stress is directly proportional to the strain i.e.,
$Stress \propto Strain$
$Stress = k.Strain$
$\frac{Stress}{Strain} = k$
Where k is the proportionality constant and is known as modulus of elasticity.
17) a The excess pressure inside a soap bubble is:
$P_i = \frac{4T}{R} + P_0$
Where, P_i → inside pressure, P_0 → outside pressure
Here, P_0 and T is constant, so when R increases, P_i decreases.
18) c The motion of a planet around the Sun is a periodic motion but not a simple harmonic motion.
19) c Change in temperature of the medium changes the velocity of sound waves and hence the wavelength of sound waves. This is because frequency $\left(f = \frac{v}{\lambda}\right)$ is fixed.
20) c During isothermal process, internal energy of a system always remains constant.
Hence, $dU = 0$
21) c $Q = ms\Delta\theta$
$s = \frac{Q}{m\Delta\theta}$
At constant temperature, $\Delta\theta = 0 \Rightarrow c = \infty$ (infinite).
22) d
23) d
24) d The phenomenon of polarization confirmed that light is a transverse wave.
25) a As $\lambda = \frac{h}{\sqrt{2mK}}$
$\lambda \propto \frac{1}{\sqrt{m}}$
Out of the given particles, m is least for electron, therefore, electron has the largest value of de Broglie wavelength.
26) b Jump to second orbit leads to Balmer series. When an electron jumps from 4^{th} orbit to 2^{nd} orbit it gives rise to second line of Balmer series.
27) b In a capacitive ac circuit, the voltage lags behind the current in phase by $\pi/2$ radian.
28) a $M = \frac{\mu_0 N_1 N_2 A}{l}$
∴ M become 4 times.
29) b When the heater is connected to the supply its initial current will be slightly higher than its steady value but due to heating effect of the current, the temperature will rise. This causes an increase in resistance and a slight decrease in current to steady current.
30) b 18 g of H_2O = N_A H_2O molecules = $8 \times N_A$ neutrons
1 g of H_2O = $\frac{8}{18} \times N_A$ neutrons
1.8 g of H_2O = $\frac{8}{18} \times 1.8 \times N_A = 0.8\ N_A$ neutrons
31) d Electronic configuration of Na is: $1s^2 2s^2 2p^6 3s^1$
Here, the valence electron is in 3s orbital ($3s^1$). For s-orbital, the l value (azimuthal quantum number) is zero, so magnetic quantum number will be zero.

32) b

33) a If any central metal atom combined with corbonyl group than central metal atom shows always zero oxidation state.

34) d Copper is less reactive metal and has positive standard reduction potential. Metal with high standard reduction potential cannot displace other metal with low standard reduction potential values.
Hence, Copper (E°=0.34 V) cannot displace iron (E°=-0.44 V) from ferrous sulphate solution. So, no reaction will take place.

35) a Ionization potential increases along the period.

36) d Cryolite → Na_3AlF_6

37) a ${NO_2}^+$ is produced when conc. HNO_3 reacts with conc. H_2SO_4.
$HNO_3 + H_2SO_4 \rightarrow {HSO_4}^- + {NO_2}^+ + H_2O$

38) c Ammoniacal $AgNO_3$ (Tollen's reagent) reacts with terminal acetylenes to form the silver acetylide which precipitates out of the solution.
$RC \equiv CH + AgNO_3 + NH_4OH \rightarrow RC \equiv CAg \downarrow + NH_4NO_3 + H_2O$

39) c When chlorine gas is passed over dry slaked lime at room temperature, the main reaction product is $CaOCl_2$ (bleaching powder).
$Ca(OH)_2 + Cl_2 \rightarrow CaOCl_2 + H_2O$

40) b Zn^{2+} has $3d^{10}$ configuration and does not have vacant d-subshell.

41) d $f(x) = \sqrt{(x-2)^2 + 2}$
The least value of f(x) is $\sqrt{2}$ when $x - 2 = 0$.
Hence, the range is $[\sqrt{2}, \infty)$.

42) c We know that $\sin^{-1}\left(\frac{2x}{1+x^2}\right) = 2\tan^{-1}x\,, for -1 \le x \le 1$
So, $\lim_{x\to 0}\frac{1}{x}\sin^{-1}\left(\frac{2x}{1+x^2}\right) = \lim_{x\to 0}\frac{2\tan^{-1}x}{x} = 2$

43) a $y = \sqrt{sinx + y}$
or, $y^2 = sinx + y$
Differentiating w.r.t. x,
$2y\frac{dy}{dx} = cosx + \frac{dy}{dx}$
$\therefore \frac{dy}{dx} = \frac{cosx}{2y-1}$

44) a $f'(x) = \frac{1}{2} - \frac{2}{x^2}$ and $f''(x) = \frac{4}{x^3}$
Now, $f'(x) = 0$ or $x^2 = 4$ or $x = \pm 2$
$\therefore f''(x) > 0$ for $x = 2$
So, f has local minima at x = 2

45) a $\int sec^2xcosec^2x\,dx = \int\frac{cos^2x+sin^2x}{cos^2xsin^2x}dx = \int(sec^2x + cosec^2x)\,dx = tanx - cotx + c$

46) d Let $x \in (A \cap \bar{B})$
$A \cap \bar{B} = \{x : x \in A \text{ and } x \in \bar{B}\} = \{x : x \in A \text{ and } x \notin B\} = (A - B)$

47) b System has no solution if $D = 0$
$\begin{vmatrix} k & 3 \\ 1 & 2 \end{vmatrix} = 0$
or, $2k - 3 = 0$
$\therefore k = 3/2$

48) c $(1 + 2 + 3 + \cdots + n) = \frac{1}{5}(1^2 + 2^2 + 3^2 + \cdots + n^2)$
$\frac{n(n+1)}{2} = \frac{1}{5}\frac{n(n+1)(2n+1)}{6}$
$2n + 1 = 15$
$n = 7$

49) a Let α and β be the roots of the equation.
Then sum of the roots = $-\frac{p}{1} = -p$ and product of roots = $\frac{q}{1} = q$
Now, $\alpha + \beta = \alpha^2 + \beta^2 = (\alpha+\beta)^2 - 2\alpha\beta$
or, $-p = (-p)^2 - 2q$
$\therefore p^2 + p = 2q$

50) d Since, $\sqrt{-4} \notin R$. $(\sqrt{-4}, \sqrt{4})$ is not a complex number.

51) c $log_b 8 = 3 \Rightarrow log_b 2^3 = 3 \Rightarrow 3log_b 2 = 3 \Rightarrow log_b 2 = 1$
$log_a b = log_2 b . log_a 2 = log_2 b . log_3 2 . log_a 3 = 1 . log_3 2.2 = 2log_3 2 = log_3 2^2 = log_3 4$

52) c Since, given vectors are co-planar,
$\begin{vmatrix} a & 1 & 1 \\ 1 & b & 1 \\ 1 & 1 & c \end{vmatrix} = 0$
or, $a(bc - 1) - 1(c - 1) + 1(1 - b) = 0$

or, $abc - a - c + 1 + 1 - b = 0$
$\therefore abc + 2 = a + b + c$

53) a $(b + c)cosA + (c + a)cosB + (a + b)cosC$
$= b\ cosA + c\ cosA + c\ cosB + a\ cosB + a\ cosC + b\ cosC$
$= (b\ cosA + a\ cosB) + (c\ cosA + a\ cosC) + (b\ cosC + c\ cosB)$
$= c + b + a$ (Projection Law)

54) a $\cos^{-1}(-x) - \sin^{-1}x = \pi - \cos^{-1}x - \sin^{-1}x = \pi - (\cos^{-1}x + \sin^{-1}x) = \pi - \frac{\pi}{2} = \frac{\pi}{2}$

55) a $f(x) = x^6 + tan^2x$
$f(-x) = (-x)^6 + [\tan(-x)]^2 = x^6 + tan^2x = f(x)$
Hence, given function is an even function.

56) c To find y-intercept, put x = 0 and z = 0
$0 + 2y - 2(0) = 9$
$\therefore y = 9/2$

57) d $16x^2 - 9y^2 = 144$
or, $\frac{16x^2}{144} - \frac{9y^2}{144} = \frac{144}{144}$
or, $\frac{x^2}{9} - \frac{y^2}{16} = 1$
Here, $a^2 = 9, b^2 = 16$
Length of latus rectum = $\frac{2b^2}{a} = \frac{2(16)}{3} = \frac{32}{3}$

58) d $x = acos\theta$ and $y = bsin\theta$
$\frac{x}{a} = cos\theta$ …(1) and $\frac{y}{b} = sin\theta$ …(2)
Squaring and adding (1) and (2), we get,
$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, which is an ellipse.

59) b Comparing with $x^2 + y^2 + 2gx + 2fy + c = 0$
$2g = -8 \Rightarrow g = -4; 2f = 1 \Rightarrow f = 1/2; c = -20$
Y-intercept = $2\sqrt{f^2 - c} = 2\sqrt{\frac{1}{4} + 20} = 2\sqrt{\frac{81}{4}} = 2.\frac{9}{2} = 9$ units

60) b The point of intersection of lines $3x + y + 2 = 0, 2x - y + 3 = 0$ is: (-1,1)
Substituting the value in $x + py = 3$
$-1 + p = 3$
i.e., $p = 4$

Section-B (2 marks)

61) d Author has mentioned in third line of passage 'I never went out of the ship till we came into the Downs'.

62) a In a long ship journey which continues for months there is a need of fresh water and food. It can be inferred from the passage that Captain sent in his lifeboat for fresh water and foods. For food and related items word 'provisions' is used which means Cookery, the act of supplying or providing food, etc.

63) b 'Farthing' is a unit of money and in the passage, captain was not willing to receive any money from the author as a friendly gesture. Farthing means – A coin formerly used in Great Britain worth one fourth of a penny.

64) c Passage shows relationship of author and captain in a positive light. As captain refused to take 'single penny for the services', 'author's invitation to captain' and 'borrowing of money from captain for home' are some examples that show that captain's attitude for the author was friendly and kind.

65) a Let u be the velocity of projection of the ball. The ball will cover maximum horizontal distance when angle of projection with horizontal, $\theta = 45°$.
Then, $R_{max} = \frac{u^2}{g}$
Here, $R_{max} = 100\ m$
$\frac{u^2}{g} = 100$ m
As, $v^2 - u^2 = 2as$
At highest point, $v = 0, a = -g, s = H$
$H = \frac{u^2}{2g} = \frac{100}{2} = 50\ m$

66) b Force of friction, $f = \mu N = \mu mg = 0.5 \times 10\ kg \times 10\ ms^{-2} = 50\ N$
Force that produces acceleration,
$F' = F - f = 100 - 50 = 50\ N$
$a = \frac{F'}{m} = \frac{50\ N}{10\ kg} = 5\ ms^{-2}$

67) b Kinetic energy, $K = \frac{1}{2} I\omega^2$

$\omega = \sqrt{\frac{2K}{I}} = \sqrt{\frac{2\times1500}{1.2}} = 50\ rad/s$

$\omega = \omega_0 + \alpha t = 0 + \alpha t \quad [\omega_0 = 0]$

$t = \frac{\omega}{\alpha} = \frac{50}{25} = 2\ sec$

68) c Weight of body on the surface of Earth $= mg = 72\ N$

Acceleration due to gravity at height h is

$g_h = \frac{gR_E^2}{(R_E+h)^2} = \frac{gR_E^2}{\left(R_E+\frac{R_E}{2}\right)^2} = \frac{4}{9}g \qquad \because h = \frac{R_E}{2}$

Gravitational force on body at height h is

$F = mg_h = m \times \frac{4}{9}g = \frac{4}{9}mg = \frac{4}{9}\times 72 = 32\ N$

69) c For floating equilibrium,

Weight of metallic sphere = weight of liquid displaced

$V\rho g = \frac{4}{5}V\rho_W g + \frac{1}{5}V\rho_L g$

$\rho = \frac{4\rho_W+\rho_L}{5} = \frac{4\times10^3+13.5\times10^3}{5} = 3.5\times10^3\ kg/m^3$

70) c $d_2 = \frac{d_1}{1+\gamma\Delta T}$

$\gamma = \frac{d_1-d_2}{d_2\Delta T} = \frac{998-992}{992\times(40-20)} = 3\times10^{-4}\ /^\circ C$

71) c $\frac{E_2}{E_1} = \left(\frac{T_2}{T_1}\right)^4$

$\frac{T_2}{T_1} = \left(\frac{E_2}{E_1}\right)^{1/4} = \left(\frac{16\times10^6}{1\times10^6}\right)^{1/4} = 2$

$T_2 = 2T_1 = 2\times(127+273) = 2\times400 = 800\ K = (800-273)^\circ C = 527^\circ C$

72) c Frequency of sound heard by driver

$n' = \frac{v+v_s}{v-v_s}n = \frac{335+5}{335-5}\times165 = 170\ Hz$

Number of beats, $x = n' - n = 170 - 165 = 5$

73) c $C_p = 2 + 4 = 6\ \mu F$

Also, $\frac{1}{C} = \frac{1}{6} + \frac{1}{6} = \frac{1}{3}$

$C = 3\ \mu F$

Total charge, $Q = CV = 3\times12 = 36\ \mu C$

Voltage across 6 μF capacitor $= \frac{36}{6} = 6\ V$

∴ Voltage across each of 2 μF and 4 μF capacitors $= 12 - 6 = 6\ V$

74) c Here, $I_g = 1\ mA = 1\times10^{-3}\ A, G = 10\ \Omega, V = 2.5\ V$

From the figure,

$V = I_g(G+R)$

$R = \frac{V}{I_g} - G = \frac{2.5}{1\times10^{-3}} - 10 = 2500 - 10 = 2490\ \Omega$

75) a Here, $H = 2\times10^3 Am^{-1}, B = 8\pi\ T$

Since, $\mu_r = \frac{\mu}{\mu_0} = \frac{\mu H}{\mu_0 H} = \frac{B}{\mu_0 H} = \frac{8\pi}{4\pi\times10^{-7}\times2\times10^3} = 10^4$

76) b Induced emf, $V = -\frac{d\phi}{dt} = -\frac{(0.01-0.002)}{1\times10^{-3}} \qquad [\because \phi = BA]$

$V = 0.01\times10^3 = 10\ V$

Also, $V = IR$

$I = \frac{10}{2} = 5\ A$

Rate of heat evolved $= I^2R = 5^2\times2 = 50\ J/s$

77) d According to lens maker's formula,

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

$\frac{1}{30} = (\mu-1)\left(\frac{1}{\infty} - \frac{1}{-10}\right)$

$\frac{1}{30} = \frac{(\mu-1)}{10}$

$\mu = \frac{4}{3}$

78) a Width of slit, $d = \frac{n\lambda D}{x} = \frac{1\times500\times10^{-9}}{2.5\times10^{-3}} = 2\times10^{-4}\ m = 0.2\ mm$

79) c Here, $\frac{N_0-N}{N_0} = \frac{3}{4}$

$\frac{N}{N_0} = \frac{1}{4} = \left(\frac{1}{2}\right)^2$
$\therefore$ Number of half-lives, $n = 2$
$n = \frac{t}{t_{1/2}}$
$t = n \times t_{1/2} = 2 \times 30 = 60$ days

80) d $E^0{}_{cell} = E^0{}_{(Ag^+/Ag)} - E^0{}_{(Cu^{2+}/Cu)}$
$0.46 = 0.80 - E^0{}_{(Cu^{2+}/Cu)}$
$E^0{}_{(Cu^{2+}/Cu)} = 0.80 - 0.46 = 0.34\ V$

81) b

82) b The boiling point increases with increase in the size of alkyl group and decreases with increase in branching. Therefore, $CH_3CH_2CH_2CH_2Cl$ has the highest boiling point.

83) b For isoelectronic ions, the ionic radius decreases with increase in nuclear charge.
$O^{2-} > F^- > Na^+ > Mg^{2+} > Al^{3+}$

84) b $N_a = \frac{V_b \times N_b}{V_a} = \frac{32 \times 0.5}{25} = 0.64\ N$
Equivalent weight, $E = \frac{w \times 1000}{V \times N} = \frac{7.2 \times 1000}{250 \times 0.64} = 45$
Molecular weight $= 2 \times 45 = 90$

85) a $[H_3O^+] = \alpha C = 0.01 \times 0.1 = 10^{-3}$
$p^H = -\log[H_3O^+] = 3$
$p^{OH} = 14 - 3 = 11$

86) b $g\big(f(x)\big) = (sinx + cosx)^2 - 1 = sin^2x + 2sinx.cosx + cos^2x - 1 = 1 + sin2x - 1 = sin2x$
Clearly, $g(f(x))$ is invertible in
$-\frac{\pi}{2} \le 2x \le \frac{\pi}{2}$ $(\because\ sin\theta\ is\ invertible\ when -\pi/2 \le \theta \le \pi/2)$
or, $-\frac{\pi}{4} \le x \le \frac{\pi}{4}$

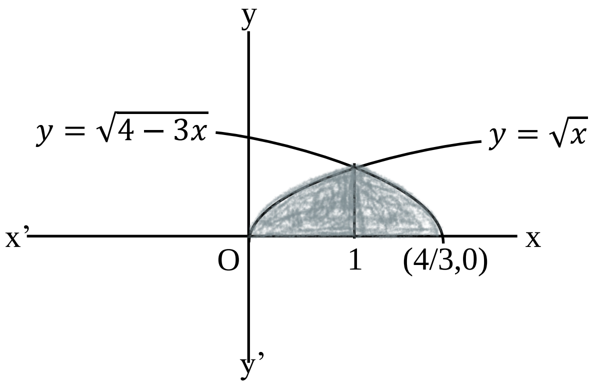
87) b $\lim\limits_{x \to 2} \frac{x^2-x-2}{x^2-2x-\sin(x-2)}$ $\left(\frac{0}{0}\ form\right)$
$= \lim\limits_{x \to 2} \frac{x^2-2x+x-2}{x^2-2x-\sin(x-2)} = \lim\limits_{x \to 2} \frac{(x-2)(x-1)}{x(x-2)-\sin(x-2)} = \lim\limits_{x \to 2} \frac{(x+1)}{x-\frac{\sin(x-2)}{x-2}} = \lim\limits_{x \to 2} \frac{x^2-x-2}{x^2-2x-\sin(x-2)} = \frac{2+1}{2-1} = 3$

88) c $f(x) = \begin{cases} x, & x \le 1 \\ x^2 + bx + c, & x > 1 \end{cases}$
$\therefore f'(x) = \begin{cases} 1, & x < 1 \\ 2x + b, & x > 1 \end{cases}$
f(x) is differentiable at x = 1.
Then, it must be continuous at x = 1 for which
$\lim\limits_{x \to 1^+} f(x) = \lim\limits_{x \to 1^-} f(x)$
or, $1 + b + c = 1$
or, $b + c = 0$ ------ (1)
Also, $f'(1^+) = f'(1^-)$
or, $\lim\limits_{x \to 1^+} f'(x) = \lim\limits_{x \to 1^-} f'(x)$
or, $2 + b = 1$
or, $b = -1$
From (1), $b + c = 0$
or, $-1 + c = 0$
or, $c = 1$
Hence, $b = -1\ and\ c = 1$

89) c $y = \sqrt{logx + y}$
or, $y^2 = logx + y$
or, $2y\frac{dy}{dx} = \frac{1}{x} + \frac{dy}{dx}$
$\therefore \frac{dy}{dx} = \frac{1}{x(2y-1)}$

90) a Put $x = \tan\theta$ so that, $\sqrt{x^2+1} = sec\theta, dx = sec^2\theta d\theta$
$\therefore I = \int \frac{sec\theta.sec^2\theta}{tan^4\theta} d\theta = \int \frac{cos\theta}{sin^4\theta} d\theta = -\frac{1}{3}.\frac{1}{sin^3\theta} + c = -\frac{1}{3}.\frac{\frac{1}{cos^3\theta}}{\frac{sin^3\theta}{cos^3\theta}} + c$
$= -\frac{1}{3}\frac{sec^3\theta}{tan^3\theta} + c = -\frac{1}{3}\frac{(x^2+1)^{3/2}}{x^3} + c$

91) a



$$A = \int_0^1 (\sqrt{x}dx) + \int_1^{\frac{4}{3}} (\sqrt{4-3x}dx)$$
$$= \left(\frac{x^{3/2}}{3/2}\right)_0^1 + \left(\frac{(4-3x)^{3/2}}{-3(3/2)}\right)_1^{4/3} = \frac{2}{3} + \frac{2}{3}\left(\frac{1}{3}\right) = \frac{2}{3} + \frac{2}{9} = \frac{8}{9} sq.units$$

92) a $cot\theta - tan\theta = sec\theta$

$\Rightarrow \frac{cos\theta}{sin\theta} - \frac{sin\theta}{cos\theta} = \frac{1}{cos\theta}$ $[cos\theta \neq 0, sin\theta \neq 0]$

$\Rightarrow cos^2\theta - sin^2\theta = sin\theta$

$\Rightarrow 1 - 2sin^2\theta = sin\theta$

$\Rightarrow 2sin^2\theta + sin\theta - 1 = 0$

$\Rightarrow (2sin\theta - 1)(sin\theta + 1) = 0$

Either, $(2sin\theta - 1) = 0$ or, $(sin\theta + 1) = 0$

$\Rightarrow sin\theta = \frac{1}{2} = sin\frac{\pi}{6}$ $\Rightarrow sin\theta = -1$ (not possible)

$\Rightarrow \theta = n\pi + (-1)^n \frac{\pi}{6}$

93) d Vowels are A, A and E.

Even places are 2nd , 4th and 6th. Their arrangements at these places will be $\frac{3!}{2!} = 3$

Therefore, total number of required words = $\frac{4!}{2!} \times 3 = 12 \times 3 = 36$

94) a
$$\begin{vmatrix} x & 3 & 7 \\ 2 & x & 2 \\ 7 & 6 & x \end{vmatrix} = 0$$

Applying $R_1 \rightarrow R_1 + R_2 + R_3$,
$$\begin{vmatrix} x+9 & x+9 & x+9 \\ 2 & x & 2 \\ 7 & 6 & x \end{vmatrix} = 0$$
$$\Rightarrow (x+9)\begin{vmatrix} 1 & 1 & 1 \\ 2 & x & 2 \\ 7 & 6 & x \end{vmatrix} = 0$$

Applying $C_2 \rightarrow C_2 - C_1$ and $C_3 \rightarrow C_3 - C_1$,
$$\Rightarrow (x+9)\begin{vmatrix} 1 & 0 & 0 \\ 2 & x-2 & 0 \\ 7 & -1 & x-7 \end{vmatrix} = 0$$

$\Rightarrow (x+9)(x-2)(x-7) = 0$

$\Rightarrow x = -9, 2, 7$

$\therefore$ Other roots are 2, 7.

95) c $z^2 = (1+i)^2 = 1 + 2i + i^2 = 1 + 2i - 1 = 2i$

The multiplicative inverse of 2i = $\frac{1}{2i} = \frac{-i^2}{2i} = \frac{-i}{2}$

96) b $Sum = \frac{1}{1!} + \frac{4}{2!} + \frac{7}{3!} + \frac{10}{4!} + \cdots \frac{3n-2}{n!} \ldots \infty$

Here, $T_n = \frac{3n-2}{n!} = \frac{3n}{n(n-1)!} - \frac{2}{n!} = \frac{3}{(n-1)!} - \frac{2}{n!}$

$\therefore Sum = \sum_{n=1}^{\infty} T_n = 3\sum_{n=1}^{\infty} \frac{1}{(n-1)!} - 2\sum_{n=1}^{\infty} \frac{1}{n!} = 3e - 2(e-1) = 3e - 2e + 2 = e + 2$

97) c $T_{r+1} = {}^{10}C_r \left(\sqrt{x}\right)^{10-r} . \left(\frac{-k}{2}\right)^r = {}^{10}C_r (-k)^r . x^{\frac{10-5r}{2}}$

Which does not contain x if

$\frac{10-5r}{2} = 0 \Rightarrow r = 2$
$\therefore T_{2+1} = 405$
$\Rightarrow {}^{10}C_r\,(-k)^2 = 405$
$\Rightarrow k^2 = 9$
$\Rightarrow k = \pm 3$

98) a Let the slopes be m and 3m respectively.
Then, $m + 3m = -\frac{2h}{b^2}$
$\Rightarrow 4m = -\frac{2h}{b^2}$
$\Rightarrow m = -\frac{h}{2b^2}$ …… (1)
And $m.3m = \frac{a^2}{b^2}$
$\Rightarrow 3\left(-\frac{h}{2b^2}\right)^2 = \frac{a^2}{b^2}$ from (1)
$\Rightarrow h^2 = \frac{4}{3}a^2b^2$
$\therefore h = \frac{2}{\sqrt{3}}ab$

99) a Circle (S_1) : $x^2 + y^2 - 9 = 0$
Centre (C_1) = (0,0) and r_1 = 3
Circle (S_2) : $x^2 + y^2 + 2ax + 2y + 1 = 0$
Centre (C_2) = (-a, -1) and r_2 = $\sqrt{a^2 + 1 - 1} = a$
When the circle touches externally,
$C_1C_2 = r_1 + r_2$
i.e., $\sqrt{(-a-0)^2 + (-1-0)^2} = 3 + a$
Squaring:
$a^2 + 1 = 9 + 6a + a^2$
$\Rightarrow a = -4/3$

100) c $y^2 = 4x$
$\Rightarrow 2y\frac{dy}{dx} = 4$
$\Rightarrow \frac{dy}{dx} = \frac{2}{y}$
At point (16, 8), $\frac{dy}{dx} = \frac{2}{y} = \frac{2}{8} = \frac{1}{4} = m_1$
$x^2 = 32y$
$\Rightarrow 2x = 32\frac{dy}{dx}$
$\Rightarrow \frac{dy}{dx} = \frac{x}{16}$
At point (16, 8), $\frac{dy}{dx} = \frac{16}{16} = 1 = m_2$
Now, $tan\theta = \frac{m_1 - m_2}{1 + m_1 m_2} = \frac{\frac{1}{4} - 1}{1 + \frac{1}{4} - 1} = \frac{3}{5}$
$\therefore \theta = \tan^{-1}(3/5)$

Thank You!!!!!!