

SECTION 1 - SECTION 1

Question No.1



The centre of the conic section  $x^2 + 9y^2 - 6x + 3y - 10 = 0$  is

- (6, -3)
- (3, -1/6)
- (-3, 1/2)
- (3, -3/2)

Question No.2



For the curve

$$y = \frac{x^4}{4} - \frac{x^3}{3} + \frac{x^2}{2} + x + 15$$

its tangent is parallel to the line  $y = x$  at

- only one point
- only three points
- only two points
- no point

Question No.3



The number of ways of forming a team of 11 players out of a total number of 30 players is

- $30^{11}$
- ${}^{30}C_{11}$
- ${}^{30}P_{11}$
- $30 \times 11$

Question No.4



Let  $f : [a, b] \rightarrow \mathbf{R}$  be twice differentiable,  $a < c \leq b$  and  $f(c) \leq f(x)$  for all  $x \in [a, b]$ . Then

- $f'(c) > 0$
- $f'(c) < 0$
- $f'(c) \leq 0$
- $f'(c) = 0$

Question No.5



Two loudspeakers transmit the same song at the same time. Rohan is standing 650 m from the first and 300 m from the second loudspeaker. What is the sound experienced by Rohan assuming negligible obstruction in the path of sound.

- Rohan hears sound from only second loudspeaker as it is closer.
- Rohan hears sound from only second loudspeaker as it is farther
- Rohan hears only one song coming from both loudspeakers.
- Rohan hears the words of song twice separated by some time

Question No.6

If  $\theta$  is the angle between x axis and the plane  $2x + y + 6z = 0$ , then

- $\tan \theta = \frac{2}{\sqrt{41}}$
- $\cos \theta = \frac{2}{\sqrt{41}}$
- $\sin \theta = \frac{2}{\sqrt{41}}$
- $\theta = \pi/3$

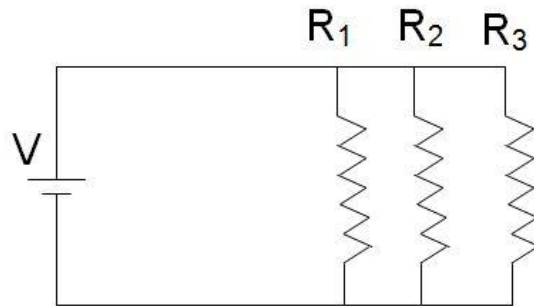
**Question No.7**

Straight line is perpendicular to a plane if

- it is perpendicular to a line on the plane
- it is perpendicular to two lines on the plane
- it is skew to a line on the plane
- it is perpendicular to two non parallel lines on the plane

**Question No.8**

Consider the following circuit. Let  $V = 12 \text{ V}$ ,  $R_1 = 2 \Omega$ ,  $R_2 = 3\Omega$ ,  $R_3 = 6\Omega$ . What is the total current through  $R_1$  and  $R_2$ ?



- 10 A
- 12 A
- 8 A
- 6 A

**Question No.9**

An ant is moving with a velocity of the following functional form  $v = 0.4 * \text{sqrt}(t) + 0.3$ . How much distance does he cover between 2 seconds and 30 seconds?

- 52.8 cm
- 50.6 cm
- 51.5 cm
- 49.2 cm

**Question No.10**

The criterion for the most stable element is that it should have

- Maximum binding energy per nucleon
- Minimum binding energy per nucleon
- Minimum binding energy
- Equal number of neutrons and protons

**Question No.11**

A company manufactures blades out of which 2% are defective. In a packet containing 10 blades the probability that two or less number of blades are defective is

- $\frac{{}^{98}P_2}{10000}$
-

$$\left(\frac{2}{100}\right)^2 \left(\frac{98}{100}\right)^8$$

$\frac{{}^{98}C_2}{10000}$

$\left(\frac{98}{100}\right)^8 \left(1 + \frac{196}{1000} + \frac{18}{1000}\right)$

**Question No.12**



Consider a light source emitting flashes of light. A mirror is kept at distance  $d$  from the source, such that the flashes of light are reflected towards the observer who is at a larger distance  $D$  from the source. Given 100 more mirrors, What is the surface over which mirrors must be placed with proper orientation such that same flash of light reaches the observer at the same time?

- Conical
- Hyperboloidal
- Spherical
- Ellipsoidal

**Question No.13**



The tangent to the curve  $y = x^2$  at  $(3, 9)$  is parallel to the line

- $x = -6y$
- $y = -6x$
- $x = 6y$
- $y = 6x$

**Question No.14**



Calculate the molarity (M), when 580g of NaCl is added to 2L of water.

- 3 M
- 2.5 M
- 80 M
- 5 M

**Question No.15**



In an inverted conical vessel of base radius 5m and height 15m, water is being filled. The rate of change of the height  $h$  of the water is  $2\text{m/s}$ . The rate of change of the volume is

- a constant
- $\frac{6}{27}\pi h^2 m^3/s$
- $\frac{1}{27}\pi h^2 m^3/s$
- $\frac{2}{9}\pi h^2 m^3/s$

**Question No.16**



A magnet is thrust into a single loop of wire of radius 7 cm. During the motion, the magnetic field component through the area of the coil ( $B\cos\theta$ , where  $\theta$  is the angle between magnetic field and normal to the area of the loop) changes from 0.06 T to 0.3 T in 0.05 seconds. The emf developed in the loop is

- 12.3 mV
- 34.5 mV
- 73.9 mV
- 25.4 mV

**Question No.17**



Select the incorrect phrase(s) about the significance of salt bridge

- I. Connects the solutions of two half-cell reactions.
- II. It keeps the solution of two half-cells electrically charged.
- III. Prevents liquid-liquid junction potential.

- I & II
- I & III
- II only
- II & III

**Question No.18**

If  $w$  and  $z$  are complex numbers such that  $\arg(w) = \arg(z) - \pi/2$  and  $|w| = 2|z|$ . Then  $w =$

- $z + 2$
- $2iz$
- $-2iz$
- $\frac{1}{2}z$

**Question No.19**

A system is said to be in equilibrium at all the times. Such a process is called

- Irreversible process
- Static process
- Quasi-static process
- Equilibrium process

**Question No.20**

Which of the following statements is not true about Coulombs law and Biot- Savart law?

- Source of magnetic field is moving charge(s)
- Sources of electric and magnetic fields are scalar quantities
- Source of electric field is charge(s)
- Magnetic field and electric fields vary inversely as square of distance from the source

**Question No.21**

For the differential equation

$$\frac{dy}{dx} + \frac{1}{x}y = \cos x, \quad x \in [1, \infty)$$

- there are in nitely many solutions
- there is no solution
- there is no solution such that  $y = 2$  when  $x = 1$
- there are two solutions such that  $y = 1$  when  $x = 1$

**Question No.22**

The diagonals of the quadrilateral ABCD are perpendicular if ABCD is

- a trapezium
- a parallelogram
- a rhombus
- a rectangle

**Question No.23**

Sunlight reflected from a glass plate (refractive index 1.52) is found to be polarised. At what angle is the observer viewing the glass plate with respect to the normal?

- $74.1^\circ$
- $56.6^\circ$
- $28.9^\circ$
- $33.3^\circ$

**Question No.24**

The boiling point of benzene is  $80^\circ\text{C}$ . Estimate its molar heat of vaporization. Assume that it obeys Trouton's rule.

- $29.96 \text{ kJ mol}^{-1}$

- 39.54 kJ mol<sup>-1</sup>
- 25.64 kJ mol<sup>-1</sup>
- 31.064 kJ mol<sup>-1</sup>

**Question No.25**



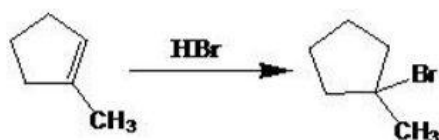
Let  $f : \mathbf{R} \rightarrow \mathbf{R}$  be one -one and onto. Denote the function  $g : \mathbf{R} \rightarrow \mathbf{R}$  such that  $f(g(x)) = g(f(x)) = x$  for all  $x \in \mathbf{R}$  by  $f^{-1}$ . Assume that  $f$  and  $g$  are differentiable. Then  $g'(x) =$

- $(-1)[f(x)]^{-2}$
- $\frac{1}{f'(x)}$
- $\frac{1}{f'(f(x))}$
- $\frac{-1}{(f(x))^2} f'(x)$

**Question No.26**



Choose the correct phrase(s) that can apply to the reaction.



- I) It's a regioselective reaction
  - II) In this reaction electrophile adds to the sp<sup>2</sup> carbon with more number of hydrogen
  - III) This reaction follows the Anti-Markovnikov's rule.
- I and III
  - I only
  - I and II
  - II only

**Question No.27**



"No pairing occurs until all orbitals of a given sub level are half filled". The statement is known as

- Aufbau principle
- Hund's rule
- Exclusion principle
- Uncertainty principle

**Question No.28**



Which of the following are nucleophiles?

- NH<sub>3</sub>
- CO<sub>2</sub>
- H<sub>3</sub>O<sup>+</sup>
- H<sup>+</sup>

**Question No.29**



The Henderson-Hasselbalch equation for acid is

- $\text{pH} = \text{pK}_a - \log \left( \frac{[\text{A}^-]}{[\text{HA}]} \right)$
- $\text{pH} = \text{pK}_a + \log \left( \frac{[\text{A}^-]}{[\text{HA}]} \right)$
- $\text{pH} = \text{pK}_a + \log \left( \frac{[\text{HA}]}{[\text{A}^-]} \right)$

$\text{pH} = \text{pK}_b + \log \left( \frac{[\text{B}]}{[\text{HB}^+]}\right)$

**Question No.30**



Which of the following function is an increasing function

- $f : \mathbf{R} \rightarrow \mathbf{R}, f(x) = e^{-x^2}$
- $f : \mathbf{R} \rightarrow \mathbf{R}, f(x) = x^3 + 3x + 1$
- $f : (0, \pi) \rightarrow \mathbf{R}, f(x) = \text{cosec}x$
- $f : \mathbf{R} \rightarrow \mathbf{R}, f(x) = x^3 - 3x$

**Question No.31**



Ms.X has a vast estate and she wants to enclose a rectangular portion  $ABCD$  in the estate to be fenced on all sides. She would like to use iron fencing for the edge  $CD$  and for all the remaining edges she would like to use wooden fencing. The rate of iron fencing is  $a$  rupees per meter and the rate for wooden fencing is  $b$  rupees per meter. Ms.X wants to spend only the amount of Rs.  $c$  for making this fence. What is the length of the side  $CD$  for which the rectangle would enclose the maximum possible area?

- $\frac{c}{a+b}$
- $\frac{c}{2b}$
- $\frac{c}{4b}$
- $\frac{c}{2(a+b)}$

**Question No.32**



The surface area of the parallelepiped whose edges are vectors  $\vec{a}, \vec{b}, \vec{c}$  is given by

- $|\vec{a} \cdot \vec{b} \times \vec{c}|$
- $(|\vec{a} \times \vec{b}| + |\vec{a} \times \vec{c}| + |\vec{c} \times \vec{b}|)$
- $\frac{1}{2} (|\vec{a} \times \vec{b}| + |\vec{a} \times \vec{c}| + |\vec{c} \times \vec{b}|)$
- $2 (|\vec{a} \times \vec{b}| + |\vec{a} \times \vec{c}| + |\vec{c} \times \vec{b}|)$

**Question No.33**



Which one of the given alkyl halides is more reactive in  $\text{S}_{\text{N}}2$  reaction?

- $\text{CH}_3\text{Cl}$  &  $\text{CH}_3\text{Br}$
- $\text{CH}_3\text{Br}$
- $\text{CH}_3\text{I}$
- $\text{CH}_3\text{Cl}$

**Question No.34**



$f : [0, 2] \rightarrow \mathbf{R}$  is defined as

$$\begin{aligned} f(x) &= x, \quad 0 \leq x < 1 \\ &= 3, \quad x = 1 \\ &= 2x - 1, \quad 1 < x \leq 2 \end{aligned}$$

Then

- $\lim_{x \rightarrow 1} f(x) = 3$
- $\lim_{x \rightarrow 1} f(x)$  does not exist
- $f$  is continuous at  $x = 1.5$
- $f$  is continuous at  $x = 1$

**Question No.35**

Identify the stable carbocation from the following.

- $\text{FCH}_2\text{CH}_2^+$
- $\text{ClCH}_2\text{CH}_2^+$
- $\text{BrCH}_2\text{CH}_2^+$
- $\text{CH}_3\text{CH}_2^+$

**Question No.36**

The number of ways of arranging a collection containing 2 identical red balls, 3 identical blue balls and a black ball is

- 720
- 60
- 120
- 6

**Question No.37**

Which physical quantity has the same unit as Energy Density?

- Angular momentum
- Pressure
- Power
- Stress

**Question No.38**

$$\int_0^{(\frac{\pi}{2})^{\frac{1}{3}}} \frac{x^2}{1+x^6} dx =$$

- $\pi/6$
- $\frac{1}{3} \tan^{-1} \left( \frac{\pi}{2} \right)$
- $\tan^{-1} \left( \frac{\pi}{2} \right)$
- does not exist

**Question No.39**

When the stationary phase is solid, then the compounds can be separated on the basis of

- Adsorption
- Partition
- Paper chromatography

- Both partition and adsorption

**Question No.40**



The freezing point of a 0.01 m aqueous solution of NaCl will be

- Below 0°C  
 0°C  
 1°C  
 2°C

**Question No.41**



The radius of planet Mercury is 2439.7 km and its mass density is 5.43 g/cm<sup>3</sup>. What is the escape velocity on Mercury?

- 424.9 cm/s  
 4249 m/s  
 424.9 km/s  
 4249 km/year

**Question No.42**



The total number of field lines passing through a given non-unit area is defined as

- Flux  
 Power  
 Flux density  
 Force

**Question No.43**



Consider the relation  $R = \{(x, y) \in A \times B : x = y^2\}$ . In which of the following cases, this relation is a function?

- $A = \{1, 25, 9\}$   $B = \{1, -5, 3, 6\}$   
  $A = \{1, 25, 9\}$   $B = \{-1, 3, -3, 5\}$   
  $A = \{1, 25, 49\}$   $B = \{1, 5, 7, -7\}$   
  $A = \{1, 25, 9, 7\}$   $B = \{-1, 5, 3\}$

**Question No.44**



The standard EMF value of a reaction I is  $E^\circ_{\text{cell}} = -1.563$  V and for a reaction II it is  $E^\circ_{\text{cell}} = +0.86$  V. Predict the feasibility of these reactions.

- Both the reactions are feasible  
 Reaction I is feasible, reaction II is not feasible  
 Both the reactions are not feasible  
 Reaction I is not feasible, reaction II is feasible

**Question No.45**



A 1 kg mass is moulded to form a disc of radius  $r$  and the same amount of mass is also used to make a ring of outer radius  $r$  and negligible width. Consider the axis passing through the centre perpendicular to the circular plane of both the objects.

- Thickness of the object is required to compare the moment of inertia  
 Disc has half the moment of inertia when compared to that of ring  
 Both have same moment of inertia  
 Ring has half moment of inertia when compared to that of disc

**Question No.46**



Oxygen is an example of

- Diamagnetic material  
 Non-magnetic material



- Ferromagnetic material
- Paramagnetic material

**Question No.47**



An underwater archer fish sees a grasshopper that is close to the water surface at an angle of  $30^\circ$  with respect to the normal. Given that the refractive index of water is 1.33, at what angle with respect to the normal should the fish shoot a jet of water that hits the grasshopper?

- $22.1^\circ$  with respect to normal in the same direction
- $22.1^\circ$  with respect to normal in the opposite direction
- $41.7^\circ$  with respect to normal in the same direction
- $30^\circ$  with respect to normal in the opposite direction

**Question No.48**



UV-Visible spectroscopy of organic compounds is usually concerned with which electronic transition?

- $\sigma \rightarrow \sigma^*$
- $n \rightarrow \pi^*$
- $\pi \rightarrow \pi^*$
- $n \rightarrow \pi^*$  and  $\pi \rightarrow \pi^*$

**Question No.49**



Arrange the following atoms and ions in the increasing order of atomic size Mg,  $Mg^{2+}$ , Al,  $Al^{3+}$

- $Mg > Mg^{2+} > Al > Al^{3+}$
- $Mg > Al > Mg^{2+} > Al^{3+}$
- $Al^{3+} > Al > Mg^{2+} > Mg$
- $Mg^{2+} > Mg > Al^{3+} > Al$

**Question No.50**



Predict the conjugate base of the following acids.

(I)  $H_2SO_4$

(II)  $N_3H$

- I- $HSO_4^-$ , II- $(N_3)^-$
- I- $H^+$ , II- $H^+$
- I- $SO_3$ , II- $N_2$
- I- $(SO_4)^{2-}$ , II- $(N_3)^-$

**Question No.51**



Binding energy of an atom is

- $\Delta E = \Delta mc^2$
- $\Delta E = \Delta mc$
- $\Delta E = m/c^2$
- $\Delta E = mc/\lambda$

**Question No.52**



Let  $a$ ,  $b$  and  $c$  be real numbers such that  $a \neq 0$ . Then

- $\{x \in \mathbb{C} : ax^2 + bx + c = 0\}$  is not empty
- $\{x \in \mathbb{N} : ax^2 + bx + c = 0\}$  is not empty
- $\{x \in \mathbb{Q} : ax^2 + bx + c = 0\}$  is not empty
- $\{x \in \mathbb{R} : ax^2 + bx + c = 0\}$  is not empty

**Question No.53**

Choose the correct statement from the following.

(I) In an electrochemical cell reaction, the half-cell in the left side corresponds to the anode, and the half-cell in the right side corresponds to the cathode.

(II) Oxidation reaction occurs at anode and reduction reaction occurs at cathode.

(III) Current flows from the cathode to the anode.

- II and III
- I, II and III
- I and II
- I and III

**Question No.54**

Angle between the xy plane and the plane  $y + z = 0$  is

- $30^\circ$
- $45^\circ$
- $60^\circ$
- $0^\circ$

**Question No.55**

A freshly prepared 50 g sample of radioactive material decays by  $\alpha$ -decay (half-life of 10 days). What is the weight of the sample after 10 days

- Slightly less than 50 g
- 25 g
- Slightly less than 25 g
- 50 g

**Question No.56**

Choose the correct phrase(s) that can apply to first order reactions.

I) The overall rate of the reaction is proportional to the concentration of one of the reactants.

II) If the concentration of the reactant is doubled, the rate is doubled.

III) The unit of rate constant for a first order reaction is  $s^{-1}$  or  $time^{-1}$ .

- I and II only
- I and III only
- I only
- I, II and III

**Question No.57**

In which of the following processes will entropy decrease?

- Expansion of a gas
- Boiling of water
- Freezing of liquid
- Melting of ice

**Question No.58**

In the following reaction the negative change in the enthalpy indicates  $\Delta H = -68.5 \text{ Kcal/mol}$

- System becomes endothermic
- System becomes exothermic
- Reactants have less energy than the products
- System absorbs energy from its surrounding

**Question No.59**

We see the Sun after it has completely set on the horizon because of

- Horizon is not flat
- Reflection from clouds
- Refraction through atmosphere
- Horizon is flat

**Question No.60**

Let  $f : \mathbf{R} \rightarrow \mathbf{R}$  be differentiable and  $g : \mathbf{R} \rightarrow \mathbf{R}$  be defined as  $g(x) = |f(x)|$ . If  $g$  is differentiable at  $a$ , Then  $g'(a)$  is

- $-|f'(a)|$
- 0
- $\pm f'(a)$
- $|f'(a)|$

**Question No.61**

During a collision of a car with a wall, the maximum damage suffered depends on

- Force
- Mass
- Velocity
- Momentum

**Question No.62**

$$\int \sqrt{(x-2)(x-3)} dx$$

- $\frac{1}{2}x\sqrt{(x-3)^2-9} + \frac{9}{2} \ln |x + \sqrt{x^2-9}|$
- $\frac{1}{2}x\sqrt{(x^2-9)} + \frac{3}{2} \ln |x + \sqrt{x^2-3}|$
- $\frac{1}{2}(x-3)\sqrt{(x-3)^2-3} + \frac{3}{2} \ln |(x-3) + \sqrt{(x-3)^2-3}|$
- $\frac{1}{2}(x-3)\sqrt{(x-3)^2-9} + \frac{9}{2} \ln |(x-3) + \sqrt{(x-3)^2-9}|$

**Question No.63**

The curves  $y = x^2$  and  $y = x^3 - x^2 + x$

- meet at two points but have a common tangent at only one point
- intersect but do not have a common tangent
- meet at two points and have a common tangent at both points.
- meet at three points

**Question No.64**

A green glass ball appears white after powdering. This is because of

- Green colour of the original glass
- Refractive index of air is greater than glass
- Reflections at boundaries of pieces
- Total internal reflections from pieces

**Question No.65**

Find the volume of 0.25 moles of gas at 200 kPa and 300 K temperature.

- 2.5 L
- 3.02 L
- 3.117 L
- 3 L

**Question No.66**

Consider a solid sphere of radius  $R$  and mass density  $\rho = k_0/r^2$ . How does the total mass enclosed within spheres of radius  $0 \leq r \leq R$  vary as a function of radius?

- $M(r) = \text{constant}$
- $M(r) \propto r$

- $M(r) \propto r^2$
- $M(r) \propto 1/r^2$

**Question No.67**

The electron in a hydrogen atom makes a transition from  $n=143$  to  $n=141$ . The wavelength of the emitted radiation is

- 0.652 m
- 6.52 m
- 0.652 cm
- 6.52 cm

**Question No.68**

Let  $y$  be function defined on  $(a, b)$  satisfying  $\frac{d^2y}{dx^2} = 1 + y^2$ . Then

- this function has one point of inflection
- this function does not have any local maxima
- this function has two points of inflection
- this function does not have any local minima

**Question No.69**

Which of the following element has no neutrons in the nucleus?

- Hydrogen
- Deuterium
- Helium
- tritium

**Question No.70**

Which of the following lines is contained in the plane  $x+3y-4z=6$ ?

- $\frac{x-6}{7} = \frac{y+4}{-5} = \frac{z-3}{-2}$
- $\frac{x-6}{1} = \frac{y}{3} = \frac{z}{-4}$
- $\frac{x}{2} = \frac{y}{2} = \frac{z+1}{2}$
- $\frac{x-1}{7} = \frac{y+5}{-5} = \frac{z+6}{-2}$

**Question No.71**

A charge  $Q$  is uniformly distributed over a spherical metal shell. The electric field inside the sphere is

- Constant
- Infinity
- Zero
- Is proportional to  $Q^2$

**Question No.72**

If  $\theta$  is the angle between  $z$  axis and the normal to the plane  $x+y-z=0$ , then

- $\cos \theta = \frac{-1}{\sqrt{3}}$
- $\tan \theta = \frac{-1}{\sqrt{3}}$
- $\theta = \pi/4$
- $\sin \theta = \frac{-1}{\sqrt{3}}$

**Question No.73**

The coordination number of hcp structure is

- 8
- 4
- 6
- 12

**Question No.74**



Choose the property, which depends only on, the amount of solute in a solution.

- Heat capacity
- Osmotic pressure
- Melting point
- Temperature

**Question No.75**



A wheel revolving at the rate 30 rev/s is brought to rest with constant negative acceleration. It completes 60 revolutions before it stops. How much time it will take to stop?

- 2s
- 1s
- 4s
- 3s

**Question No.76**



The coordination number of the  $\text{Na}^+$  in Rock salt is

- 6
- 8
- 4
- 3

**Question No.77**



Mansi, who weighs 50 kg, is walking with a speed of 5 m/s.

- Her de-Broglie wavelength is  $4 \times 10^{-3}$  m
- Her de-Broglie wavelength is  $1.66 \times 10^{-31}$  m
- Her de-Broglie waves do not exist
- Her de-Broglie wavelength is  $2.65 \times 10^{-36}$  m

**Question No.78**



A convex lens forms an image at the focus for an object located very far from the lens. Due to an accident, the top half of the lens has broken off. What happens to the image?

- Top half of the object will be imaged at focus
- Bottom half of object will be imaged at focus.
- Image remains the same as before at focus
- Image will not form.

**Question No.79**



In metals,

- Valence band and conduction band have a small gap between them
- Valence band and conduction band are very far apart.
- Valence band does not exist
- Valence band and conduction band overlap.

**Question No.80**



The point of intersection of the tangent to  $y = -x^4$  at  $(0, 0)$  and the normal to the curve  $y = \sin x$  at  $(\pi/2, 1)$  is

- $(0, 0)$
-

$(\pi/2, 0)$

$(0, \pi/2)$

$(1, 0)$

**Question No.81**

The temperature of a metal sheet of size 2m x 3m rises by  $10^{\circ}\text{C}$  from  $35^{\circ}\text{C}$  on a hot day. Assuming that the sheet behaves like a black-body, what is the excess power radiated by the sheet.

- 0.084 W
- 879.4 W
- 0.507 W
- 0.132 W

**Question No.82**

A candle is placed at a distance of 7 cm from a thin convex lens of focal length 5 cm. If the size of the candle flame is 2 cm, then the size of the image is

- 3 cm and inverted
- 5 cm and inverted
- 3 cm and upright
- 5 cm and upright

**Question No.83**

Which of the following is true about lines in space

- If a non-zero vector is perpendicular to both  $L_1$  and  $L_2$ , then they are skew
- If lines  $L_1$  and  $L_2$  are skew and  $L_1$  is parallel to  $L_3$ , then  $L_3$  and  $L_2$  are also skew
- If  $L_1$  and  $L_2$  are skew, then there is a non-zero vector is perpendicular to both  $L_1$  and  $L_2$
- If  $L_1$  does not intersect  $L_2$ , then  $L_1$  and  $L_2$  are skew lines

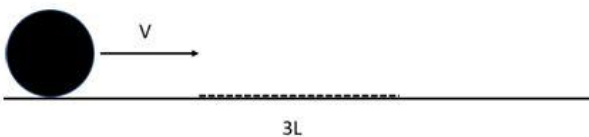
**Question No.84**

Among the following, which element will have the least negative electron gain enthalpy?

- Cl
- F
- S
- P

**Question No.85**

Consider a flat horizontal surface of length  $3L$ , in the first section of length  $L$  it is totally frictionless and, in the second section of length  $L$  it is has large friction (where no slipping is allowed) while the third and last section is again frictionless. A disk of radius  $R$  and mass  $M$  made from uniform mass density slides without rolling at a speed of  $V$  from one end and moves along the surface. What will be the speed  $V'$  at the end of the  $3L$  section?



- $V/\sqrt{2}$
- $V/3$
- $V/2$
- $V/\sqrt{3}$

**Question No.86**

$f : [0, \pi] \rightarrow \mathbf{R}$  is defined as

$$\begin{aligned} f(x) &= \sin x, \quad 0 \leq x \leq \pi/2 \\ &= 0, \quad \pi/2 < x \leq \pi \end{aligned}$$

Then

- $\lim_{x \rightarrow \pi/2} f(x) = 1$
- $f$  is neither continuous nor differentiable at  $x = \pi/2$ .
- $f$  is continuous at  $x = \pi/2$
- $f$  is differentiable at  $x = \pi/2$

**Question No.87**



If by applying a force, the shape of the body changes, then that force is

- Shearing stress
- Bulk stress
- Compressive stress
- Tensile stress

**Question No.88**



The value of

$$\int_0^2 \frac{1}{2} \sqrt{36 - 9x^2} - \int_0^1 \sqrt{1 - x^2} dx$$

is

- $5\pi$
- $35\pi$
- $\frac{35\pi}{4}$
- $\frac{5\pi}{4}$

**Question No.89**



Compound A reacts by first order kinetics. The rate constant of the reaction is  $0.45 \text{ s}^{-1}$ . Calculate the half-life of the compound A in the reaction.

- 4.62 seconds
- 3.08 seconds
- 1.54 seconds
- 2.25 seconds

**Question No.90**



Electric power transmission lines use very high voltage for long distance transmission. This is because

- The current is AC
- The power station produces electricity at high voltage
- To reduce ohmic losses
- The current is DC

**Question No.91**



Doping of IV A group element Ge with the V A group element Ar produces

- Conductor
- p-type semiconductor
- Insulator

- n-type semiconductor

**Question No.92**



Consider the diffraction pattern formed on the screen when light is shone through a circular hole. For a smaller hole,

- The size of central maximum becomes larger
- The size of central maximum becomes smaller
- The diffraction pattern disappears
- There is no change in the diffraction pattern

**Question No.93**



The line  $\frac{x-1}{3} = \frac{y-2}{4} = \frac{z+3}{2}$  is perpendicular to

- the plane  $2x + 2y - 7z = 0$
- the line  $\frac{x-1}{-3} = \frac{y-2}{4} = \frac{z+3}{2}$
- the plane  $3x + 4y + 2z = 6$
- the plane  $x + 2y - 3z = 0$

**Question No.94**



Three liquids A, B, C with same viscosity and same boiling point have specific heat of 6 J/kgK, 4 J/kgK, 2 J/kgK. Which liquid is best suited for cooling application on the basis of this information?

- A
- B
- C
- mixture of A and C in equal proportion

**Question No.95**



Sapna is sitting on a spinning chair with her feet up on the chair. She extends her hands out in the air. As a consequence,

- the chair spins slower
- the spinning of chair stops
- the chair spins faster
- she topples over.

**Question No.96**



For the curve  $y = \sqrt{1 - x^2}$  at the point  $(-1, 0)$

- the tangent has the slope  $\frac{1}{2}$
- $\frac{dy}{dx}$  does not exist.
- $\frac{dy}{dx} = 1$ .
- the tangent is parallel to the  $x$  axis.

**Question No.97**



Which of the following has the highest boiling point?

- n-octane
- Isooctane
- Isopentane
- n-pentane

**Question No.98**





Use the approximation  $f(a+h) \approx f(a)+f'(a)h$  to find an approximation to  $\sin 32^\circ$

- $\frac{1}{2} + \sqrt{3}$
- $\frac{\sqrt{3}}{2} + 1$
- $\frac{1}{2} + \frac{180\sqrt{3}}{\pi}$
- $\frac{1}{2} + \frac{\sqrt{3}\pi}{180}$

**Question No.99**



Find the maximum value of  $f(x) = |x + 1| + |x - 2|$  in  $[-3, 3]$

- 7
- 0
- 3
- 6

**Question No.100**



If  $A \subseteq \mathbf{R}$  is the largest set such that the function  $f : A \rightarrow \mathbf{R}$  where  $f(x) = \sqrt{\frac{x+2}{x-1}}$  is a well defined. Then we have  $A =$

- $[-2, 1)$
- $(-1, \infty)$
- $(1, \infty)$
- $[1, \infty)$