



JEE Main 27 Jan 2024 (Shift-1) (Memory Based)

The Actual Paper will be Updated with Solution After the Official Release

PHYSICS

SECTION-A

1. Which among the following is forward biased: (1) $_{0V}$ $_{33V}$ (2) $_{0V}$ $_{+5V}$ (3) $_{+2V}$ $_{+10V}$ (4) $_{34V}$ $_{33V}$ Ans. (1) Sol. Basic theory. ARE YOU

2. A uniform and homogeneous rod has resistance R. If rod is cut into 5 equal parts and connected in parallel find equivalent resistance ?

Ans.
$$\frac{R}{25}$$

Sol.





Give yourself an extra edge

www.eedge.in





3. Acceleration due to earth on the surface is g₀. If mass of earth remains same but radius is half, then find the acceleration on the surface for new system :

(1)
$$\frac{g_0}{2}$$
 (2) g_0 (3) 2 g_0 (4) 4 g_0

(4) Ans.

Sol.
$$g_0 = \frac{Gm}{R^2}$$

$$g = \frac{Gm}{(R/2)^2} = \frac{4Gm}{R^2} = 4g_0$$

4. Find moment of inertia about an axis passing though one corner and perpendicular to the plane.



Ans. 4 ma^2

- **Sol.** $I = ma^2 + ma^2 + m \not (\sqrt{2} a) \ \ \vec{u} + 0 = 4 ma^2$
- 5. Two particles having mass 4g & 25g have same kinetic energy. Find ratio of their momentum?

(1)
$$\frac{2}{5}$$
 (2) $\frac{2}{3}$ (3) $\frac{4}{5}$ (4) $\frac{3}{4}$

(1) Ans.

Sol.
$$KE_1 = KE_2$$

$$\frac{P_1^2}{2m_1} = \frac{P_2^2}{2m_2}$$
$$\frac{P_1}{P_2} = \sqrt{\frac{m_1}{m_2}} = \sqrt{\frac{4}{25}} = \frac{2}{5}$$





- 6. An object of mass 1000 kg is moving with 6 m/s. Find speed of object is mass 200 kg is added to it ?
 - (1) 4 m/s (2) 5 m/s (3) 8 m/s (4) 6 m/s
- Ans. (2)
- **Sol.** Linear momentum is conserved.

 $1000 \times 6 = 1200 \; (v_{\rm f})$

- \therefore $v_f = 5 m/s$
- 7. Two very long wire having current as shown. Find the magnetic field at point 'P' (in micro tesla).



Ans. 160

Sol. $\mathbf{B} = \frac{\mu_0 \mathbf{I}}{2\delta \mathbf{D}} \times 2$

$$\mathbf{B} = \frac{2 \times 10^{-7} \times 10}{\frac{5}{2} \times 10^{-2}} \times 2$$
$$\mathbf{B} = 16 \times 10^{35} \text{ Tesla}$$
$$\mathbf{B} = 160 \ \mu\text{T}$$

8. If the electron revolving in the third Bohr's orbit of hydrogen species has radius R, then what will be its radius in fourth orbit in terms of R.

EADY?

(1)
$$\frac{25R}{9}$$
 (2) $\frac{16R}{9}$ (3) $\frac{36R}{9}$ (4) $\frac{9R}{16}$

Ans. (2)

Sol.
$$\mathbf{R} = \frac{\mathrm{kn}^2}{Z}$$
$$\frac{\mathrm{R}}{\mathrm{R}'} = \frac{\frac{\mathrm{k3}^2}{Z}}{\frac{\mathrm{k4}^2}{Z}}$$
$$\Rightarrow \qquad \frac{\mathrm{R}}{\mathrm{R}'} = \frac{9}{16}$$

$$\Rightarrow$$
 R' = $\frac{16}{9}$ R





9. A charge of magnitude $10^{36}\mu$ C is placed at origin in x-y co-ordinate system. Find the potential difference between the two point $\emptyset\sqrt{3}$, $\sqrt{3}$ and $\emptyset\sqrt{6}$, 0 c. (Axis are in meters)

(1)
$$3\sqrt{3} \times 10^{3} V$$

(2) $\frac{3}{\sqrt{3}} \times 10^{3} V$
(3) $0V$
(4) $2\sqrt{3} \times 10^{3} V$

Ans. (3)

- **Sol.** Same radial distance from origin Hence Potential is same at the two given point. Thus potential difference is zero
- 10. Magnetic field having magnitude 4 Tesla makes an angle 60° with perpendicular to loop and loop has been removed from magnetic field region within 10 seconds. Find average induced emf in loop in 10 seconds in Volts?



Ans. 1

Sol. $e_{avg} = \frac{\Delta \phi}{\Delta t} = \frac{BA\cos\theta}{10}$

$$= 4 \times 2 \times \frac{5}{2} \times \frac{\cos 60}{10} = 1 \text{ volt}$$

11. Find apparent depth of the object shown in figure ?



Ans. $\frac{31}{4}$

Sol. Apparent depth =
$$\frac{6}{3/2} + \frac{6}{8/5} = 4 + \frac{15}{4} = \frac{31}{5}$$
 cm





12. An EM wave is given by

 $E = 200 \sin [1.5 \times 10^7 t 3 0.05 x] N/C$

Find the intensity of wave. [$\tilde{o}_0 = 8.85 \times 10^{312}$ SI units]

0.05

53.1 Ans.

Sol.
$$\mathbf{I} = \frac{1}{2} \tilde{\mathbf{o}}_0 E_0^2 . C_{\text{mid}}$$

 $\mathbf{I} = \frac{1}{2} \times 8.85 \times 10^{-12} \times [200]^2 \frac{1.5 \times 10^7}{0.05}$

$$I = 53.1 \text{ W/m}^2$$



Find charge on capacitor at steady state?

(1) 200 µC

(2) 300 µC

Ans. (3)







14. A particle performs SHM with an amplitude 4 cm. Speed of particle at mean position is 10 cm/sec. Find position from mean where speed is 5 cm/sec

(1) 2 cm (2)
$$2\sqrt{3}$$
 cm (3) 0.5 cm (4) $\sqrt{3}$ cm

- Ans. (2)
- Sol. $10 \text{ cm/s} = A\omega$...(i) $5 \text{ cm/s} = \omega\sqrt{A^2 - x^2}$...(ii) using (i) and (ii) $\mathbf{x} = \frac{\sqrt{3}A}{2} = 2\sqrt{3} \text{ cm}$
- **15.** Given :

$$\label{eq:m} \begin{split} m &= 0.08 \ \text{kg} \\ s_v &= 0.17 \ \text{kcal/kg-}^\circ\text{C} \\ \Delta\text{T} &= 5^\circ\text{C} \end{split}$$

Find change in internal energy (in Joule) of gas.

Ans. 284

Sol. $\Delta U = ms_v \Delta T$

 $\Delta U = 0.08 \times 0.17 \times 10^{3} \times 5$ $\Delta U = 68 \text{ cal}$ $\Delta U = 284.24 \text{ Joule}$

16. A gas undergoes isothermal expansion from 30 dm³ to 45 dm³. Find heat absorbed by gas if external pressure is 10 kPa?

EADY?

(1) 100 J	(2) 150 J	(3) 120 J	(4) 200 J

Sol.
$$\Delta V = 0$$

 $\therefore \Delta Q = W$

$$= nRT \ell n \frac{\ddot{o}V_2}{\dot{\phi}V_1} \frac{\ddot{o}}{\dot{\phi}}$$
$$= P_1 V_1 \ell n \frac{\ddot{o}V_2}{\dot{\phi}V_1} \frac{\ddot{o}}{\dot{\phi}}$$
$$= 10 \times 10^3 \times 30 \times 10^{33} \ell n \frac{\ddot{o}3}{\dot{\phi}2} \frac{\ddot{c}}{\dot{\phi}}$$
$$= 300 \times 0.4$$
$$= 120 J$$





17. A banked road of radius 400 m is there with base separation between the rails is 1.5 m, if speed of a car for safe turning is 12 m/s, then find height of one rail w.r.t to second rail?



A particle is moving from origin with initial velocity $5\hat{i}$ m/s and constant acceleration $3\hat{i} + 2\hat{j}$ m/s². 18. When position of particle is 84 m, its velocity is $\sqrt{\alpha}$ m/s. Find out α :

 $x = u_x t + \frac{1}{2}a_x t^2$ Sol. $84 = 5t + \frac{3}{2}t^2$ t = 6 sec. $\vec{v} = \vec{u} + \vec{a}t$ $\vec{v} = 5\hat{i} + (3\hat{i} + 2\hat{j})\hat{6}$ $= 23\hat{i} + 12\hat{j}$ = 529 + 144 $=\sqrt{673}$ m/s $\alpha = 673$





19. Statement-1 : Angular momentum and Plank constant have same dimensions.

Statement-2 : Moment of force and linear momentum have same dimensions.

- (1) Both statements are true
- (2) Both statements are false
- (3) Statement 1 is true and 2^{nd} is false
- (4) Statement 2 is true and 1^{st} is false
- Ans. (3)

Sol. $L = \frac{nh}{2\delta}, \qquad F = \frac{dp}{dt}$ $[L] = M^{1}L^{2}T^{31}$ $[h] = ML^{2}T^{31}$ $[\tau] = M^{1}L^{2}T^{32}$ $[P] = M^{1}L^{1}T^{31}$

20. A proton is moving in gravity free space with constant velocity v and goes undeviated. What can be the possible conditions.

(3) A, B, C, D

(4) B, C. D

- (A) E = 0, B = 0(B) $E = 0, B \neq 0$ (C) $E \neq 0, B = 0$ (D) $E \neq 0, B \neq 0$ (1) A, B, D
- Ans. (1)
- 21. $S_1 \rightarrow$ Viscosity coefficient of gas is less than liquid.

 $S_2 \rightarrow$ Surface tension decreases if insoluble impurities are added.

(2) A, B, C

- (1) S_1 is true, S_2 is true
- (2) S_1 is false, S_2 is false
- (3) S_1 is true, S_2 is false
- (4) S_1 is false, S_2 is true







22. There in a prism of apex angle of 'A'. Its refractive index is equal to Cot $\frac{A}{2}$, then find minimum angle of

deviation?

- Ans. 2
- Sol.



$$\frac{\cos\frac{A}{2}}{\sin\frac{A}{2}} = \frac{\sin\frac{A+\delta_{\min}}{2}}{\sin\frac{A}{2}}$$
$$\Rightarrow \hat{o}_{\min} = \check{o} \; 3 \; 2A$$

23. A point charge q is placed at a centre of a charged ring of total charge Q. Find tension in the ring.

Ans. $\frac{KQq}{2\delta R^2}$









 $\frac{kqQ\tilde{n}}{2\tilde{o}R^2} = T\theta$ Also $\frac{Q}{dq} = \frac{2\delta}{\tilde{n}}$

$$T = \frac{KQq}{2\eth R^2}$$

Light in incident on a convex lens of focal length 40 cm. And a metal plate is placed on focus of lens & 24. photo current is measure to be I. Find new photocurrent if lens is replaced by another lens focal length of 20 cm & metal plate is kept on its focus?

Ans. I'=I



25. In meter bridge experiment there is a resistance in right slot of length 10 cm and radius of cross section is $\sqrt{7}$ × 10³⁴ m. In left slot these is a resistance of 4.5 Ω . If balance length from left is 60 cm. If unknown resistivity is $x \times 10^{37}$. Find 'x'.

66 Ans.





Sol.



- 26. Spherometer can't be used for measurement of :
 - (1) Radius of curvature of convex mirror
 - (2) Radius of curvature of concave mirror
 - (3) Thickness of capacitor plates
 - (4) Specific rotation of liquid
- **Ans.** (4)
- Sol. Spherometer is used to measure radius of curvature of any spherical surface and any small thickness.



Bowered By Main 27 Jan 2024 (SHEPE-I) (Memory Based) load App Now Construction

E READY?

CHEMISTRY

- 1. Which of the following has maximum magnetic moment? $(1) 3d^{3}$ $(2) 3d^{6}$ $(3) 3d^7$
- Ans. (2)
- Mass of methane required to produce 22 g CO₂ upon combustion is _____. 2.
- Ans. (8)
- Moles of $CO_2 = \frac{22}{44} = 0.5 \text{ ü} \quad n_{CH_4} = 0.5 \text{ ü} \quad m_{CH_4} = 8g$ Sol.
- 3. Assertion : Boron has very high melting point (2453 K) Reason : Boron has strong crystalline lattice.
- A-T; R-T;Ans. Exp. \rightarrow Right
- Sum of bond order of CO & NO^+ is : 4.

Ans. (6)

- Sol. $CO:3; NO^+:3$
- How many of following have +4 oxidation number of central atom: 5. BaSO₄, SOCl₂, SF₄, H₂SO₃, H₂S₂O₇, SO₃

Ans. (3)

- Sol. SOCl₂, SF₄, H₂SO₃
- $PbCrO_4 + NaOH (hot excess) \longrightarrow ?$ 6. Product is : (1) dianionic; CN = 4(2) tetra-anionic; CN = 6(3) dianionic; CN = 6(4) tetra-anionic; CN = 4(4)

Ans.





7. For negative deviation from Raoult's law : (1) BP increases ; VP increases (2) BP decreases ; VP increases (3) BP decreases ; VP decreases (4) BP increases ; VP decreases (4) Ans.

8. $NaCl + H_2SO_4 + K_2Cr_2O_7 \longrightarrow Products$ Above reaction gives red fumes (A) which on hydrolysis with aqueous NaOH gives yellow solution (B). Compounds (A) and (B) are :

Ans.
$$CrO_2Cl_2$$
, Na_2CrO_4

Sol. NaCl + H₂SO₄ + K₂Cr₂O₇
$$\rightarrow$$
 CrO₂Cl₂ + Na₂SO₄ + K₂SO₄ + H₂O

(A)

$$CrO_2Cl_2 + NaOH (aq.) \rightarrow Na_2CrO_4 + NaCl + H_2O$$

(B)

Order of spin only magnetic moment for 9.

$[\text{FeF}_6]^{-3}$	$[V(H_2O)_6]^{+2}$	$\left[\mathrm{Fe}(\mathrm{H}_{2}\mathrm{O})_{6}\right]^{+2}$	
(P)	(Q)	(R)	
$(1) \mathbf{P} > \mathbf{R} > \mathbf{Q}$	(2) P > Q > R	(3) R > Q > P	(4) Q > P > R

Ans. (1)

Ans. (1)
Sol. P:
$$[FeF_6]^{-3} \Rightarrow 3d^5 (WFL) \Rightarrow n = 5$$
; $\mu = \sqrt{35}$
Q: $[V(H_2O)_6]^{+2} \Rightarrow 3d^3 \Rightarrow n = 3$; $\mu = \sqrt{15}$
R: $[Fe(H_2O)_6]^{+2} \Rightarrow 3d^6 (WFL) \Rightarrow n = 4$; $\mu = \sqrt{24}$

10. Electronic configuration of Nd(Z = 60) is :

 $[Xe] 4f^4 6s^2$ Ans.

11. **Statement-1:** (NH₄)₂CO₃ is basic. Statement-2: Acidic nature of salt of WA & WB is dependent on K_a of WA & K_b of WB. $(S_1 \rightarrow T; S_2 \rightarrow T)$ Ans.





- 12. Number of electrons present in all the compound filled subshell having n = 4 and s = +1/2.
- Ans. (16)
- **13.** Consider following data :

 $2HI(g) \rightarrow H_2(g) + I_2(g)$

	Experiment-1	Experiment-2	Experiment-3
HI(mole/litre)	0.005	0.01	0.02
Rate (mol $L^{-1} s^{-1}$)	$7.5 imes 10^{-4}$	3×10^{-3}	$1.2 imes 10^{-2}$

Find order of reaction.

Ans. (2)

Sol. Rate = $K[HI]^x x$ = order

$$\frac{(\text{Rate})_2}{(\text{Rate})_1} = \frac{\ddot{\mathbf{o}}\hat{\mathbf{U}}\text{HI}}{\dot{\mathbf{j}}} \frac{\dot{\mathbf{j}}}{\dot{\mathbf{o}}}$$
$$\frac{3 \times 10^{-3}}{7.5 \times 10^{-4}} = \frac{\ddot{\mathbf{o}}}{\dot{\mathbf{o}}} \frac{0.01}{0.005} \frac{\ddot{\mathbf{o}}}{\dot{\mathbf{o}}}$$
$$4 = 2^{x}$$
$$\therefore x = 2$$

14. If 3 moles of an ideal gas at 300 K expands isothermally from 30 dm³ to 45 dm³ against constant pressure of 80 K pascal then the amount of heat transfer is _____ joule.

Ans. (1200)

```
Sol. Process \Rightarrow Isothermal, irreversible \Rightarrow \Delta E = 0

P_{ext} = Constant = 80 \text{ kPa}

Expansion V_1 = 30 \text{ dm}^3 V_2 = 45 \text{ dm}^3

\Delta E = 0 = q + W

q = -W

q = -[-P(V_2 - V_1)]

q = 80 \text{ kPa} [45 \text{ dm}^3 - 30 \text{ dm}^3]

= 80 \times 10^3 \text{ Pa} \times 15 \times 10^{-3} \text{ m}^3

= 1200 \text{ J}
```





15. The mass of silver (Ag = 108 gm/mole) displaces by a quantity of electricity which displaces 5600 ml of O_2 at STP will be :

Ans. (108)

Sol. mole × valency factor = mole × valency factor

$$\frac{W}{108} \times 1 = \frac{5600}{22400} \times 4$$

W = 108 g

16. Which of the following has +4 oxidation state ?

(1) $H_2S_2O_7$ (2) H_2SO_3

- Ans. (2)
- Sol. $H_2S_2O_3$

+2 + x - 6 = 0

$$x = +4$$

17. Which halogen does not shows variable oxidation state ?

(2) Cl_2

 $(1) F_2$

- Ans. (1)
- **Sol.** F: Only (-1) in compounds

(:: is not EN)

18. Statement-1: 4f & 5f series are written separately in periodic table in order to preserve principle of classification.

 $(3) Br_2$

(4) I_2

Statement-2: s-Block elements can be found on earth in pure form.

- Ans. First statement is correct and second is not correct.
- **19.** Which of the following compound is most acidic?



Ans. (3)



20. Which of the following is the strongest Bronsted base?





- **21.** The correct statement regarding stereochemistry of S_N1 and S_N2 reaction is
 - (1) $S_N 1$ Racemisation
 - $S_N 2$ Retention
 - (2) $S_N 1$ Racemisation
 - $S_N 2$ Inversion
 - (3) $S_N 1$ Retention
 - S_N2 Inversion
 - (4) $S_N 1$ Inversion
 - $S_N 2$ Retention

Ans. (2)

22. Which of the following has maximum enol content?





Ans. (1)

23. The correct order of acidic strength of the following compounds is







24. The correct IUPAC name of following compound is



- (1) 1,1-Dimethyl-3-ethyl cyclohexane
- (2) 3-Ethyl-1,1-dimethyl cyclohexane
- (3) 1-Ethyl-3,3-dimethyl cyclohexane
- (4) 3,3-Dimethyl-1-ethyl cyclohexane

Ans. (2)

- **25.** Cyclohexene is classified in
 - (1) Benzenoid aromatic
 - (3) Benzenoid non aromatic

(4) Acyclic

(4) Peptide linkage

(2) Alicyclic

Ans. (2)

26. Which of the following is polar solvent

(1) CCl_4 (2) CHCl_3

(3) $CH_2 = CH_2$

(4) CO₂

EADY

Ans. (2)

- 27. When nucleotide forms dimer the linkage present between is
 - (1) Disulphide linkage (2) Glycosidic linkage
 - (3) Phosphodiester linkage

Ans. (3)





28. How many groups show meta directing effect on benzene ring?





How many products including stereoisomers are obtained in above reaction?

Ans.

4



Give yourself an extra edge www.ayjr.in





JEE Main 27 Jan 2024 (Shift-1) (Memory Based)





www.eedge.in



Sol. By
$$T = S_1$$

$$\Rightarrow \frac{x}{25} + \frac{y}{16} = \frac{1}{25} + \frac{4}{25} \cdot \frac{1}{16}$$

$$\Rightarrow \frac{x}{25} + \frac{y}{40} = \frac{4+1}{100}$$

$$\Rightarrow \frac{x}{25} + \frac{y}{40} = \frac{1}{20}$$

$$\Rightarrow 8x + 5y = 10$$

$$\Rightarrow \frac{x^2}{25} + \left(\frac{10-8x}{5}\right)^2 \frac{1}{16} = 1$$

$$\Rightarrow \frac{x^2}{25} + \frac{4}{25} \left(\frac{5-4x}{16}\right)^2 = 1$$

$$\Rightarrow x^2 + \frac{(5-4x)^2}{4} = 25$$

$$\Rightarrow 4x^2 + (5-4x)^2 = 100$$

$$\Rightarrow 20x^2 - 8x - 15 = 0$$

$$x_1 + x_2 = 2$$

$$x_1x_2 = \frac{-15}{4}$$
length of chord = $|x_1 - x_2|\sqrt{1 + m^2}$

$$= \frac{\sqrt{1691}}{5}$$
4. If $f(x) = x^3 + x^2f'(1) + xf''(2) + f'''(3)$, then find f'(10).
Ans. (202)
Sol. f'(x) = 3x^2 + 2xf'(1) + f'(2)
$$f''(x) = 6x + 2f'(1)$$

$$f'''(x) = 6$$

$$f'(1) = -5$$

$$f''(2) = 2$$

$$\Rightarrow f(10) - 300 + 20(-5) + 2$$

$$= 202$$
5. Let $\int_0^1 \frac{dx}{\sqrt{x+3} + \sqrt{x+1}} = A + B\sqrt{2} + C\sqrt{3}$ then the value of $2A + 3B + C$ is
(1) 3 (2) 4 (3) 5 (4) 6



Sol. On rationalising $\int \frac{(\sqrt{x+3} - \sqrt{x+1})}{2} dx$ $=\frac{2}{2}\left\{(x+3)^{3/2}-(x+1)^{3/2}\right\}_{0}^{1}$ $=\frac{1}{3}\{8-3\sqrt{3}-(2\sqrt{2}-1)\}$ $=\frac{1}{2}\{9-3\sqrt{3}-2\sqrt{2}\}$ $=\left(3-\sqrt{3}-\frac{2\sqrt{2}}{3}\right): A = 3, B = -\frac{2}{3}, C = -1$ $\therefore 2A + 3B + C = 6 - 2 - 1 = 3$ If |z-i| = |z-1| = |z+i|, $z \in C$, then the numbers of z satisfying the equation are 6. (3) 2 (1)0(2)1(4)4(2) Ans. z is equidistant from 1, i, & - i Sol. only z = 0 is possible \therefore number of z equal to 1 (3) A = 2B (4) A = BIf sum of coefficients in $(1 - 3x + 10x^2)^n$ and $(1 + x^2)^n$ is A and B respectively then 7. (1) $A^3 = B$ (2) $A = B^3$ (2) Ans. $A = 8^n$ Sol. $\mathbf{B}=2^{n}$ (B) \therefore A = B³ Let a_1, a_2, \dots, a_{10} are 10 observations such that $\sum_{i=1}^{10} a_i = 50$ and $\sum_{i \neq i}^{10} a_i \cdot a_j = 1100$, then their 8. standard deviation will be $(3) \sqrt{15}$ (4) $\sqrt{10}$ (1) $\sqrt{5}$ (2) $\sqrt{30}$ (1) Ans. $(a_1 + a_2 + \dots + a_{10})^2 = 50^2$ Sol. $\Rightarrow \sum a_1^2 + 2 \sum_{i \neq i} a_i a_j = 2500$ $\Rightarrow \sum a_1^2 = 300$ $\sigma^2 = \frac{\sum a_i^2}{10} - \left(\frac{\sum a_i}{10}\right)^2$ $\Rightarrow \sigma^2 = 5 \Rightarrow S.D = \sqrt{5}$

Give yourself an extra edge



www.eedge.in



If $f(x) = \begin{bmatrix} \cos x & -\sin x & 0\\ \sin x & \cos x & 0\\ 0 & 0 & 1 \end{bmatrix}$ then 9. **Statement-1** : f(-x) is inverse of f(x)**Statement-2**: f(x + y) = f(x)f(y)(1) Both are true (2) Both are false (3) Only statement 1 is true (4) Only statement 2 is true Ans. (1) $f(x)f(y) = \begin{bmatrix} \cos x & -\sin x & 0\\ \sin x & \cos x & 0\\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \cos y & -\sin y & 0\\ \sin y & \cos y & 0\\ 0 & 0 & 1 \end{bmatrix}$ Sol. $\begin{bmatrix} \cos(x+y) & -\sin(x+y) & 0 \end{bmatrix}$ $= \begin{vmatrix} \sin(x+y) & \cos(x-y) & 0 \\ 0 & 0 & 1 \end{vmatrix}$ = f(x + y) $\therefore f(x) f(-x) = f(0)$ If $a = \lim_{x \to 0} \frac{\sqrt{1 + \sqrt{1 + x^4}} - \sqrt{2}}{x^4}$ and $b = \lim_{x \to 0} \frac{\sin^2 x}{\sqrt{2} - \sqrt{1 + \cos x}}$ find $a \cdot b^3$ (4) 48 10. (3)-16 (1) 16 (2) 32 (4) 48Ans. (2) Sol. $a = \lim_{x \to 0} \frac{\sqrt{1 + x^4} - 1}{x^4 \sqrt{1 + \sqrt{1 + x^4}} + \sqrt{2}}$ $= \lim_{x \to 0} \frac{x^{4}}{x^{4} \left[\sqrt{1 + \sqrt{1 + x^{4}} + \sqrt{2}} \right] \left[\sqrt{1 + x^{4}} + 1 \right]}$ $=\frac{1}{2\sqrt{2}\times 2}=\frac{1}{4\sqrt{2}}$ $b = \lim_{x \to 0} \frac{\sin^2 x}{(1 - \cos x)} \left(\sqrt{2} + \sqrt{1 + \cos x}\right)$ $= 2 \times \left(\sqrt{2} + \sqrt{2}\right) = 4\sqrt{2}$ $\therefore ab^3 = \left(4\sqrt{2}\right)^2 = 32$





If the minimum distance of centre of the circle $x^2 + y^2 - 4x - 16y + 64 = 0$ from any point on the 11. parabola $y^2 = 4x$ is d, find d^2 (20) Ans. Sol. Normal to parabola is $y = mx - 2m - m^3$ centre $(2, 8) \rightarrow 8 = 2m - 2m - m^3$ \Rightarrow m = -2 : p is $(m^2, -2m) = (4, 4)$ \Rightarrow d² = 4 + 16 = 20 If $\vec{a} = \hat{i} + 2\hat{j} + \hat{k}$, $\vec{b} = 3(\hat{i} - \hat{j} + \hat{k})$, $\vec{a} \times \vec{c} = \vec{b} & \vec{a} \cdot \vec{c} = 3$ find $\vec{a} \cdot (\vec{c} \times \vec{b} - \vec{b} - \vec{c})$ 12. (2) - 24(3) 18(1) 24(4) 15Ans. (1) $\begin{bmatrix} \vec{a} \ \vec{c} \ \vec{b} \end{bmatrix} = (\vec{a} \times \vec{c}) \cdot \vec{b} = |\vec{b}|^2 = 27$ Sol. : we need = 27 - 0 - 3 = 24Consider the line L : 4x + 5y = 20. Let two other lines are L₁ and L₂ which trisect the line L and 13. pass through origin, then tangent of angle between lines L_1 and L_2 is (3) $\frac{40}{41}$ (4) $\frac{10}{41}$ $(1) \frac{20}{41}$ (2) $\frac{30}{41}$ Ans. (2) Let line L intersect the lines L_1 and L_2 at P and Q Sol. $P\left(\frac{10}{3},\frac{4}{3}\right), Q\left(\frac{5}{3},\frac{8}{3}\right)$ $\therefore m_{OA} = \frac{2}{5}$ $m_{OQ} = \frac{8}{5}$ $\tan \theta = \frac{\left|\frac{8}{5} - \frac{2}{5}\right|}{1 + \frac{16}{25}}$ $=\left(\frac{6}{5}\times\frac{25}{41}\right)$ $=\frac{30}{41}$



14. If
$$h^{n-1}C_r = (k^2 - 8)^n C_{r+1}$$
, then the range of 'k' is
(1) $k \in (2\sqrt{2}, 3]$ (2) $k \in (2\sqrt{2}, 3)$ (3) $k \in [2, 3)$ (4) $k \in (2\sqrt{2}, 8)$
Ans. (1)
Sol. ${}^{n-1}C_r = (k^2 - 8) \frac{n}{r+1} \cdot {}^{n-1}C_r$
 $\Rightarrow k^2 - 8 - \frac{r+1}{n}$
here $r \in [0, n-1]$
 $\Rightarrow r+1 \in [1, n]$
 $\Rightarrow k^2 - 8 \in [\frac{1}{n}, 1]$
 $\Rightarrow k^2 \in [8 + \frac{1}{n}, 9]$
 $\Rightarrow k \in (2\sqrt{2}, 3]$
15. If $ax + \beta y = 9\ln[2x + 3y - 8\lambda] = x + C$ is the solution of $(2x + 3y - 2)dx + (4x + 6y - 7)dy = 0$,
then $a + \beta + \gamma =$
(1) 18 (2) 19 (3) 20 (4) 21 (2)
Ans. (1)
Sol. Let $2x + 3y = t$
 $\Rightarrow 2 + 3\frac{dy}{dx} = \frac{dt}{dx}$
Now $(t-2) + (2t-7)(\frac{dt}{dx} - 2) \times \frac{1}{3} = 0$
 $\Rightarrow -\frac{(3t-6)}{2t-7} = \frac{dt}{dx} - 2$
 $\Rightarrow \frac{dt}{dx} = \frac{t-8}{2t-7}$
 $\Rightarrow \int \frac{2t-7}{t-8} dt = \int dx$
 $\Rightarrow 2t + |9|n|t - 8| = x + C$
 $\Rightarrow 2(2x + 3y) + 9|n|2x + 3y - 8| = x + C$





find least

16.	$f: N - \{1\} \rightarrow N$ and $f(n) =$ highest prime	e factor of 'n', then f is			
	(1) one-one, onto	(2) many-one, onto			
	(3) many-one, into	(4) one-one, into			
Ans.	(3)				
Sol.	'4' is not image of any element \Rightarrow into				
	$f(10) = 5 = f(15) \Rightarrow$ many-one				
17.	If $P(X)$ represent the probability of getting a '6' in the X^{th} roll of a die for the first time. Also				
	a = P(X = 3)				
	$b = P(X \ge 3)$				
	$c = P\left(\frac{X \ge 6}{x > 3}\right)$, then $\frac{b + c}{a} = ?$				
Ans.	(12)				
Sol.	$P(X=3) = \left(\frac{5}{6}\right)^2 \cdot \frac{1}{6} = a$				
	$P(X \ge 3) = \left(\frac{5}{6}\right)^2 = b$				
	$P\left(\frac{X \ge 6}{X > 3}\right) = \left(\frac{5}{6}\right)^2 = c$				
	$\therefore \frac{\mathbf{b} + \mathbf{c}}{\mathbf{a}} = \frac{2\left(\frac{5}{6}\right)^2}{\left(\frac{5}{6}\right)^2 \cdot \frac{1}{6}} = 12$				
18.	If the angle between two vectors $\vec{a} = \vec{a}$	$\alpha \hat{i} - 4 \hat{j} - \hat{k}$ and $\vec{b} = \alpha \hat{i} + \alpha \hat{j} + 4 \hat{k}$ is acute then find			
	positive integral value of α .				
	(1) 4 (2) 5	(3) 6 (4) 7			
Ans.	(2)				
Sol.	$\vec{a} \cdot \vec{b} > 0$				
	$\Rightarrow \alpha^2 - 4\alpha - 4 > 0$				
	$\alpha < (2 - 2\sqrt{2}) \text{ or } \alpha > (2 + 2\sqrt{2})$				
19.	If $S = \{1, 2, \dots, 10\}$ and $M = P(S)$,				
	If ARB such that $A \cap B \neq \phi$ where $A \in M$, $B \in M$				
	Then				

- (1) R is reflexive and symmetric (2) Only symmetric
- (3) Only reflexive (4) Symmetric and transitive
- Ans. (2)





Sol. $\phi \cap \phi = \phi \qquad \Rightarrow (\phi, \phi) \notin R \qquad \Rightarrow \text{not reflexive.}$ If $A \cap B \neq \phi \qquad \Rightarrow B \cap A \neq \phi \Rightarrow \text{Symmetric}$ If $A \cap B \neq \phi$ and $B \cap C \neq \phi \Rightarrow A \cap C = \phi$ for example $A = \{1, 2\}$ $B = \{2, 3\}$ $C = \{3, 4\}$

20. If four points (0, 0), (1, 0), (0, 1), (2k, 3k) are concyclic, then k is

(1)
$$\frac{4}{13}$$
 (2) $\frac{5}{13}$ (3) $\frac{7}{13}$ (4) $\frac{9}{13}$

Ans. (2)

Sol. Equation of circle is x(x-1) + y(y-1) = 0 $x^{2} + y^{2} - x - y = 0$ B(2k, 3k) $\Rightarrow 4k^{2} + 9k^{2} - 2k - 3k = 0$ $\Rightarrow 13k^{2} = 5k$ $\Rightarrow k = 0, \frac{5}{13}$ $\therefore k = \frac{5}{13}$

21. If f(x) is differentiable function satisfying $f(x) - f(y) \ge \log \frac{x}{y} + x - y$, then find $\sum_{N=1}^{20} f'\left(\frac{1}{N^2}\right)$

READY?

Ans. (2890)

Sol.

Let x > y $\lim_{y \to x} \frac{f(x) - f(y)}{x - y} \ge \frac{\log x - \log y}{x - y} + 1$ $f'(x^{-}) \ge \frac{1}{x} + 1$ $f'(x^{-}) = f'(x^{+})$ $f(x) = f(x^{+})$ $f(x) = \frac{1}{x} + 1$ $f'(x) = \frac{1}{x} + 1$

$$\sum_{N=1}^{20} f'\left(\frac{1}{N^2}\right) = \sum (N^2 + 1) = \frac{20 \times 21 \times 41}{6} + 20 = 2890$$

Give yourself an extra edge



www.eedge.in



22. Let
$$\frac{dx}{dt} + ax = 0$$
 and $\frac{dy}{dt} + by = 0$ where $y(0) = 1$, $x(0) = 2$, and $x(t) = y(t)$, then t is
(1) $\frac{\ln 3}{a-b}$ (2) $\frac{\ln 2}{b-a}$ (3) $\frac{\ln 2}{a-b}$ (4) $\frac{\ln 3}{b-a}$
Ans. (3)
Sol. $\frac{dx}{dt} + ax = 0$
 $\Rightarrow \ln x = -at + c$
 $x(0) = 2 \Rightarrow c = \ln 2$
 $\therefore x = 2e^{-at}$
 $\frac{dy}{dt} + by = 0 \Rightarrow y = e^{-bt}$
 $x(t) = g(t)$
 $2e^{-at} = e^{-bt}$
 $\Rightarrow t = \frac{\ln 2}{a-b}$

23. If H(a, b) is the orthocentre of $\triangle ABC$ where A(1, 2), B(2,3) & C(3, 1), then find $\frac{36I_1}{I_2}$ if $I_1 = \int_{a}^{b} x \sin(4x - x^2) dx$ and $I_2 = \int_{a}^{b} \sin(4x - x^2) dx$

$$I_1 = \int_{a}^{b} x \sin(4x - x^2) dx$$
 and $I_2 = \int_{a}^{b} \sin(4x - x^2) dx$

Ans. (72)

Sol. \triangle ABC is isosceles

 \Rightarrow H lies on angle bisector passing through (3, 1) which is x + y = 4

$$\therefore a+b=4$$

Now apply (a + b - x) in I_1

$$2I_{1} = \int_{a}^{b} 4\sin(4x - x^{2}) dx$$
$$\Rightarrow 2I_{1} = 4I_{2}$$
$$\Rightarrow \frac{I_{1}}{I_{2}} = 2$$
$$\therefore \frac{36I_{1}}{I_{2}} = 72$$

Give yourself an extra edge





24.
$$f(x) = \begin{cases} -\frac{2id(x-3)}{2^{-1}(x)}, & x > 3 \\ -\frac{a(x^2 - 7x + 12)}{b|x^2 - 7x + 12|}, & x < 3. \text{ Find number of ordered pairs (a, b) so that } f(x) \text{ is continuous} \\ b, & x = 3 \end{cases}$$
at $x = 3$
at $x = 3$
Ans. (1)
Sol. LHL = RHL = f(3)
 $-\frac{a}{b} = 2^1 = b$
 $\Rightarrow b = 2 \text{ and } a = -4$
 $\Rightarrow (a, b) = (-4.2)$
25. Let $A = \begin{bmatrix} 2 & 0 & 1 \\ 1 & 0 & 0 \\ 3 & 2 & 0 \end{bmatrix}, B = [B_1 B_2 B_3] \text{ where } B_1, B_2, B_3 \text{ are column matrices such that}$
 $AB_1 = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}, AB_2 = \begin{bmatrix} 2 \\ 0 \\ 1 \end{bmatrix}, AB_3 = \begin{bmatrix} 3 \\ 2 \\ 1 \\ 1 \end{bmatrix}$
 $\alpha = \text{sum of diagonal elements of B} \\ \beta = |B|, \text{ then find } [\alpha^3 + \beta^3] \end{cases}$
Ans. (1.125)
Sol. $A^{-1} = \begin{bmatrix} 0 \\ 0 \\ -\frac{3}{2} & \frac{1}{2} \\ 1 & -2 & 0 \end{bmatrix}$
 $B_1 = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}, B_2 = \begin{bmatrix} 0 \\ \frac{1}{2} \\ 2 \end{bmatrix}, B_3 = \begin{bmatrix} 2 \\ -\frac{5}{2} \\ -1 \end{bmatrix}$
 $Tr(B) = -\frac{1}{2}$
 $|B| = -1$
 $\therefore a = -\frac{1}{2}, b = -1$
 $|a^3 + \beta^1| = \frac{8}{8} = 1.125$

Give yourself an extra edge www.ayjr.in





26. If cos(2x) - a sinx = 2a - 7 has a solution for $a \in [p, q]$ and $r = tan9^\circ + tan63^\circ + tan81^\circ + tan27^\circ$, then p.q. r = ?(3) $30\sqrt{5}$ (2) $32\sqrt{5}$ (4) $48\sqrt{5}$ (1) $40\sqrt{5}$ Ans. (4) $2(\sin^2 x - 4) + a(\sin x + 2) = 0$ Sol. $2(\sin x - 2) + a = 0$ \Rightarrow a = 4 - 2 sinx $a \in [2, 6]$ Also, $r = \left(\tan 9^\circ + \frac{1}{\tan 9^\circ}\right) + \left(\tan 27^\circ + 1\frac{1}{\tan 27^\circ}\right)$ $=\frac{2}{\sin 18^\circ}+\frac{2}{\sin 54^\circ}$ $=\frac{2\times4}{\sqrt{5}-1}+\frac{2\times4}{\sqrt{5}+1}$ ARE YOU JEE READY? $=\frac{8\times 2\sqrt{5}}{4}=4\sqrt{5}$ \therefore pqr = $48\sqrt{5}$