ALLEN CAREER INSTITUTE KOTA (RAJASTHAN)

DISTANCE LEARNING PROGRAMME

JEE (Main)

MOCK TEST

JEE(Main) : NURTURE TEST SERIES

ANSWER KEY

PART-1 : PHYSICS

SECTION-I	Q.	1	2	3	4	5	6	7	8	9	10
	A.	D	C	B	C	B	D	A	C	B	B
	Q.	11	12	13	14	15	16	17	18	19	20
	A.	B	D	A	A	A	B	A	A	B	A
SECTION-II	Q.	1	2	3	4	5					
	A.	810	2	1	648	765					

PART-2 : CHEMISTRY

SECTION-I	Q.	1	2	3	4	5	6	7	8	9	10
	A.	A	B	A	C	D	A	C	C	A	A
	Q.	11	12	13	14	15	16	17	18	19	20
	A.	B	D	D	B	B	D	B	C	D	C
SECTION-II	Q.	1	2	3	4	5					
	A.	6	492	6	6	4					

PART-3 : MATHEMATICS

SECTION-I	Q.	1	2	3	4	5	6	7	8	9	10
	A.	A	C	A	A	C	C	C	B	B	D
	Q.	11	12	13	14	15	16	17	18	19	20
	A.	D	D	D	B	B	A	B	C	C	A
SECTION-II	Q.	1	2	3	4	5					
	A.	6	8	8	-1	1					

HINT – SHEET

PART-1 : PHYSICS

SECTION-I

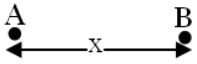
1. Ans (D)

Slope of v-t curve is constant so acceleration will be constant.

Initially speed decreases and it becomes zero and after that it increases.

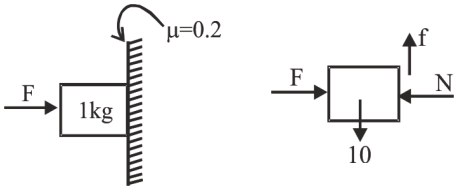
Initially velocity in negative direction and then in positive, so it will be change in direction of motion once.

2. Ans (C)



$$V_{avg} = \frac{2x}{t_1 + t_2} = \frac{2x}{\frac{x}{30} + \frac{x}{20}} = 24 \text{ m/s}$$

3. Ans (B)



$N = F$, $f = 10$

$f \le \mu N$

$10 \le (0.2)\ (F)$

$F \ge \frac{10}{0.2} \Rightarrow F \ge 50$ Newton

4. Ans (C)

$R = u\cos\theta \times t$

$100 = u\cos\theta \times 5$

$u\cos\theta = 20$

Now

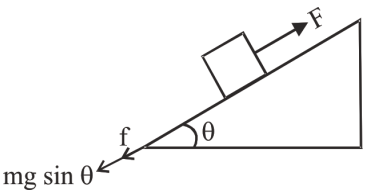
Also $R = \frac{2(u\cos\theta)(u\sin\theta)}{g}$

$\Rightarrow 100 = \frac{2 \times 20 \times (u\sin\theta)}{10}$ or $u\sin\theta = 25$

Now $R' = \frac{2(u\cos\theta + V_{trolley})(u\sin\theta)}{g}$

$= \frac{2(20+10)(25)}{10} = 150$ m

5. Ans (B)



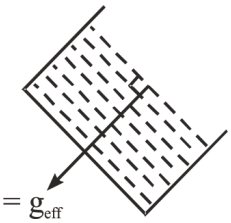
mg sin θ

$F = mg\sin\theta + f$

$F = mg\sin\theta + \mu mg\cos\theta$

6. Ans (D)

The surface will always be $\perp^r$ to the effective gravity.



$g\cos\theta = g_{eff}$

Hence option (4)

7. Ans (A)

As $S = t^3 + 5$

$\frac{ds}{dt} = 3t^2 = v$

$\therefore \quad a_t = \frac{dv}{dt} = 6t$

at t = 2 sec

$|\vec{a}| = \sqrt{a_c^2 + a_t^2}$

$= \sqrt{\left(\frac{v^2}{R}\right)^2 + a_t^2} = \sqrt{\left(\frac{9t^4}{R}\right)^2 + \left(\frac{dv}{dt}\right)^2}$

$= \sqrt{(7.2)^2 + 144}$

$|\vec{a}| = 14$ m/s^2

8. Ans (C)

$mu + 2m \times 0 = mv_1 + 2mv_2$

or $+v_1 + 2v_2 = u$ ...(i)

$\frac{1}{2}mu^2 + \frac{1}{2} \times 2m \times 0 = \frac{1}{2}mv_1^2 \times 2mv_2^2$

$v_1^2 + 2v_2^2 = u^2$ ...(ii)

From eq. (i), $v_1 = u - 2v_2$

On substituting the value of v_1 in eq. (ii), we get

$(u - 2v_2)^2 + 2v_2^2 = u^2$

$u^2 + 4v_2^2 - 4uv_2 + 2v_2^2 = u_2$

$6v_2^2 = 4uv_2$

$v_2 = \frac{4}{6}u = \frac{2}{3}u$

and $v_1 = u - 2v_2 = u - 2 \times \frac{2}{3}u = -\frac{u}{3}$

$K_i = \frac{1}{2}mu^2$

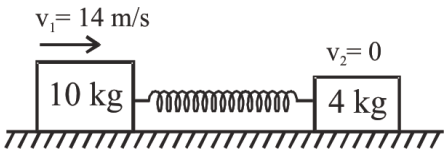
$K_f = \frac{1}{2}mv_1^2 = \frac{1}{2}m\left(-\frac{u}{3}\right)^2 = \frac{1}{9}K_i$

$\therefore$ Percentage loss of energy of the colliding particle

$= \frac{K_i - K_f}{K_i} \times 100$

$= \frac{K_i\left(1 - \frac{1}{9}\right)}{K_i} \times 100 = \frac{800}{9} = 88.9\%$

9. Ans (B)



$V_{cm} = \frac{10 \times 14 + 4 \times 0}{10 + 4} = \frac{10 \times 14}{14} = 10$ m/s.

10. Ans (B)

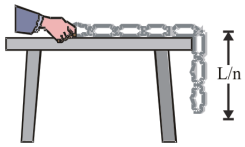
Fraction of length of the chain hanging from the table

$$= \frac{1}{n} = \frac{60\text{cm}}{200\text{cm}} = \frac{3}{10} \Rightarrow n = \frac{10}{3}$$

Work done in pulling the chain on the table

$$W = \frac{mgL}{2n^2}$$

$$= \frac{4 \times 10 \times 2}{2 \times (10/3)^2} = 3.6\ \text{J}$$



11. Ans (B)

By applying law of conservation of energy

$$mgR = \frac{1}{2}mv^2 \Rightarrow v = \sqrt{2Rg}$$

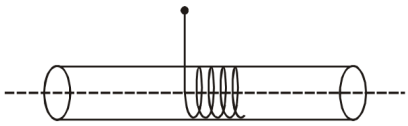
12. Ans (D)

If $\vec{\tau}_{ext} = 0 \Rightarrow \vec{L}$ = constant.

13. Ans (A)

$I_1\omega_1 = I_2\omega_2$

14. Ans (A)



Mg - T = Ma

$$TR = I\alpha = \left(\frac{MR^2}{2}\right) \times \frac{a}{R}$$

15. Ans (A)

For the closed organ pipe, the fundamental note is of frequency

$$f = \frac{\upsilon}{4\ell} = 512\ \text{Hz} \quad \text{(given)}$$

For the open organ pipe, the fundamental note is of frequency

$$f' = \frac{\upsilon}{2\ell} = 2 \times \frac{\upsilon}{4\ell} = 2 \times 512 = 1024\ \text{Hz}$$

16. Ans (B)

$$\gamma = \frac{\Delta V}{V\,\Delta T}$$

Given $\frac{\Delta V}{V} = 0.12\%$ or 0.0012

$$\gamma = \frac{0.0012}{20} = 6 \times 10^{-5}/^\circ\text{C}$$

Since $\alpha = \frac{\gamma}{3} = 2 \times 10^{-5}/^\circ\text{C}$

17. Ans (A)

Since, the block of ice at 0ºC is large, the whole of ice will not melt, hence final temperature is 0ºC. Q_1 = heat given by water in colling upto 0ºC

$= ms\,\Delta\theta = 80 \times 1 \times (30 - 0)$

$= 2400$ cal

18. Ans (A)

$R = R_1 + R_2 + R_3$

$$\frac{3L}{K_{eq}A} = \frac{L}{\frac{K}{2}A} + \frac{L}{5KA} + \frac{L}{KA}$$

$$K_{eq} = \frac{15}{16}K$$

19. Ans (B)

$E \alpha T^4$

$$\frac{1 \times 10^6}{16 \times 10^6} = \frac{400^4}{T}$$

$T = 800$ K

$= 527°C$

20. Ans (A)

$$\frac{1}{2}mgh = (mcdt)\,J$$

$$\frac{1}{2} \times 9.8 \times 84 = 1 \times dJ \times 4.2$$

$dT = 0.098°C$

PART-1 : PHYSICS

SECTION-II

1. **Ans (810)**

$F = \frac{1}{2}\rho\left(v_1^2 - v_2^2\right)A$

$F = \frac{1}{2} \times 1.2 \times \left(70^2 - 65^2\right) \times 2$

$= 810$ N

2. **Ans (2)**

Given that

$g_{Planet} = g_{earth}$ ... (1)

$(density)_{Planet} = 2(density)_{earth}$ ... (2)

Radius of earth = R ... (3)

Asked :

$R_{Planet} = ?$

From (1)

$\frac{GM_P}{R_P^2} = \frac{GM_e}{R_e^2}$

$\frac{R_p^2}{R_e^2} = \frac{M_P}{M_e}$

$R_P = R_e\sqrt{\frac{M_P}{M_e}}$ ...(4)

From (2)

$\left(\frac{M_P}{\frac{4}{3}\pi R_P^3}\right) = 2\left(\frac{M_e}{\frac{4}{3}\pi R_e^3}\right)$

$\frac{M_P}{M_e} = 2\left(\frac{R_P}{R_e}\right)^3$ ...(5)

From (4) & (5)

$\frac{R_P}{R_e} = \sqrt{\frac{M_P}{M_e}} = \sqrt{2\left(\frac{R_P}{R_e}\right)^3}$

$\left(\frac{R_P}{R_e}\right)^2 = 2\left(\frac{R_P}{R_e}\right)^3$

$\frac{R_P}{R_e} = \frac{1}{2}$

So $R_P = \frac{R_e}{2}$ or $\frac{R}{2}$

3. **Ans (1)**

$t = \frac{\Delta\phi}{\omega} = \frac{\pi/2 - -\pi/6}{2\pi/6} = \frac{\pi/3}{\pi/3} = 1$ sec

4. **Ans (648)**

$\omega = 120\pi$, $k = \frac{2\pi}{3}$, $v = \frac{\omega}{\kappa}$

$\therefore v = \frac{120\pi}{2\pi/3} = 180$ m/s

$T = v^2\mu = 180 \times 180 \times \frac{3 \times 10^{-2}}{1.5} = 648$ N

5. **Ans (765)**

$\Delta Q = Q_1 + Q_2 + Q_3 + Q_4$

$= 5960 - 5585 - 2980 + 3645 = 1040$ J

$\Delta W = W_1 + W_2 + W_3 + W_4$

$= 2200 - 825 - 1100 + W4 = 275 + W4$

For a cyclic process, Uf = Ui

$\Delta U = U_f - U_i = 0$

From first law of thermodynamics,

$\Delta Q = \Delta U + \Delta W$

$1040 = 0 + 275 + W4$ or $W4 = 765$ J

PART-2 : CHEMISTRY

SECTION-I

1. **Ans (A)**

$$A(g) + 2B(s) \rightleftharpoons 2C(g)$$

$t = 0$	2	4	–
$t = t_{eq.}$	1	2	2

$K_p = \frac{\left(\frac{2}{4} \times 9\right)^2}{\left(\frac{1}{4} \times 9\right)} = 9$

2. **Ans (B)**

When volume increases at equilibrium then equilibrium shifts in that direction in which number of moles increases so amount of $Cl_2(g)$ increases.

3. Ans (A)

When 25 % litration is complete

[salt] = 25 [acid] = 75 $K_a = 10^{-5}$ pKa = 5

$pH = pKa + \log \frac{[salt]}{[acid]} = 5 + \log \frac{1}{3}$

when 50 % litration is complete

[salt] = 50 [acid] = 50

$pH = pKa + \log \frac{[salt]}{[acid]} = 5$

when 75% titration is complete

[salt] = 75 [acid] = 25

$pH = pKa + \log \frac{[salt]}{[acid]} = 5 + \log 3$

4. Ans (C)

pOH = 10 ; $[OH^-] = 10^{-10}$ M

Number of moles of OH– ion in 1 mL of solution

Number of ions of OH^- will be :

$6.023 \times 10^{23} \times 10^{-13} = 6.023 \times 10^{10}$

5. Ans (D)

No. of atoms $\Rightarrow \frac{10^{-3}}{18} \times 3 = \frac{10^{-3}}{6}$mol

6. Ans (A)

$2C_8H_{18} + 25O_2 \longrightarrow 16CO_2 + 18H_2O$

required oxygen $\Rightarrow \frac{25 \times 32}{2 \times 114} \times 570 = 2000$ g

7. Ans (C)

NH_4^+

Oxidation number of N is x + 4 – 1

x = – 3

N_2H_4 the O.N of N is 2x + 4 = 0 2x = – 2

x = – 1

NH_2OH the O.N of N

= x + 3(+1) + 1(–2) = 0

x = –1

N_2O the ON of N is

2x – 2 = 0

x = 1

then the order of oxidation number is

$NH_4^+ < N_2H_4 < NH_2OH < N_2O$

8. Ans (C)

A. Question: The correct thermodynamic conditions for the spontaneous reaction at all temperatures is:

B. Given Data: N/A

C. Concept: For a reaction to be spontaneous, the Gibbs free energy change (ΔG) must be negative.

$\Delta G = \Delta H - T\Delta S$

D. Mathematical Calculation: To ensure that ΔG is always negative, regardless of the temperature:

1. **ΔH** must be **negative** (exothermic reaction).
2. **ΔS** must be **positive** (increase in disorder).

E. Final Answer: $\Delta H < 0$ and $\Delta S > 0$

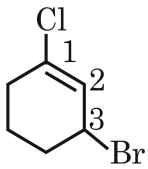
9. Ans (A)

Stability of carbocation $\propto + m_1 + I_1 + h \propto \frac{1}{-m}$

10. Ans (A)

Stability of Carbocation α No. of α-hydrogen of carbocation

11. Ans (B)

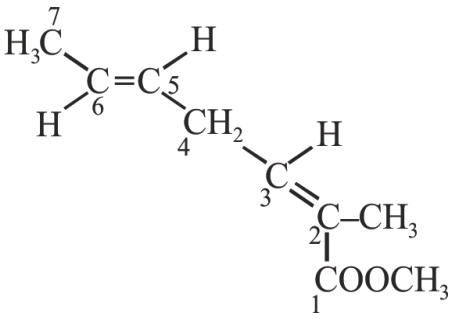


Double bond more priority

12. Ans (D)

(a) and (b) are not isomer because they have different molecular formula. Molecular formula of (a) is C_8H_{18} & mol for. of (b) is C_8H_{16}.

13. Ans (D)



14. Ans (B)

Correct order of dipole moment :

$CCl_4 < CHCl_3 < CH_2Cl_2 < CH_3Cl$

$BF_3 < NF_3 < NH_3$

O-dichlorobenzene > m-dichlorobenzene > p-dichlorobenzene

15. Ans (B)

The Correct Answer is (B)

16. Ans (D)

Radius $\propto \frac{1}{Z_{eff}}$

$\Rightarrow$ Due to Lanthanide contraction.

17. Ans (B)

The Correct Answer is (B)

18. Ans (C)

Maximum possible covalency of $\underline{B} = 4$

19. Ans (D)

All Hydrogen present in different plane

20. Ans (C)

Ionic Compound having polyatomic anion

$\boxed{\text{T.S.} \times \frac{1}{\text{Polarising power}}}$

PART-2 : CHEMISTRY

SECTION-II

1. Ans (6)

$2NO_3^- + 3Cu_2O + 14H^+ \rightarrow 2NO + 6Cu^{2+} + 7H_2O$

$\therefore$ e = 6

2. Ans (492)

$2Fe_{(s)} + \frac{3}{2}O_{2(g)} \rightarrow Fe_2O_{3(s)}, \Delta H^o = -822\,kJ/mol$ .....(1)

$C_{(s)} + \frac{1}{2}O_{2(g)} \rightarrow CO_{(g)}, \Delta H^o = -110\,kJ/mol$ .....(2)

$3C_{(s)} + Fe_2O_{3(s)} \rightarrow 2Fe_{(s)} + 3CO_{(g)}, \Delta H_3 = ?$

$(3) = 3 \times (2) - (1)$

$\Delta H_3 = 3 \times \Delta H_2 - \Delta H_1$

$= 3(-110) + 822$

$= 492\,kJ/mole$

3. Ans (6)

Fact

4. Ans (6)

CH_4, CCl_3^-, SO_4^{2-}, NH_3, XeO_4, $AsCl_3$ are sp^3 hybridised

5. Ans (4)

S $\rightarrow 3S^2\ 3P^4\ 3d^0$

G.S. $\rightarrow 3S^2\ 3P^4\ 3d^0$

$ES_1 \rightarrow$ 

$\Rightarrow$ Vacant orbital - 4

PART-3 : MATHEMATICS

SECTION-I

1. Ans (A)

By midpoint formula the points B and C are (9, 3) and (– 5, 5).

Hence G by $\left(\frac{\sum x_i}{3}, \frac{\sum y_i}{3}\right) = \left(\frac{5}{3}, 3\right)$

2. Ans (C)

Let the line is $3x + y = K$

$\because$ it passes through (2, 2) $\Rightarrow 6 + 2 = K \Rightarrow K = 8$

$\Rightarrow$ line is $3x + y = 8 \Rightarrow \frac{x}{8/3} + \frac{y}{8} = 1$

$\Rightarrow$ sum of intercepts $= \frac{8}{3} + 8 = \frac{32}{3}$

3. Ans (A)

Here centre is $(-1, 3)$ and distance from (3, 0) is $\sqrt{(3+1)^2 + 3^2} = 5$

4. Ans (A)

Intersection of both lines is $(2, -5)$ is centre and $2\pi r = 8\pi \Rightarrow r = 4$ hence circle

$\Rightarrow (x-2)^2 + (y+5)^2 = 4^2$

5. Ans (C)

Given parabola is $\left(x + \frac{1}{4}\right)^2 = \frac{1}{2}\left(y + \frac{1}{8}\right)$

6. Ans (C)

Here $e = \sqrt{1 - \frac{b^2}{a^2}} = \sqrt{1 - \frac{20}{36}} = \frac{2}{3}$

$\Rightarrow$ distance $= \frac{2a}{e} = \frac{2(6)}{2/3} = 18$

7. Ans (C)

Given hyperbola is $\frac{x^2}{9} - \frac{y^2}{4} = 1$

its eccemtnicity = $\sqrt{1 + \frac{b^2}{a^2}} = \sqrt{1 + \frac{4}{9}} = \frac{\sqrt{13}}{3}$

Hence foci = $(\pm ae, 0) = \left(\pm\sqrt{13}, 0\right)$

8. Ans (B)

$\sum_{i=1}^{n} a_i = \frac{n}{2}\{2a_1 + (n-1)\} = 192$

$\Rightarrow 2a_1 + (n-1) = \frac{384}{n} \ldots (1)$

$\sum_{i=1}^{n/2} a_{2i} = \frac{n}{4}\left[2a_1 + 2 + \left(\frac{n}{2} - 1\right)2\right] = 120$

$\Rightarrow 2a_1 + n = \frac{480}{n} \ldots (2)$

Thus,

$1 = \frac{480}{n} - \frac{384}{n} \Rightarrow n = 480 - 384 = 96$

9. Ans (B)

S.O.R. $= \frac{-b}{a} = \frac{--}{+} \Rightarrow \alpha + \beta > 0$

& P.O.R. $= \frac{c}{a} = \frac{-}{+} \Rightarrow \alpha\,\beta < 0$

{Given $(\beta > \alpha)$}

So β has greater magnitude ($\beta > 0$ & $\alpha < 0$)

So, $0 < |\alpha| < \beta$

10. Ans (D)

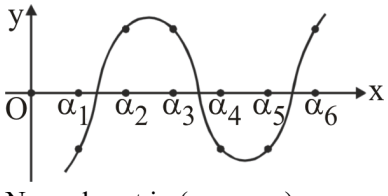
$x^4 - 100x^3 + 2x^2 + 4x + 10 = 0 \longrightarrow \alpha, \beta, \gamma, \delta$

equation whose roots are $\frac{1}{\alpha}, \frac{1}{\beta}, \frac{1}{\gamma}, \frac{1}{\delta}$ is

$10x^4 + 4x^3 + 2x2 - 100x + 1 = 0 \longrightarrow \frac{1}{\alpha}, \frac{1}{\beta}, \frac{1}{\gamma}, \frac{1}{\delta}$

S.O.R. $\Rightarrow \frac{1}{\alpha} + \frac{1}{\beta} + \frac{1}{\gamma} + \frac{1}{\delta} = \frac{-4}{10} = \frac{-2}{5}$

11. Ans (D)



No real root in $(-\infty, \alpha_1)$

12. Ans (D)

$T_{r+1} = {}^{65}C_r 5^{(65-r)} \frac{1}{2} 7^{r/6}$

$\therefore \quad \frac{65 - r}{2} \in I \quad \& \quad \frac{r}{6} \in I$

r = 1, 3, 5, 7, ..., 65

& also, r = 0, 6, 12, 18, 24, ...60

No. common 'r'

$\therefore$ total integral terms = 0

13. Ans (D)

$\sum_{r=0}^{20} r(20-r)\left({}^{20}c_r\right)^2$

$= \sum_{r=0}^{20} r(20-r)\,{}^{20}c_r \times {}^{20}c_{20-r}$

$= \sum_{r=0}^{20} r \times \frac{20}{r}\,{}^{19}c_{r-1} \times \frac{(20-r)}{(20-r)} \times 20 \times {}^{19}c_{19-r}$

$= \sum_{r=0}^{20} (20)^2\,{}^{19}c_{r-1} \times {}^{19}c_{19-r}$

$= (20)^2 \times {}^{38}C_{18}$

$= 400 \times {}^{38}C_{20}$ (use ${}^{n}C_r = {}^{n}C_{n-r}$)

14. Ans (B)

${}^{6}C_3 \times 2 \times 1 \times 1 = 40$

15. Ans (B)

${}^{4}C_2\left[{}^{6}C_2 - 1\right]\left[{}^{7}C_1 - \left({}^{3}C_1 \times {}^{4}C_2\right)\right] = 1428$

16. Ans (A)

$(4k_1) + (4k_2 + 1) + (4k_2 + 2) = 35$

$k_1 + k_2 + k_3 = 8$

Ans. $= {}^{10}C_2 = 45$

17. Ans (B)

$\frac{|x| - 1}{|x| - 2} \geqslant 0$

$\Rightarrow \quad x \in (-\infty, -2) \cup [-1, 1] \cup (2, \infty)$

18. Ans (C)

$$\ell ny = \frac{1}{2}\ell n(1+2x) + \frac{1}{2}\ell n(1+4x) - \frac{1}{3}\ell n(1+3x)$$

$$-\frac{1}{5}\ell n(1+5x) - \frac{1}{7}\ell n(1+7x)$$

$$\frac{1}{y}\frac{dy}{dx} = \frac{1}{(1+2x)} + \frac{1}{(1+4x)} - \frac{1}{(1+3x)} - \frac{1}{(1+5x)} - \frac{1}{(1+7x)}$$

$y'(0) = y(0)\cdot[1 + 1 - 1 - 1 - 1] = -1$ $(y(0) = 1)$

19. Ans (C)

Mode = Variate corresponding to heighest freq.

$= 3$ $[{}^6C_3$ is greaterst]

20. Ans (A)

$f(x) = (1 \pm x^n)$

PART-3 : MATHEMATICS

SECTION-II

1. Ans (6)

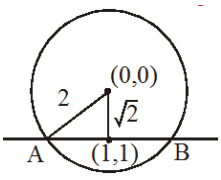
Lines are concurrent, if $\begin{vmatrix} 4 & 3 & -1 \\ 1 & -1 & 5 \\ b & 5 & -3 \end{vmatrix} = 0$

$\Rightarrow 4(3 - 25) - 3(-3 - 5b) - (5 + b) = 0$

$-88 + 9 + 15b - 5 - b = 0 \Rightarrow -84 + 14b = 0$

$\therefore b = 6$

2. Ans (8)



Length of AB $= 2\sqrt{2^2 - (\sqrt{2})^2} = 2\sqrt{2}$

$\Rightarrow (AB)^2 = (2\sqrt{2})^2 = 8$

3. Ans (8)

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

$$\frac{S}{2} = S - \frac{S}{2} = 1 + \frac{2}{2} + \frac{3}{2^2} + \frac{4}{2^3} + \ldots\infty$$

$$\frac{S}{2} = \frac{1}{1 - \frac{1}{2}} + \frac{1 \cdot \frac{1}{2}}{\left(1 - \frac{1}{2}\right)^2} = 4$$

$S = 8$

4. Ans (-1)

common roots = w, w^2

so $w + w^2 = -1$

5. Ans (1)

$$\lim_{x\to 0} \frac{x\tan^2 2x}{\tan 4x \sin^2 x} = \lim_{x\to 0} \frac{x\left(\frac{\tan^2 2x}{4x^2}\right)4x^2}{\left(\frac{\tan 4x}{4x}\right)4x\left(\frac{\sin^2 x}{x^2}\right)x^2} = 1$$