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JEE - MAIN 2019

9th April 2019, Slot - 2

(2:30 pm - 5:30 pm)

Question Paper

Solutions

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PHYSICS

1. **Four point charges –q, +q, +q and –q are placed on y-axis at y = 2d, y = -d, y = +d and y = +2d, respectively. The magnitude of the electric field E at a point on the x –axis at x = D, with D>>d, will behave as:**

1. $E\alpha\frac{1}{D^4}$ **2.** $E\alpha\frac{1}{D^3}$ **3.** $E\alpha\frac{1}{D^2}$ **4.** $E\alpha\frac{1}{D}$

Ans: **1**

Sol: **Electric field one to A and D together will be along –ve x-axis, since, the vertical components get cancelled.**

Similarly, due B and C, in the +ve X- axis

Net electric field due to A and D $=2\times\frac{kq}{D^2+4d^2}\times\frac{D\left(-\hat{i}\right)}{\sqrt{D^2+4d^2}}$ **At P**

Electric field one to B and C at P $=2\times\frac{kq}{D^2+d^2}\times\frac{D}{\sqrt{D^2+d^2}}\left(\hat{i}\right)$

$\therefore$**Net electric field at** $P=\vec{E}=2kqD\left(\frac{1}{\left(D^2+d^2\right)^{3/2}}-\frac{1}{\left(D^2+d^2\right)^{3/2}}\right)\hat{i}$

Since, d<<<D,

$$\vec{E}\approx 2KqD\left(\frac{1}{D^3\left(1+\frac{d^2}{D^2}\right)^{3/2}}-\frac{1}{D^2\left(1+\frac{4d^2}{D^2}\right)^{3/2}}\right)\hat{i}$$

$$\approx\frac{2KqD}{D^3}\left(1-\frac{3}{2}\frac{d^2}{D^2}-1+\frac{3}{2}\times\frac{4d^2}{D^2}\right)\hat{i}$$

$$\therefore E\propto\frac{1}{D^4}$$

2. **A massless spring(k = 800 N/m), attached with a mass (500g) is completely immersed in 1 kg of water. The spring is stretched by 2cm and released so that it starts vibrating. What would be the order of magnitude of the change in the temperature of water when the vibrations stop completely? (Assume that the water**

container and spring receive negligible heat and specific heat of mass = 400 J/kg K, specific heat of water = 4148J /kg K)

A. 10^{-2} K 2. 10^{-3} K 3. 10^{-4} K 4. 10^{-5} K

Ans: 4

Sol: Finally, the block comes to its equilibrium position, where $Kx_{eq} = mg - veg$

$$800\left(x_{eq}\right) = (0.5)(10) - veg$$

Energy lost by body due to oscillatins

$$= \frac{1}{2}K\left(x_{eq} + x\right)^2 - \frac{1}{2}K\left(x_{eq}\right)^2 - \left(mg - veg\right)$$

$$= \frac{1}{2}K\left(x^2\right) + \left(kx_{eq} - mg + (0)veg\right)x$$

$$= \frac{1}{2}kx^2 = \frac{1}{2}(800)(0.02)^2$$

$$= 400 \times 4 \times 10^{-4}$$

$$= 0.16J$$

This is equal to the heat transferred

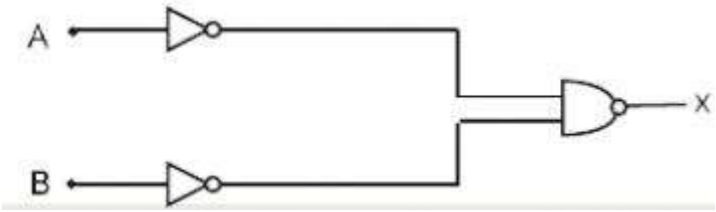
$$0.16J = (0.5)(400)(\Delta T) + (1)(4184)(\Delta T)$$

$$0.16 = (4384)\Delta T$$

$$\Delta T = \frac{16}{4.384} \times \frac{10^{-2}}{10^3}$$

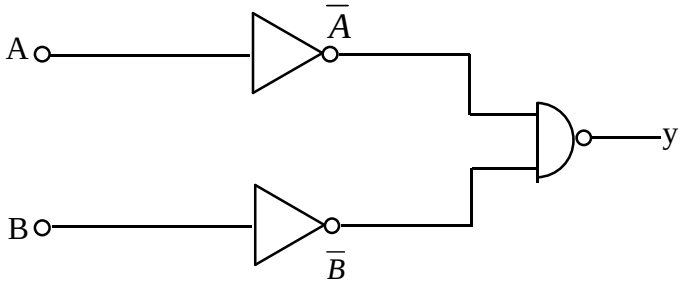
$\therefore$ **It is of the order of 10^{-5}**

3. The logic gate equivalent to the given logic



A. NAND 2. OR 3. AND 4. NOR

Ans: 2



Sol: $\overline{\overline{A}}\,\overline{\overline{B}} = A + B = OR\ gate$

4. **50 W/m^2 energy density of sunlight is normally incident on the surface of a solar panel. Some part of incident energy(25%) is reflected from the surface and the rest is absorbed. The force exerted on 1m^2 surface area will be close to (c=3×10^8 m/s):**

1. 15×10^{-8} N **2.** $20\times10^{-8}N$ **3.** $10\times10^{-8}N$ **4.** $35\times10^{-8}N$

Ans: **2**

Sol: **Energy density** $50W/m^2\,(\theta = 0^o)$ $F = \frac{IA\cos\theta}{C}(a) + \frac{2IA\cos^2\theta}{C}(r)$ **b**

Reflected 25%absorbed: 75% $= \frac{IA}{C}.\frac{3}{4} + \frac{2IA}{C}.\frac{1}{4}$

(R) **(a)**

Area = 1m^2 $= \frac{5IA}{4C} = \frac{5\times50\times1}{4\times3\times10^8}$

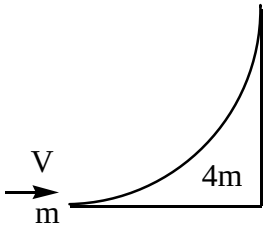
$= \frac{250}{12}\times10^{-8} \approx 20\times10^{-8}N$

5. **A wedge of mass M = 4m lies on a frictionless plane. A particle of mass m approaches the wedge with speed υ. There is no friction between the particle and the plane or between the particle and the wedge. The maximum height climbed by the particle on the wedge is given by :**

1. $\frac{2\upsilon^2}{5g}$ **2.** $\frac{\upsilon^2}{2g}$ **3.** $\frac{2\upsilon^2}{7g}$ **4.** $\frac{\upsilon^2}{g}$

Ans: **1**

Sol: $\frac{1}{2}\times\mu_{red}\times V_{rel}{}^2 = mgh_{max}$



$$\frac{1}{2}\times\frac{4m}{5}\times V^2 = mgh_{max} \Rightarrow h_{max} = \frac{2v^2}{5g}$$

6. **In a conductor, if the number of conduction electrons per unit volume is $8.5\times10^{28}m^{-3}$ and mean free time is 25 fs (femto second), it's approximate resistivity is:$\left(m_e = 9.1\times10^{-31}kg\right)$**

1. $10^{-8}\Omega m$ **2.** $10^{-6}\Omega m$ **3.** $10^{-5}\Omega m$ **4.** $10^{-7}\Omega m$

Ans: 1

Sol: **n=no.of conduction electron per unit vol =** $8.5\times10^{28}m^{-3}$

$\tau = 25\,fs$

Using the formula $\int = \frac{m}{ne^2\tau} = \frac{9.1\times10^{-31}}{8.5\times10^{28}\times\left(1.6\times10^{-19}\right)^2\times25\times10^{-15}} \approx 10^{-8}\Omega m$

7. **A test particle is moving in a circular orbit in the gravitational field produced by a mass density $\rho(r) = \frac{K}{r^2}$. Identify the correct relation between the radius R of the particle's orbit and its period T:**

1. TR is a constant **2. T/R is constant**

3. T/R^2 **is a constant** **4.** T^2/R^3 **is a constant**

Ans: 2

Sol: $\left(\frac{4\pi GK}{R}\right) = \frac{mv^2}{R} \Rightarrow V = \sqrt{4\pi GK}$

$$w = \frac{V}{R} = \frac{1}{R}\sqrt{4\pi GK} = \frac{2\pi}{T} \Rightarrow \frac{T}{R} = \sqrt{\frac{H}{GK}} = cons\tan t$$

8. **Two cars A and B are moving away from each other in opposite directions. Both the cars are moving with a speed of $20ms^{-1}$ with respect to the ground. If an observer in**

car A detects a frequency 2000 Hz of the sound coming from car B, what is the natural frequency of the sound source in car B? (speed of sound in air $= 340 ms^{-1}$)

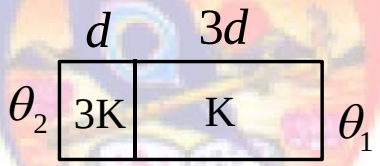
1. 2250 Hz **2. 2150 Hz** **3. 2300 Hz** **4. 2060 Hz**

Ans: 1

Sol: observer in A defects 2000 Hz

$$2000 = f\left[\frac{340-20}{340+20}\right] \Rightarrow f = 2000 \times \frac{36}{32} = 2250 Hz$$

9. Two materials having coefficients of thermal conductivity '3K' and 'K' and thickness 'd' and '3d', respectively, are joined to forma slab as shown in the figure. The temperatures of the outer surfaces are 'θ_2' and 'θ_1' respectively, $(\theta_2 > \theta_1)$. The temperature at the interface is:



1. $\frac{\theta_1}{6} + \frac{5\theta_2}{6}$ **2.** $\frac{\theta_2 + \theta_1}{2}$ **3.** $\frac{\theta_1}{10} + \frac{9\theta_2}{10}$ **4.** $\frac{\theta_1}{3} + \frac{2\theta_2}{3}$

Ans: 3

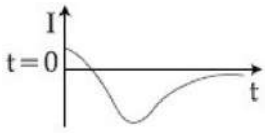
Sol: $H_1 = H_2$

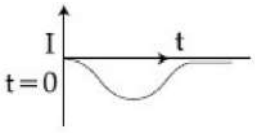
$$\frac{(3K)A(\theta_2 - \theta)}{d} = \frac{KA(\theta - \theta_1)}{3d}$$

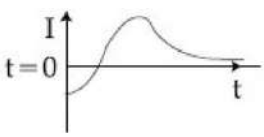
$$9\theta_2 - 9\theta = \theta - \theta_1$$

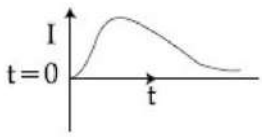
$$\Rightarrow \theta = \frac{9}{10}\theta_2 + \frac{1}{10}\theta_1$$

10. A very long solenoid of radius R is carrying current $I(t) = kte^{-\alpha t}(k > 0)$, as a function of time $(t \geq 0)$. Counter clockwise current is taken to be positive. A circular conducting coil of radius 2R is placed in the equatorial plane of the solenoid and concentric with the solenoid. The current induced in the outer coil is correctly depicted, as a function of time, by:

1. 

2. 

3. 

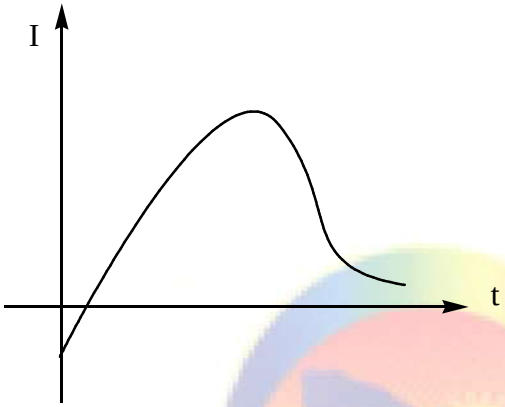
4. 

Ans: 3

Sol: $I(t) = kt\, e^{-\alpha t}$

$$i_{ind} = \frac{-1}{r}.\frac{d\phi}{dt} = \frac{-1}{r}.\pi R^2.\frac{dB}{dt}\frac{\mu_0 i}{2\pi R}$$

$$\textbf{Resistance} = \frac{-\pi R^2 \mu_0 K}{2\pi R r} e^{-\alpha t}\left[1-\alpha t\right)$$



So graph is

11. Two coils 'P' and 'Q' are separated by some distance. When a current of 3 A flows through coil 'P', a magnetic flux of $10^{-3}Wb$ passes through 'Q'. No current is passed through 'Q'. When no current is passes through 'P' and a current of 2 A passes through 'Q', the flux through 'P' is:

1. $6.67\times10^{-4}Wb$ **2.** $3.67\times10^{-4}Wb$ **3.** $6.67\times10^{-3}Wb$ **4.** $3.67\times10^{-3}Wb$

Ans: 1

Sol: $\phi_P = M^{i}Q, \quad \phi_Q = mi_P$

$$\Rightarrow 10^{-3} = m(3)$$

$$\Rightarrow M = \frac{1}{3}\times10^{-3}$$

$$\phi_P = \frac{1}{3}\times10^{-3}\times2 = 6.67\times10^{-4}$$

12. The physical sizes of the transmitter and receiver antenna in a communication system are :

1. Inversely proportional to carrier frequency

2. Independent of both carrier and modulation frequency

3. Inversely proportional to modulation frequency

4. Proportional to carrier frequency

Ans: 1

Sol: $l \propto \lambda$ **and** $\lambda \propto \frac{1}{\omega C}$ $\left(\because \omega_C \text{ is final frequency }\right) \Rightarrow l \propto \frac{1}{\omega_C}$

13. The area of a square is $5.29 cm^2$ **. The area of 7 such squares taking into account the significant figures is:**

1. $37.03 cm^2$ **2.** $37 cm^2$ **3.** $37.030 cm^2$ **4.** $37.0 cm^2$

Ans: 3

Sol: Total area $5.29 cm^2 \times 7$

$= 37.03 cm^2$

In accord to significant figures it should be 37.0 cm^2

14. Moment of inertia of a body about a given axis is $1.5 kgm^2$ **. Initially the body is at rest. In order to produce a rotational kinetic energy of 1200 J, the angular acceleration of** $20 rad/s^2$ **must be applied about the axis for a duration of:**

1. 2 s **2. 2.5 s** **3. 5 s** **4. 3 s**

Ans: 1

Sol: $I = 1.5 kgm^2$

Rot. $K\varepsilon = 1200 J$

$1200 = \frac{1}{2} \times 1.5 \times \omega^2$

$\omega = 40 rad/s$

$\therefore \quad t = \frac{\omega}{\alpha} = \frac{40}{20} = 2s$

15. A He^+ **ion is in its first excited state. Its ionization energy is:**

1. 54.40 eV **2. 6.04 eV** **3. 13.60 eV** **4. 48.36 eV**

Ans: 3

Sol: For 1st excited states

$TE = -\frac{13.6 \times 2^2}{2^2} = -13.6$

$\therefore B.E = 13.6 \ eV$

$v = f\lambda$

$= \frac{4}{3} \times 240$

$= 320\, m/s$

16. **The specific heats, C_P and C_V of a gas of diatomic molecules, A, are given (in units of $Jmol^{-1}K^{-1}$) by 29 and 22, respectively. Another gas of diatomic molecules, B, has the corresponding values 30 and 21. If they are treated as ideal gases, then :**

1. A has a vibrational mode but B has none

2. Both A and B have a vibrational mode each

3. A is rigid but B has a vibrational mode

4. A has one vibrational mode and B has two.

Ans: **3**

Sol: $l = 2m$

3rd harmonic mode

$\Rightarrow f = \frac{3}{2l}\sqrt{\frac{T}{\mu}}$

$f = 3f_0$

$f_0 = \frac{f}{3} = 80Hz$

17. **A convex lens of focal length 20 cm produces images of the same magnification 2 when an object is kept at two distance x_1 and $x_2 (x_1 > x_2)$ from the lens. The ratio of x_1 and x_2 is :**

1. 2 : 1 **2. 5 : 3** **3. 4 : 3** **4. 3 : 1**

Ans: **4**

18. **A string 2.0 m long and fixed at its ends is driven by a 240 Hz vibrator. The string vibrates in its third harmonic mode. The speed of the wave and its fundamental frequency is :**

1. 320 m/s, 80 Hz **2. 180 m/s, 120 Hz**

3. 320 m/s, 120 Hz **4. 180 m/s, 80 Hz**

Ans: 1

Sol: Given string is in 3rd harmonic mode

$$\Rightarrow n=\frac{3v}{2\ell}$$

$$240=\frac{3(v)}{2(2)}$$

$$v=320m/s$$

Fundamental frequency $\Rightarrow n=\frac{v}{2\ell}\Rightarrow\frac{320}{2(2)}=80Hz$

19. A moving coil galvanometer has a coil with 175 turns and area $1cm^2$. It uses a torsion band of torsion constant $10^{-6}N-m/rad$. The coil is placed in a magnetic field B parallel to its plane. The coil deflects by 1° for a current of 1 mA. The value of B (in Tesla) is approximately:

1. 10^{-2} **2.** 10^{-1} **3.** 10^{-3} **4.** 10^{-4}

Ans: 3

Sol: $\tau=K\theta=NtAB$

$$\Rightarrow 10^{-6}\left(1.\frac{\pi}{180}\right)=175\times10^{-3}\times10^{-4}\times B$$

$$\Rightarrow B\approx10^{-3}T$$

20. A thin smooth rod of length L and mass M is rotating freely with angular speed ω_0 about an axis perpendicular to the rod and passing through its centre. Two beads of mass m and negligible size are at the centre of the rod initially. The beads are free to slide along the rod. The angular speed of the system, when the beads reach the opposite ends of the rod, will be:

1. $\frac{M\omega_0}{M+2m}$ **2.** $\frac{M\omega_0}{M+m}$ **3.** $\frac{M\omega_0}{M+3m}$ **4.** $\frac{M\omega_0}{M+6m}$

Ans: 4

Sol: Angular momentum is conserved

$$I_{ini}\omega_0=I_{An}\omega$$

$$\Rightarrow \frac{mL^2}{T^2}\omega_0 = \left(\frac{ML^2}{12}+\frac{mL^2}{4}+\frac{ML^2}{4}\right)\omega$$

$$\Rightarrow \omega = \frac{M\omega_0}{M+6m}$$

21. A wooden block floating in a bucket of water has $\frac{4}{5}$ of its volume submerged. When certain amount of an oil is poured into the bucket, it is found that the block is just under the oil surface with half of its volume under water and half in oil. The density of oil relative to that of water is:

1. 0.6 **2. 0.7** **3. 0.8** **4. 0.5**

Ans: 1

Sol: $\int wod = \frac{4}{5}\int water$

$$\frac{v}{2}\int_{oil} g + \frac{v}{2}\int_{water} g = \int_{wood} g$$

$$\Rightarrow \int oil + \int water = 2\left(\int wood\right)$$

$$\Rightarrow \int oil + \int water = \frac{8}{5}\int water$$

$$\Rightarrow \frac{\int oil}{\int water} = 0.6$$

22. The resistance of a galvanometer is 50 ohm and the maximum current which can be passed through it is 0.002 A. What resistance must be connected to it in order to convert it into an ammeter of range 0 – 0.5A?

1. 0.5 ohm **2. 0.02 ohm** **3. 0.2 ohm** **4. 0.002 ohm**

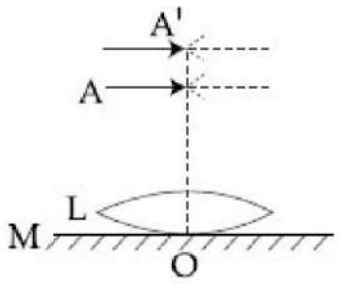
Ans: 3

Sol: $50(0.002) = R(0.5-0.002)$

$$0.1 \approx R(0.5)$$

$$R \approx 0.2\Omega$$

23. **A thin convex lens L (refractive index = 1.5) is placed on a plane mirror M. When a pin is placed at A, such that OA = 18 cm, its real inverted image is formed at A itself, as shown in figure. When a liquid of refractive index μ_l is put between the lens and the mirror, the pin has to be moved to A', such that $OA' = 27cm$, to get its inverted real image at A' itself. The value of μ_l will be:**



1. $\sqrt{2}$ **2.** $\sqrt{3}$ **3.** $\frac{4}{3}$ **4.** $\frac{3}{2}$

Ans: **3**

Sol: **At A**

Reff = 18cm

Reff = -9 cm

$$P_{net} = 2P_L + P_M$$

$$\frac{1}{9} = \frac{2}{f_L + 0}$$

$$\frac{1}{18}(\mu - 1)\left(\frac{2}{R_L}\right) \qquad R_L = 18cm$$

At A'

Reff = 27cm

Reff= -27/2 cm

Pnet = $2P_{cem}$ + $2P_{liquid}$

$$\frac{2}{27} = \frac{1}{9} + 2(\mu - 1)\left(\frac{-1}{18}\right)$$

$$\frac{1}{9}\left(\frac{-1}{3}\right) = 2(\mu - 1)\left(\frac{-1}{18}\right) \quad \mu = \frac{4}{3}$$

24. **The position vector of a particle changes with time according to the relation $\vec{r}(t)=15t^2\hat{i}+\left(4-20t^2\right)\hat{j}$. What is the magnitude of the acceleration at t = 1?**

1. 25 **2. 100** **3. 50** **4. 40**

Ans: 3

Sol: $\vec{V}=30t\hat{i}-40t\,\hat{j}$

$\vec{a}=30\hat{i}-40\hat{j}$

$|a|=\sqrt{30^2+40^2}=50$

25. **A particle of mass 'm' is moving with speed '2υ' and collides with a mass '2m' moving with speed 'υ' in the same direction. After collision, the first mass is stopped completely while the second one splits into two particles each of mass 'm', which move at angle 45° with respect to the original direction.**

The speed of each of the moving particle will be:

1. $\upsilon/\left(2\sqrt{2}\right)$ **2.** $2\sqrt{2}\upsilon$ **3.** $\sqrt{2}\upsilon$ **4.n** $\upsilon/\sqrt{2}$

Ans: 2

Sol: $P_i=P_f$

$4mv=2\left(\frac{mv_1}{\sqrt{2}}\right)$

$v_1=2\sqrt{2}v$

26. **The position of a particle as a function of time t, is given by $x(t)=at+bt^2-ct^3$ where a, b and c are constants. When the particle attains zero acceleration, then its velocity will be:**

1. $a+\frac{b^2}{3c}$ **2.** $a+\frac{b^2}{2c}$ **3.** $a+\frac{b^2}{c}$ **4.** $a+\frac{b^2}{4c}$

Ans: 1

Sol: $x=at+bt^2-ct^3$

$V=a+2bt-3ct^2$

Accn= 2b-6ct=0

$$\Rightarrow t=\frac{b}{3C}$$

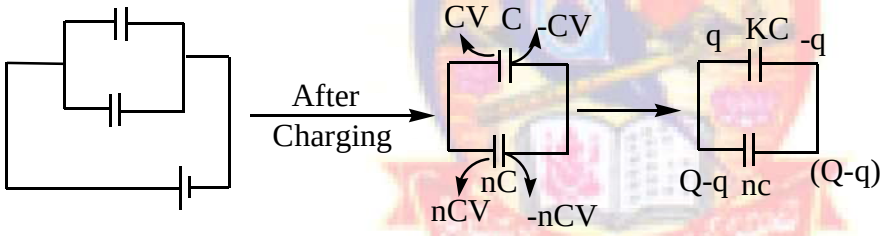
$$V=a+\frac{2b^2}{3C}-\frac{b^2}{3C}=a+\frac{b^2}{3C}$$

27. The parallel combination of two air filled parallel plate capacitors of capacitance C and nC is connected to a battery of voltage, V. When the capacitors are fully charged, the battery is removed and after that a dielectric material of dielectric constant K is placed between the two plates of the first capacitor. The new potential difference of the combined system is:

1. $\frac{V}{K+n}$ **2.** $\frac{(n+1)V}{(K+n)}$ **3. V** **4.** $\frac{nV}{K+n}$

Ans: 2

Sol:



$$Q=CV(n+1)$$

$$\frac{q}{KC}=\frac{Q-q}{nC}\quad q\left(\frac{n+K}{nK}\right)=\frac{Q}{n}$$

$$q=\frac{QK}{n+K}$$

$$V'=\frac{q}{KC}=\frac{1}{C}\frac{Q}{n+K}=\frac{V(n+1)}{(n+K)}$$

28. A metal wire of resistance 3Ω is elongated to make a uniform wire of double its previous length. This new wire is now bent and the ends joined to make a circle. If two points on this circle make an angle 60° at the centre, the equivalent resistance between these two points will be:

1. $\frac{5}{2}\Omega$ **2.** $\frac{5}{3}\Omega$ **3.** $\frac{12}{5}\Omega$ **4.** $\frac{7}{2}\Omega$

Ans: 2

Sol: $R=\frac{\partial L}{A}=\frac{\partial L^2}{V}$ $R\propto L^2$

After doubling $R=12\Omega$

For A . B wire $R\propto L$

Parallel $\frac{1}{\text{Reff}}=\frac{1}{2}+\frac{1}{10}=\frac{3}{5}$ $\text{Reff}=\frac{5}{3}\Omega$

29. Diameter of the objective lens of a telescope is 250 cm. For light of wavelength 600 nm. Coming from a distant object, the limit of resolution of the telescope is close to:

1. $3.0\times10^{-7}rad$ **2.** $4.5\times10^{-7}rad$ **3.** $2.0\times10^{-7}rad$ **4.** $1.5\times10^{-7}rad$

Ans: 1

Sol: $\sin\theta=\frac{1.22\lambda}{b}=\frac{1.22\left(6\times10^{7}\right)}{2.5}$

$\theta\approx\frac{7.32}{2.5}\times10^{-7}\approx3\times10^{-7}rad$

30. A particle 'P' is formed due to a completely inelastic collision of particles '*x*' and '*y*' having de-Broglie wavelengths 'λ_x' and 'λ_y' respectively. If x and y were moving in opposite directions, then the de-Broglie wavelength of 'P' is:

1. $\lambda_x-\lambda_y$ **2.** $\frac{\lambda_x\lambda_y}{\left|\lambda_x-\lambda_y\right|}$ **3.** $\lambda_x+\lambda_y$ **4.** $\frac{\lambda_x\lambda_y}{\lambda_x+\lambda_y}$

Ans: 2

Sol: $P_x=\frac{h}{\lambda_x}$ $p_y=\frac{h}{\lambda_y}$

$\left|P_x-P_y\right|=P_P=h\left|\frac{1}{\lambda_x}-\frac{1}{\lambda_y}\right|$

$P_P=\frac{h}{\lambda_P}$ $\lambda_P=\frac{1}{\left|\frac{1}{\lambda_x}-\frac{1}{\lambda_y}\right|}=\frac{\lambda_x\lambda_y}{\left|\lambda_x-\lambda_y\right|}$

CHEMISTRY

31. **Assertion: For the extraction of iron, haematite ore is used.**

Reason: Haematite is a carbonate ore of iron.

Both the assertion and reason are

1. Both the assertion and reason are Correct and the reason is the correct explanation for the assertion.
2. Only the assertion is correct.
3. Both the assertion and reason are Correct, but the reason is not the correct explanation for the assertion
4. Only the reason is correct

Ans: **2**

Sol:

32. **What would be the molality of 20% (mass / mass) aqueous solution of KI?**

(molar mass of $KI = 166 gmol^{-1}$**)**

1. 1.08 **2. 1.35** **3. 1.51** **4.1.48**

Ans: **3**

Sol: **20% mass/mass** $\Rightarrow$ **20g KI in 100g of solution**

$\Rightarrow$ **mass of KI in solution =20g**

No.of moles of solute $= = \frac{20}{166} = 0.120 moles$

$\therefore = \frac{\text{no. of moles of solute}}{\text{weight of solvent}}$

$= \frac{0.1204}{8} \times 1000 = \frac{12.04}{8}$

33. **A solution of** $Ni(NO_3)_2$ **is electrolysed between platinum electrodes using 0.1 Faraday electricity. How many mole of Ni will be deposited at the cathode?**

1. 0.10 **2. 0.15** **3. 0.20** **4. 0.05**

Ans: **4**

Sol: **For 2F of electricity** $\rightarrow$ **1 mole of Ni is deposited**

$\Rightarrow 0.1F \rightarrow \Rightarrow x = \frac{0.1}{2} = 0.05$ **moles**

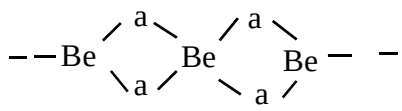
34. **The structures of beryllium chloride in the solid state and vapour phase, respectively, are :**

1. Chain and chain **2. Chain and Dimeric**

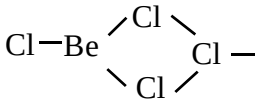
3. Dimeric and dimeric **4. Dimeric and chain**

Ans: **2**

Sol: **The structure of $BeCl_2$ in solid state – chain**



In vapour state – demeric



35. **Noradrenaline is a/an :**

1. Antacid **2. Antihistamine**

3. Antidepressant **4. Neurotransmitter**

Ans: **4**

Sol: **Noradrenaline is a neurotransmitter**

36. **HF has highest boiling point among hydrogen halides, because it has:**

1. Strongest van der Waal's interactions

2. Lowest ionic character

3. Strongest hydrogen bonding

4. Lowest dissociation enthalpy

Ans: **3**

Sol: **HF forms strong hydrogen bonding due to which the molecules have attractive force Hence, have highest boiling points among hydrogen halides**

37. **At a given temperature T, gases Ne, Ar, Xe and Kr are found to deviate from ideal gas behaviour. Their equation of state is given as $p = \frac{RT}{V-b}$ at T.**

Here, be is the van der Waals constant. Which gas will exhibit steepest increase in the plot of Z (compression factor) vs p ?

1. Ne **2. Xe** **3. Ar** **4. Kr**

Ans: 2

Sol: $P = \frac{RT}{v-b}$

$\frac{pv}{RT} = 1 + \frac{Pb}{RT}$

To exhibit steepest slope b should be minimum

So, it is more for Xe(due to large size)

38. Which of the following compounds is a constituent of the polymer

$\left[-HN-\overset{\overset{O}{\|}}{C}-NH-CH_2-\right]_n$ **?**

1. Ammonia **2. Methylamine**

3. Formaldehyde **4. N-methyl urea**

Ans: 3

Sol: $-\left[NH-\overset{\overset{O}{\|}}{C}-NH-CH_2\right]_n-$

= monomers are formaldehyde and urea

39. During compression of a spring the work done is 10 kJ and 2 kJ escaped to the surroundings as heat. The change in internal energy, ΔU (in kJ) is:

1. -12 **2. 8** **3. 12** **4. -8**

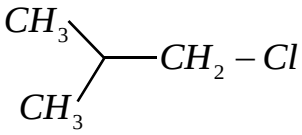
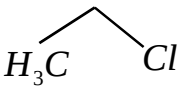
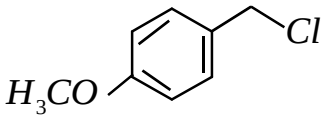
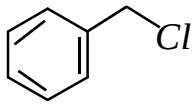
Ans: 2

Sol: **During compression of a spring work done is 10kJ**

Heat escaped to surroundings 2kJ

The change in internal energy $\Delta U = 10-2 = 8$

40. Increasing order of reactivity of the following compounds for S_N1 substitution is:

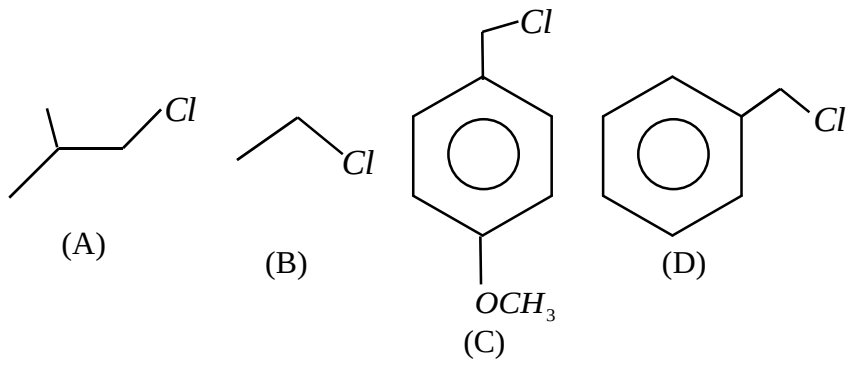
A)  **B)**  **C)**  **D)** 

1. (B) < (C) < (D) < (A) **2. (A) < (B) < (D) < (C)**

3. (B) < (C) < (A) < (D) **4. (B) < (A) < (D) < (C)**

Ans: 4

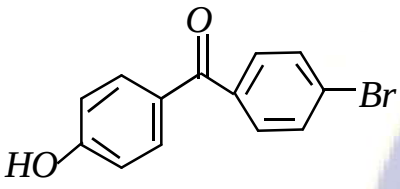
Sol:



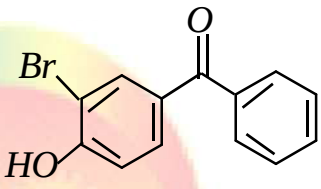
(A) (B) (C) (D)

41. p-Hydroxybenzophenone upon reaction with bromine in carbon tetrachloride gives:

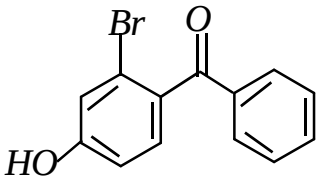
1.



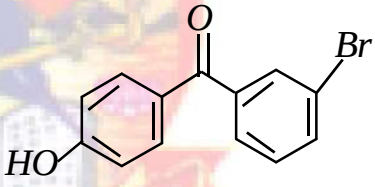
2.



3.

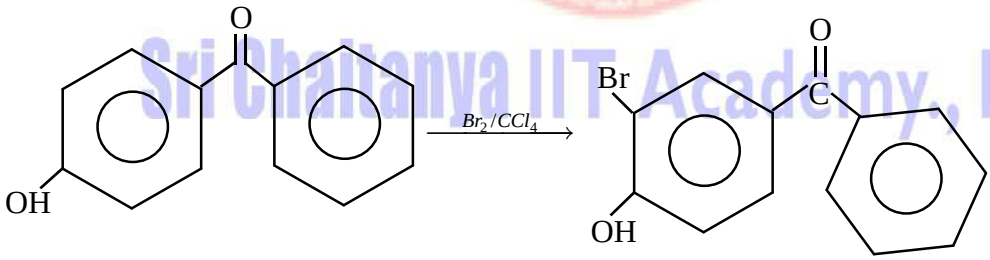


4.



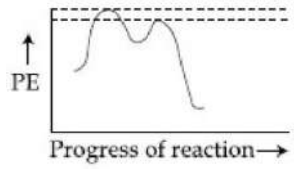
Ans: 2

Sol:

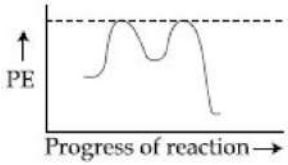


42. Which of the following potential energy (PE) diagrams represents the S_N1 reaction?

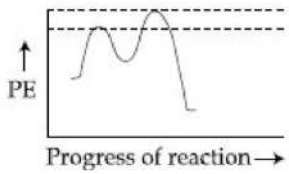
1.



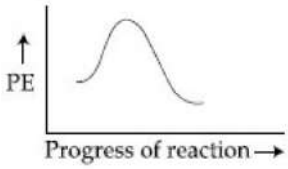
2.



3.

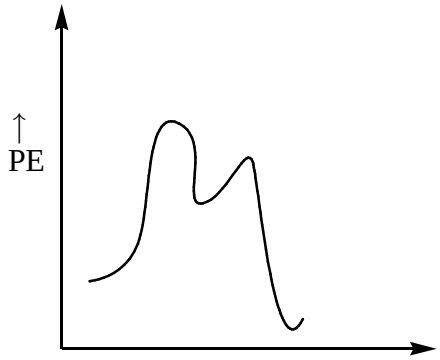


4.



Ans: 1

Sol: **For SN' carboncation will be formed So 7.5 is**



43. **Which one of the following about an electron occupying the 1s orbital in a hydrogen atom is incorrect? (The Bohr radius is represented by a_0).**

1. The electron can be found at a distance $2a_0$ from the nucleus

2. The probability density of finding the electron is maximum at the nucleus

3. The total energy of the electron is maximum when it is at a distance a_0 from the nucleus

4. The magnitude of the potential energy is double that of its kinetic energy on a an average

Ans: **3**

Sol: **Total energy of the electron is minimum when it is at a distance a_0 due (-)ve sign**

44. **In the following reaction carbonyl compound** $+MeOH \underset{\longleftarrow}{\overset{HCl}{\longrightarrow}} acetal$ **Rate of the reaction is the highest for:**

1. Acetone as substrate and methanol in excess

2. Propanal as substrate and methanol in stoichiometric amount

3. Propanal as substate and methanol in excess

4. Acetone as substrate and methanol in stoichiometric amount

Ans: **3**

Sol: **Propanal as substrate and methanol ixcess to form acetal because aldehyde is more reactive**

45. **10 mL of 1 mM surfactant solution forms a monolayer covering $0.24cm^2$ on a polar substrate. If the polar head is approximated as a cube, what is its edge length?**

1. 2.0 pm **2. 0.1 nm** **3. 2.0 nm** **4. 1.0 pm**

Ans: **1**

Sol: **Given the surtactrant solution has molar concentration is $10^{-3}M$. Volume of solution = 10mL**

$\therefore$ **no.of moles of surtactant** $=10\times10^{-3}\times10^{-3}$**moles**

$10^{-5}moles$

No.of polarheads = $6\times10^{23}\times10^{-5}$

$=6\times10^{18}$

Area coverd on polar substrate $=0.24\times10^{\{4\}}m^2$

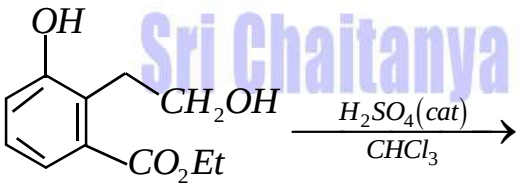
$a^2\times6\times10^{18}=2.4\times10^{-5}$

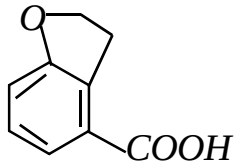
$a^2=4\times10^{-24}$

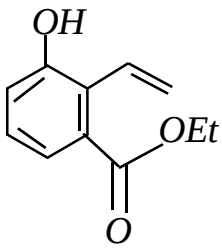
$a=2\times10^{-12}m$

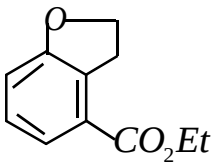
$\therefore a=2.0\,pm$

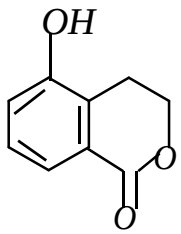
46. **The major product of the following reaction is:**



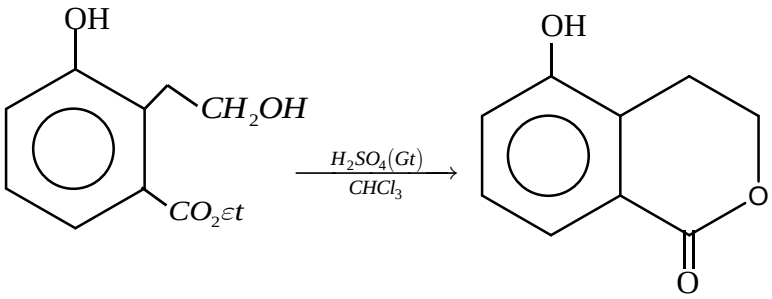
1. 

2. 

3. 

4. 

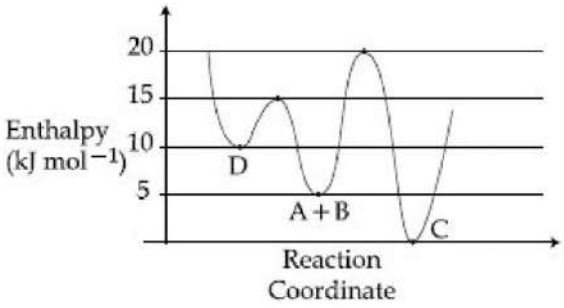
Ans: **4**



Sol:

47. Consider the given plot of enthalpy of the following reaction between A and B.

$A+B\rightarrow C+D$. Identify the incorrect statement.



1. C is the thermodynamically stable product

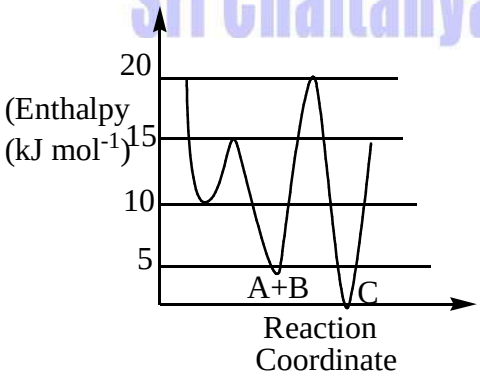
2. Formation of A and B from C has highest enthalpy of activation

3. Activation enthalpy to form C is $5kJmol^{-1}$ less than that to form D

4. D is kinetically stable product

Ans: 3

Sol:



Activation enthalpy to form C is 10kJ mol^{-1} less than that to form D

48. The peptide that gives positive ceric ammonium nitrate and carbylamines tests is:

1. Asp – Gln 2. Ser – Lys 3. Gln – Asp 4. Lys – Asp

Ans: 2

Sol: For ceric ammonium nitrate test one – OH group should present.

For carbynlamine test $-NH_2$ group should present ser – Lys contain these

49. The one that is not a carbonate ore is:

1. Calamine 2. Siderite 3. Malachite 4. Bauxite

Ans: 4

Sol: Banxite is not a carbonate ore

50. The amorphous form of silica is:

1. Tridymite 2. Quartz 3. Kieselguhr 4. Cristobalite

Ans: 3

Sol: Kieselguhr is an amorphous form of silicer

51. The correct statements among I to III regarding group 13 element oxides are,

(I) Boron trioxide is acidic II) Oxides of aluminium and gallium are amphoteric

III) Oxides of indium and thallium are basic

1. (I) and (II) only 2. (I), (II) and (III)

3. (I) and (III) only 4. (II) and (III) Only

Ans: 2

Sol: Boron trioxide is acidic

Aluminium and gallium are amphoteric

In, Tl are basic

52. The correct statement among I to III are:

I) Valence bond theory cannot explain the color exhibited by transition metal complexes

II) Valence bond theory can predict quantitatively the magnetic properties of transition metal complexes

III) Valence bond theory cannot distinguish ligands as weak and strong field ones.

1. (I) and (III) only 2. (II) and (III) only

3. (I), (II) and (III) 4. (I) and (II) only

Ans: 1

Sol: Valence bond theory cannot explain the color exhibited by transition metal complexes

2) Valance bond theory cannt predict untitatively the magnetic properties of transition metal complexes

3) Valence bond theory cannot distinguish ligands as weak and strong field ones

53. The layer of atmosphere between 10 km to 50 km above the sea level is called as :

1) Thermosphere 2) Troposhere 3) Mesosphere 4) Stratosphere

Ans: 4

Sol: Layer of atmosphere between 10 to 50 km is stratosphere

54. Among the following species, the diamagnetic molecule is:

1. B_2 **2.** O_2 **3.** CO **4.** NO

Ans: 3

Sol: The diamagnetic molecule amons the given is CO

55. The maximum number of possible oxidation states of actionoides are shown by:

1. Neptunium (Np) and plutonium (Pu)

2. Nobelium (No) and lawrencium (Lr)

3. Berkelium (Bk) and californium (Cf)

4. Actinium (Ac) and throrium (Th)

Ans: 1

Sol: Max oxidation states of getinoies are NP, Ph

56. Molal depression constant for a solvent is 4.0 K kg mol^{-1}**. The depression in the freezing point of the solvent for 0.03 mol** kg^{-1} **solution of** K_2SO_4 **is : (Assume complete dissociation of the electrolyte)**

1. $0.24K$ **2.** $0.12K$ **3.** $0.18K$ **4.** $0.36K$

Ans: 4

Sol: Molal depression constant $= K_f = 4\,K\,kg\,mol^{-1}$

Molality $= 4\times(0.03)(3) = 0.36K$

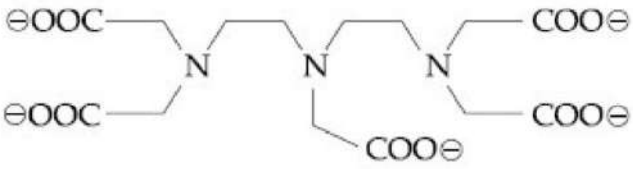
57. Hinsberg's reagent is:

1. $C_6H_5SO_2Cl$ **2.** $SOCl_2$ **3.** $(COCl)_2$ **4.** C_6H_5COCl

Ans: 1

Sol: **Hinsberg's reagent is** $C_5H_5SO_2Cl$

58. **The maximum possible denticities of a ligand given below towards a common transition and inner-transition metal ion, respectively, are :**



1. 8 and 8 **2. 6 and 8** **3. 8 and 6** **4. 6 and 6**

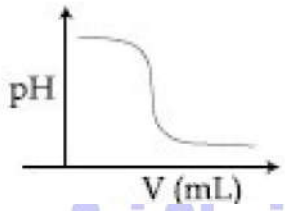
Ans: **2**

Sol: **The maximum denticities of transition metal =6**

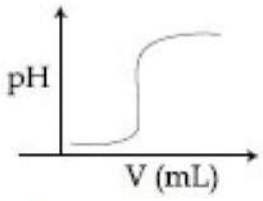
For inner – transition metal = 8

59. **In an acid-base titration, 0.1 M HCl solution was added to the NaOH solution of unknown strength. Which of the following correctly shows the change of pH of the titration mixture in this experiment ?**

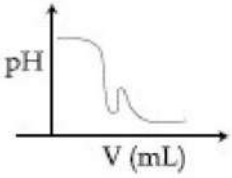
A)



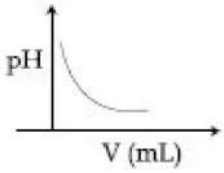
B)



C)



D)



1. (D) **2. (A)** **3. (C)** **4. (B)**

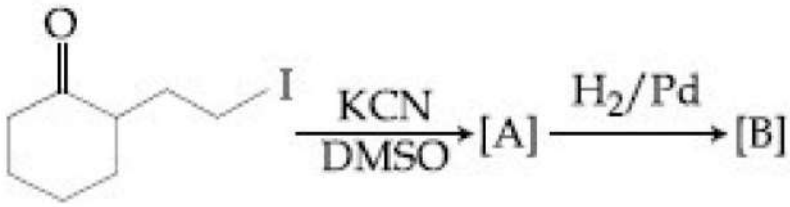
Ans: **2**

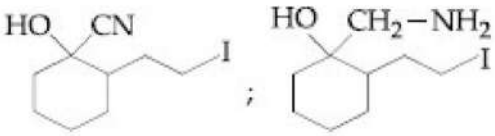
Sol: **Given HCl titrated with NaOH**

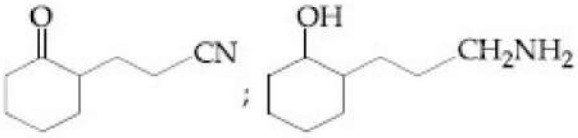
$\Rightarrow$ **initially NaOH is present** $\Rightarrow$ pH **is more**

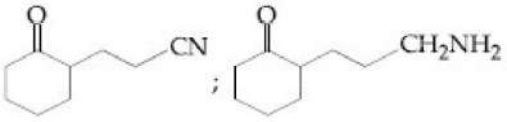
$\therefore$ **graph is**

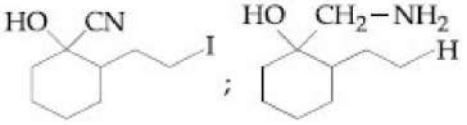
60. The major products A and B for the following reactions are, respectively:



1. 

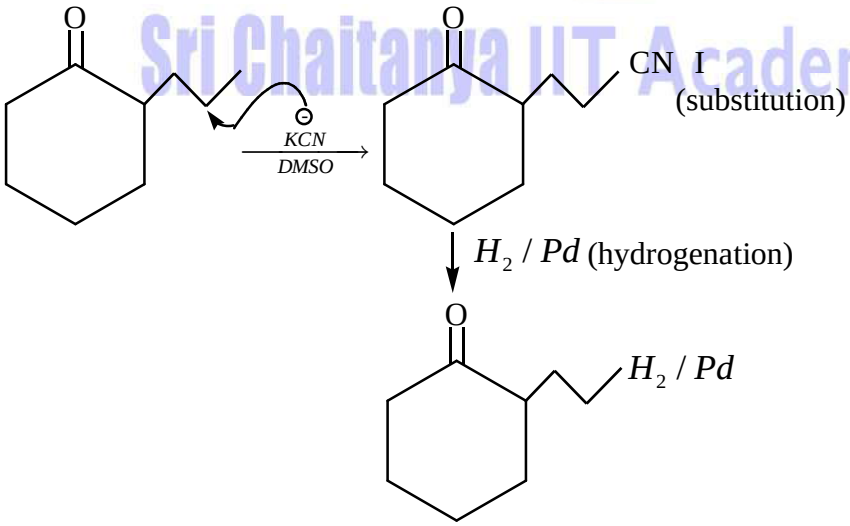
2. 

3) 

4) 

Ans: 2

Sol:



MATHS

61. **The domain of the definition of the function** $f(x)=\frac{1}{4-x^2}+\log_{10}\left(x^3-x\right)$ **is**

1. $(-1,0)\cup(1,2)\cup(2,\infty)$ **2.** $(-2,-1)\cup(-1,0)\cup(2,\infty)$

3. $(-1,0)\cup(1,2)\cup(3,\infty)$ **4.** $(1,2)\cup(2,\infty)$

Ans: 1

Sol: $f(x)=\frac{1}{4-x^2}+\log_{10}^{\left(x^3-x\right)}$

$4-x^2\neq 0$

$x\neq +2,-2$

and $x^2-x>0$ **for** $\log_{10}^{\left(x^3-x\right)}$ **to be defined**

$x(x-1)(x+1)>0$

$x>1$ **are** $x\in(-1,0)$

So domain f(x) $=(-1,0)\cup(1,2)\cup(2,\infty)$

62. **The total number matrices** $A=\begin{bmatrix}0 & 2y & 1\\ 2x & y & -1\\ 2x & -y & 1\end{bmatrix},(x,y\in R,x\neq y)$ **for which** $\mathbf{A^TA=3I_3}$ **is**

1. 2 **2. 6** **3) 4** **4) 3**

Ans: 3

Sol: $A=\begin{pmatrix}0 & 2y & 1\\ 2x & y & -1\\ 2x & -y & 1\end{pmatrix}A^TA=3I_3(given)$

$$A^TA\begin{pmatrix}0 & 2x & 2x\\ 2x & y & -y\\ 1 & -1 & 1\end{pmatrix}\begin{pmatrix}0 & 2y & 1\\ 2x & y & -1\\ 2x & -y & 1\end{pmatrix}=3I_3$$

$$=\begin{pmatrix}8x^2 & 0 & 0\\ 0 & 6y^2 & 0\\ 0 & 0 & 3\end{pmatrix}=\begin{pmatrix}3 & 0 & 0\\ 0 & 3 & 0\\ 0 & 0 & 3\end{pmatrix}$$

$8x^2=3$ **and** $6y^3=3$

$x=\pm\sqrt{\frac{3}{8}},\ y=\pm\frac{1}{\sqrt{2}}$

Total four solution for (x,y)

63. If the sum and product of the first three terms in an A.P are 33 and 1155, respectively, then a value of its 11th term is

1. -25 **2. 25** **3. -35** **4. -36**

Ans: 1

Sol: Let "a" be the first term and "d" be common difference

Given $a+(a+d)(a+2d)=33,\quad a(a+d)(a+2d)=1155$

$3(a+d)=33$ $\qquad a(a+2d)=105$

$a+d=11$ $\qquad (11-d)(11+d=105)$

$d=-4\quad (or)\quad +4$

For d=-4

$a+d=11$

$a=15$

11th term is 1+10d

$t_{11}=15+10(-4)=-25$

64. The vertices B and C of a ΔABC **lie on line,** $\frac{x+2}{3}=\frac{y-1}{0}=\frac{z}{4}$ **such that BC=5 units,**

Then the area (in sq.units) of this triangle, given that the point A(1, -1,2)

1. $\sqrt{34}$ **2.** $5\sqrt{17}$ **3.** $2\sqrt{34}$ **4. 6**

Ans: 1

Sol: Given B & C of ΔABC **lie on the line** $\frac{x+2}{3}=\frac{y-1}{0}=\frac{z}{y}\quad BC=5$

A(1,-1,2)

Area of triangle $ABC=\frac{1}{2}\times(BC)\times$ **(ter distance from a to line)**

let us take a point on the line

$P(3\lambda-2,1,4\lambda)$

AP line is perpendicular to direction of given line

$\overrightarrow{AP}=(3\lambda-3,2,4\lambda-2)$ *i.e* $\left(3\lambda-3\hat{i}+2\hat{j}+(4\lambda)\right)\hat{k}$

$\overrightarrow{AP}.\vec{L}=0$

$(3\lambda-3)\hat{i}+2\hat{j}+(4\lambda-2)\hat{k}.\left(3\hat{i}+0\hat{j}+4\hat{k}\right)=0$

$9\lambda-9+10\lambda-8=0$

$25\lambda=17$

$\lambda=\frac{17}{25}$

$P\left(\frac{1}{25},1,\frac{68}{25}\right)$

$\left|\overline{AP}\right|=\sqrt{\left(\frac{24}{25}\right)^2+2^2+\left(\frac{18}{25}\right)^2}$

Area of triangle ABC $=\frac{1}{x}\times5\times\left|\overline{AD}\right|=\sqrt{34}$

65. If the function $f(x)=\begin{cases}a|\pi-x)+1, & x\le5\\ b|x-\pi|+3, & x>5\end{cases}$ **is continuous at x = 5, then the value of a-b is**

1. $\frac{-2}{\pi+5}$ **2.** $\frac{2}{\pi+5}$ **3.** $\frac{2}{\pi-5}$ **4.** $\frac{2}{5-\pi}$

Ans: 4

Sol: $f(x)\begin{cases}a|\pi-x|+1 & x\le5\\ b|x-\pi|+3 & x>5\end{cases}$ **is continuous at x=5**

$a|\pi-5|+1=b|5-\pi|+3$

$a(5-\pi)+1=b(5-\pi)+3$

$(a-b)(5-\pi)=2$

$a-b=\frac{2}{5-\pi}$

66. **If the tangent to the parabola $y^2 = x$ at a point $(\alpha+\beta),(\beta>0)$ is also a tangent to the ellipse, $x^2+2y^2=1$, then α is equal to**

1. $2\sqrt{2}-1$ **2.** $\sqrt{2}+1$ **3.** $2\sqrt{2}+1$ **4.** $\sqrt{2}-1$

Ans: 2

Sol: **tangent to** $x^2+2y^2=1$

Is $y = mx+\sqrt{a^2m^2+b^2}$

$$y = mx+\sqrt{m^2+\frac{1}{2}}$$

$$\frac{1}{16m^2} = m^2+\frac{1}{2}$$

$$\frac{1}{6m^2} = \frac{2m^2+1}{2}$$

$$\left(4m^2-1\right)^2 = 2$$

$$\alpha = \sqrt{2+1}$$

67. **If $p \Rightarrow (q \vee r)$ is false, then the truth values of p,q,r are respectively :**

1. F,F,F **2. T,T,F** **3. T,F,F** **4. F,T,T**

Ans: 3

Sol: $p \Rightarrow (qvr)$ **is false, then truth values of p,q,r are respective for** $p \Rightarrow (qvr))$ **is false**

If (qvr) **is false**

The q is false and r is false

And p is true

68. **If m is choosen in the quadratic equation $\left(m^2+1\right)x^2-3x+\left(m^2+1\right)^2=0$ such that the sum of its roots is greatest, then the absolute difference of the cubes of its roots is**

1. $4\sqrt{3}$ **2.** $8\sqrt{3}$ **3.** $10\sqrt{5}$ **4.** $8\sqrt{5}$

Ans: 4

Sol: **Given quadratic** $\left(m^2+1\right)x^2-3x+\left(m^2+1\right)^2=0$

$\frac{3}{m^2+1}$ **is greatest at M = 0**

$x^2-3x+1=0$

$|\alpha^3-\beta^3|=|(\alpha-\beta)(\alpha^2+\beta^2)|$

$=\left|\sqrt{(\alpha+\beta)^2-4\alpha\beta}(\alpha+\beta)^2-\alpha\beta\right|$

$=\sqrt{9-4}(9-1)$

$=8\sqrt{5}$

69. The value of $\sin 10^o \sin 30^o \sin 50^o \sin 70^o$ **is**

1. $\frac{1}{16}$ **2.** $\frac{1}{18}$ **3.** $\frac{1}{32}$ **4.** $\frac{1}{36}$

Ans: 1

Sol: $\sin 10^o \sin 30^o \sin 50^o \sin 70^o$

$=\sin 10^0 \sin 30^o \sin(60+10) \sin^o(60-10)$

$=\frac{1}{2}\sin\left(\frac{3}{4}-\sin^2 10\right)$

$=\frac{1}{8}(3\sin 10-4\sin^3 10)=\frac{1}{16}$

70. If $f(x)=[x]-\left[\frac{x}{4}\right], x\in R$ **, where [x] denotes the greatest integer function, then:**

1. Both $\lim_{x\to 4-} f(x)$ **and** $\lim_{x\to 4+} f(x)$ **exist but are not equal**

2. f is continous at x = 4

3. $\lim_{x\to 4-} f(x)$ **exist but** $\lim_{x\to 4+} f(x)$ **does not exist**

4. $\lim_{x\to 4+} f(x)$ **exist but** $\lim_{x\to 4-} f(x)$ **does not exist**

Ans: 2

Sol: $f(x)=[x]-\left[\frac{x}{4}\right], x\in R \qquad [.]=G.I.F$

$\lim_{x\to 4}[x]-\left[\frac{x}{4}\right]$

$\lim_{x\to 4^+}[x]-\left[\frac{x}{4}\right]$

$4-1=3$

So, $\lim_{x\to 4}[x]-\left[\frac{x}{4}\right]=3$

$at\ x=4\quad f(x)=[4]-\left[\frac{4}{4}\right]=3$

So, it is continuous at x = 4

71. The area (in sq. units) of the smaller of the two circles that touch the parabola, $y^2=4x$ **at the point (1,2) and the x-axis is**

1. $4\pi\left(2-\sqrt{2}\right)$ **2.** $4\pi\left(3+\sqrt{2}\right)$ **3.** $8\pi\left(2-\sqrt{2}\right)$ **4.** $8\pi\left(3-2\sqrt{2}\right)$

Ans: 4

Sol: Given parabola $\Rightarrow y^2=4x$

$\Rightarrow$ **Let centre is** (x_1,y_1)

$(x-x_1)^2+(y-y_1)^2=y_1^2$ **is the eq of circele**

$x_1^2-2x_1-4y_1+5=0$ **.....(1)**

$\Rightarrow$ **normal at** $(1,2)$ **to the parabola is x+y = 3**

$\Rightarrow x_1+y_1=3$ **....(2) (It passes through centre)**

$\Rightarrow x_1=\frac{-2\pm\sqrt{4+4(7)}}{2}=-1+2\sqrt{2}$

$=2\sqrt{2}-1$

$area=\pi r^2=\pi y_1^2=\pi\left[16+8-16\sqrt{2}\right]$

$=8\pi\left(3-2\sqrt{2}\right)$

72. Two newspapers A and B are published in a city. It is known that 250% of the city population reads A and 20% reads B while 8% reads both A and B. Further, 30% of those who read A but not B look into advertisements and 40% of those who read B but not A also look into advertisements, while 50% of those who read both A and

B look into advertisements. Then the percentage of the population who look into advertisements is:

1. 12.8 **2. 13.9** **3. 13** **4) 15**

Ans: 2

Sol: $P(A)=\frac{1}{4}=\frac{25}{100}$

$P(B)=\frac{1}{5}=\frac{20}{100}$

$P(A\cap B)=\frac{8}{100}$

$P(A\cap \overline{B})=\frac{25}{100}-\frac{8}{100}=\frac{17}{100}$

$P(\overline{A}\cap B)=\frac{20}{100}-\frac{8}{100}=\frac{12}{100}$

P(advertisement) $=\frac{30}{100}\times\frac{17}{100}+\frac{40}{100}\times\frac{12}{100}+\frac{8}{100}\times\frac{50}{100}$

$\%=\frac{1390}{100}=13.9$

73. The area (in sq.units) of the region $A=\left\{(x,y):\frac{y^2}{2}\le x\le y+4\right\}$ **is**

1. 18 **2. 16** **3.** $\frac{53}{3}$ **4. 30**

Ans: 1

Sol: $A=\int_{-2}^{4} y+4-\frac{y^2}{2}dy=18$

74. If $\cos x\frac{dy}{dx}-y\sin x=6x,\left(0<x<\frac{\pi}{2}\right)$ **and** $y\left(\frac{\pi}{3}\right)=0$**, then** $y\left(\frac{\pi}{6}\right)$ **is equal to**

1. $\frac{\pi^2}{2\sqrt{3}}$ **2.** $-\frac{\pi^2}{4\sqrt{3}}$ **3.** $-\frac{\pi^2}{2\sqrt{3}}$ **4.** $-\frac{\pi^2}{2}$

Ans: 3

Sol: $\cos x.\frac{dy}{dx}-y\sin x=6x$

$$y\left(\frac{\pi}{3}\right)=0\Rightarrow e=\frac{-\pi^2}{3}$$

$$y\left(\frac{\pi}{6}\right)=\frac{\pi^2}{2\sqrt{3}}$$

75. **If $f:R\to R$ is a differentiable function and $f(2)=6$, then $\lim\limits_{x\to 2}\int\limits_{6}^{f(x)}\frac{2t\,dt}{(x-2)}$ is**

1. 0 **2.** $24f'(2)$ **3.** $12f'(2)$ **4.** $2f'(2)$

Ans: 3

Sol: $\lim\limits_{x\to 2}\dfrac{\int\limits_{6}^{f(x)}2+dt}{x-2}$

$=\lim\limits_{x\to 2}2.f(x).f'(x)$

$=2\times 6\times f'(2)=12f'(2)$

76. **If some three consecutive coefficients in the binomial expansion of $(x+1)^n$ in powers of x are in the ratio 2 : 15 : 70, then three coefficients is**

1. 964 **2. 227** **3. 232** **4. 625**

Ans: 3

Sol: $(x+1)^n$ ${}^nC_{r-1},{}^nC_r,{}^nC_{r+1}$ **are consecutive terms**

${}^nC_{r-1}:{}^nC_r:{}^nC_{r+1}=2:15:70$

$\Rightarrow n=16,r=2,\ \dfrac{{}^nC_{r-1}+{}^nC_r+{}^nC_{r+1}}{3}=\dfrac{{}^{16}C_1+{}^{16}C_2+{}^{16}C_3}{3}=232$

77. **If the system of equation $2x+3y-z=0$, $x+ky-2z=0$ and $2x-y+z=0$ has a non – trivial solution (x, y, z) , then $\frac{x}{y}+\frac{y}{z}+\frac{z}{x}+k$ is equal to**

1. $\frac{3}{4}$ **2.** $\frac{1}{2}$ **3. -4** **4.** $-\frac{1}{4}$

Ans: 2

Sol: $\begin{vmatrix} 2 & 3 & -1 \\ 1 & K & -2 \\ 2 & -1 & 1 \end{vmatrix} = 0$

$\Rightarrow K\frac{9}{2}$

$2x+3y-z=0$

$2x-y+z=0$

$4y-2z=0$

$z=2y$

$x=-\frac{y}{z}$

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

78. **If unit vector $\vec{a}$ makes angles $\pi/3$ with $\hat{i},\pi/4$ with $\hat{j}$ and $\theta\in(0,\pi)$ with $\hat{k}$, then a value of θ is**

1. $\frac{2\pi}{3}$ **2.** $\frac{5\pi}{6}$ **3.** $\frac{5\pi}{12}$ **4.** $\frac{\pi}{4}$

Ans: **1**

Sol: $\cos^2\alpha+\cos^2\beta+\cos^2\gamma=1$

$\frac{1}{4}+\frac{1}{2}+\cos^2\gamma=1$

$\cos^2\gamma=\frac{1}{4}$

$\gamma=\frac{\pi}{3},\frac{2\pi}{3}$

79. **The value of the integral $\int_0^1 x\cot^{-1}\left(1-x^2+x^4\right)dx$ is**

1. $\frac{\pi}{2}-\frac{1}{2}\log_e 2$ **2.** $\frac{\pi}{4}-\log_e 2$ **3.** $\frac{\pi}{4}-\frac{1}{2}\log_e 2$ **4.** $\frac{\pi}{2}-\log_e 2$

Ans: **3**

Sol: $\int_0^1 x\cot^{-1}\left(1-x^2+x^4\right)dx$

$x^2 = t$

$= \frac{1}{2}\int_0^1 \cot^{-1}\left(1-t+t^2\right)dt$

$= \frac{1}{2}\int_0^1 \cot^{-1}\left(1+t\left(t-1\right)\right)dt$

$= \frac{1}{2}\int_0^1 \tan^{-1}t + \tan^{-1}\left(1-t\right)dt$

$= \int_0^1 \tan^{-1}t dt$

$= \frac{\pi}{4} - \frac{1}{2}\ln 2$

80. **If the two lines $x+\left(a-1\right)y=1$ and $2x+a^2y=1\left(a\in R-\left\{0,1\right\}\right)$ are perpendicular, then the distance of their point of intersection from the origin is**

1. $\frac{2}{5}$ **2.** $\frac{2}{\sqrt{5}}$ **3.** $\sqrt{\frac{2}{5}}$ **4.** $\frac{\sqrt{2}}{5}$

Ans: 3

Sol: $m_1m_2 = -1$

$-\frac{1}{a-1}+\frac{+2}{a^2}=+1$

$a^2\left(a-1\right)+2=0$

$a^3-a^2+2=0$

$x-2y=1\ 2x+y=1$

$x=\frac{3}{5}\ \ y=\frac{-1}{5}$

$d=\sqrt{x^2+y^2}=\frac{\sqrt{10}}{5}=\sqrt{\frac{2}{5}}$

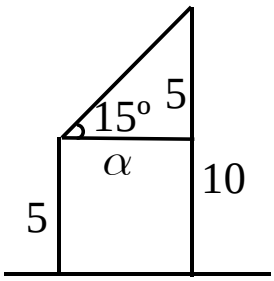
81. **Two poles standing on a horizontal ground are of heights 5 m and 10 m respectively. The line joining their tops makes an angle of 15º with ground. Then the distance (in m) between the poles, is**

1. $5\left(2+\sqrt{3}\right)$ **2.** $5\left(2+\sqrt{3}\right)$ **3.** $\frac{5}{2}\left(2+\sqrt{3}\right)$ **4.** $10\left(\sqrt{3}-1\right)$

Ans: 1

Sol: $\tan 15^\circ = \frac{5}{d}$

$d = 5\left(2+\sqrt{3}\right)$



82. Let P be the plane, which contains the line of intersection of the planes, $x+y+z-6=0$ and $2x+3y+z+5=0$ and it is perpendicular to the $xy-$ plane. Then the distance of the point (0,0,256) from P is equal to

1. $63\sqrt{5}$ **2.** $17/\sqrt{5}$ **3.** $205\sqrt{5}$ **4.** $11/\sqrt{5}$

Ans: 4

Sol: $x+y+z-6+\lambda\left(2x+3y+12+5\right)=0$

$\perp r \quad to \quad z=0$

$\Rightarrow 1+\lambda=0 \quad \Rightarrow \lambda=-1$

$\Rightarrow x+2y+11=0$

$\perp r$ **distance from (0,0,256)**

83. The mean and the median of the following ten numbers in increasing order 10,22,26,29,34,x,42,67,70,y are 42 and 35 respectively, then $\frac{y}{x}$ is equal to

1. 7/2 **2. 7/3** **3. 9/4** **4. 8/3**

Ans: 2

Sol: 10,22,26,29,34,x,42,67,70,y

Median = 35

$\frac{34+x}{2}=35$

$\Rightarrow x=36$

Mean = 42

10+22+26+29+34+x+42+67+70+y

=420

$\Rightarrow y = 84$

$\frac{y}{x} = \frac{84}{36} = \frac{7}{3}$

84. The common tangent to the circle $x^2 + y^2 = 4$ and $x^2 + y^2 + 6x + 8y - 24 = 0$ also passes through the point:

1. (4,-2) **2. (-4,6)** **3. (6,-2)** **4. (-6, 4)**

Ans: 3

Sol: $\Rightarrow$ **touching internally**

$\tan\theta = \frac{4}{3}$

$\Rightarrow$ **common tangent is S-S'=0**

$\Rightarrow$ **6x+8y=20**

$\Rightarrow$ **3x+4y-10=0**

85. Let $z \in C$ be such that $|z| < 1$. If $\omega = \frac{5+3z}{5(1-z)}$, then:

1. $5\,\mathrm{Im}(\omega) < 1$ **2.** $5\,\mathrm{Re}(\omega) > 1$ **3.** $4\,\mathrm{Im}(\omega) > 5$ **4.** $5\,\mathrm{Re}(\omega) > 4$

Ans: 2

Sol: $(5-5z)\omega = 5+3z$

$5\omega - 5 = (5\omega + 3)z$

$z = \frac{5\omega - 5}{5\omega + 3} \quad |z| < 1$

$|5\omega - 5| < |5\omega + 3|$

$16 < 40(\omega - \bar{\omega})$

Re $(\omega) > \frac{1}{5}$

86. **A rectangle is inscribed in a circle with a diameter lying along the line $3y = x + 7$. If the two adjacent vertices of the rectangle are (-8, 5) and (6,5) then the area of the rectangle(in sq. units) is:**

1. 98 **2. 56** **3. 84** **4. 72**

Ans: **3**

Sol: $\underbrace{(-8,5)\ and\ \ (6,k)}_{\left(-1,\frac{k+5}{2}\right)}$

$\frac{3k+15}{2} = 6$

$\Rightarrow K = -1$

$A = 6 \times 14$

$= 84$

87. **If $\int e^{\sec x}\left(\sec x \tan x\ f(x) + \left(\sec x\ \tan x + \sec^2 x\right)\right)dx\ = e^{\sec x} f(x) + C$, then a possible choice of $f(x)$ is:**

1. $x\sec x + \tan x + \frac{1}{2}$ **2.** $\sec x + x\tan x - \frac{1}{2}$

3. $\sec x + \tan x + \frac{1}{2}$ **4.** $\sec x - \tan x - \frac{1}{2}$

Ans: **3**

Sol: $f(x) = \int\left(\sec x \tan x + \sec^2 x\right)dx$

$= \sec x + \tan x + c$

88. **A water tank has the shape of an inverted right circular cone, whose semi-vertical angle is $\tan^{-1}\left(\frac{1}{2}\right)$. Water is poured into it at a constant rate of 5 cubic meter per minute. Then the rate (in m/min), at which the level of water is rising at the instant when the depth of water in the tank is 10m; is:**

1. $1/10\pi$ **2.** $1/15\pi$ **3.** $1/5\pi$ **4.** $2/\pi$

Ans: **3**

Sol: $= \frac{\pi}{12}.3\lambda^2.\frac{dh}{dt}\frac{dx}{dt} = \frac{1}{5\pi}$

89. **The sum of the series $1+2\times3+3\times5+4\times7+.....$ upto 11^{th} term is**

1. 946 **2. 915** **3. 945** **4. 916**

Ans: 1

Sol: $\sum_{r=1}^{11} r(2r-1)$

$2\sum_{r=1}^{11} r^2 - \sum_{r=1}^{11} r$

$2\times\frac{11\times12\times23}{6} - \frac{11\times12}{2}$

=946

90. **Some identical balls are arranged in rows to form an equilateral triangle. The first row consists of one ball, the second row consists of two balls and so on. If 99 more identical balls are added to the total number of balls used in forming the equilateral triangle, then all these balls can be arranged in a square whose each side contains exactly 2 balls less than the number of balls each side of the triangle contains. Then the number of balls used form the equilateral triangle is**

1. 225 **2. 157** **3.190** **4. 262**

Ans: 3

Sol: $\frac{n(n+1)}{2} + 99 = (n-2)^2$

$\Rightarrow n = 19$

$\frac{19(20)}{2} = 190$

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