JEE Main 24 June 2022(Second Shift)

Total Time: 180

Total Marks: 300.0

Physics

Q.No.1: Identify the pair of physical quantities that have same dimensions :

A.	velocity gradient and decay constant
B.	wien's constant and Stefan constant
C.	angular frequency and angular momentum
D.	wave number and Avogadro number

Marks:[4.00]

Q.No.2: The distance between Sun and Earth is *R*. The duration of year if the distance between Sun and Earth becomes 3*R* will be :

A.	$\sqrt{3}$ years
B.	3 years
C.	9 years
D.	$3\sqrt{3}$ years

Marks:[4.00]

Q.No.3: A stone of mass *m* tied to a string is being whirled in a vertical circle with a uniform speed. The tension in the string is

A.	the same throughout the motion.
B.	minimum at the highest position of the circular path.
C.	minimum at the lowest position of the circular path.
D.	minimum when the rope is in the horizontal position.

Marks:[4.00]

Q.No.4: Two identical charged particles each having a mass 10 g and charge 2.0×10^{-7} C are placed on a horizontal table with a separation of *L* between

them such that they stay in limited equilibrium. If the coefficient of friction between each particle and the table is 0.25, find the value of L. [Use g = 10 ms^{-2}]

A.	12 cm
B.	10 cm
C.	8 cm
D.	5 cm

Marks:[4.00]

Q.No.5: A Carnot engine takes 5000 kcal of heat from a reservoir at 727°C and gives heat to a sink at 127°C. The work done by the engine is

A.	3×10^6 J
B.	Zero
C.	12.6×10^6 J
D.	8.4×10^6 J

Marks:[4.00]

Q.No.6: Two massless springs with spring constant 2 k and 9 k, carry 50 g and 100 g masses at their free ends. These two masses oscillate vertically such that their maximum velocities are equal. Then, the ratio of their respective amplitude will be

A.	1 : 2
B.	3 : 2
C.	3 : 1
D.	2 : 3

Marks:[4.00]

Q.No.7: What will be the most suitable combination of three resistors A = 2 Ω, B = 4 Ω, C = 6 Ω so that $\left(\frac{22}{3}\right)$ Ω is equivalent resistance of combination?

A.	Parallel combination of A and C connected in series with B.
B.	Parallel combination of A and B connected in series with C.
C.	Series combination of A and C connected in parallel with B.
D.	Series combination of B and C connected in parallel with A.

Marks:[4.00]

Q.No.8: The soft-iron is a suitable material for making an electromagnet. This is because soft-iron has

A.	Low coercivity and high retentivity

B.	Low coercivity and low permeability
C.	High permeability and low retentivity
D.	High permeability and high retentivity

Marks:[4.00]

Q.No.9: A proton, a deuteron and an α-particle with same kinetic energy enter into a uniform magnetic field at right angle to magnetic field. The ratio of the radii of their respective circular paths is :

A.	$1:\sqrt{2}:\sqrt{2}$
B.	$1:1:\sqrt{2}$
C.	$\sqrt{2}:1:1$
D.	$1:\sqrt{2}:1$

Marks:[4.00]

Q.No.10: Given below are two statements:
Statement-I : The reactance of an ac circuit is zero.
It is possible that the circuit contains a capacitor and an inductor.
Statement-II : In ac circuit, the average power delivered by the source never becomes zero.
In the light of the above statements, choose the correct answer from the options given below.

A.	Both Statement I and Statement II are true
B.	Both Statement I and Statement II are false
C.	Statement I is true but Statement II is false
D.	Statement I is false but Statement II is true

Marks:[4.00]

Q.No.11: Potential energy as a function of *r* is given by $U = \frac{A}{r^{10}} - \frac{B}{r^5}$, where *r* is the interatomic distance, *A* and *B* are positive constants. The equilibrium distance between the two atoms will be:

A.		$\left(\frac{A}{B}\right)^{\frac{1}{5}}$
B.		$\left(\frac{B}{A}\right)^{\frac{1}{5}}$
C.		$\left(\frac{2A}{B}\right)^{\frac{1}{5}}$
D.		$\left(\frac{B}{2A}\right)^{\frac{1}{5}}$

Marks:[4.00]

Q.No.12: An object of mass 5 kg is thrown vertically upwards from the ground. The air resistance produces a constant retarding force of 10 N throughout the motion. The ratio of time of ascent to the time of descent will be equal to [Use g = 10 ms^{-2}].

A.		1 : 1
B.		$\sqrt{2} : \sqrt{3}$
C.		$\sqrt{3} : \sqrt{2}$
D.		2 : 3

Marks:[4.00]

Q.No.13: A fly wheel is accelerated uniformly from rest and rotates through 5 rad in the first second. The angle rotated by the fly wheel in the next second, will be:

A.		7.5 rad
B.		15 rad
C.		20 rad
D.		30 rad

Marks:[4.00]

Q.No.14: A 100 g of iron nail is hit by a 1.5 kg hammer striking at a velocity of 60 ms^{-1}. What will be the rise in the temperature of the nail if one fourth of energy of the hammer goes into heating the nail?
[Specific heat capacity of iron = 0.42 Jg^{-1} $°C^{-1}$]

A.		675°C

B.		1600°C
C.		16.07°C
D.		6.75°C

Marks:[4.00]

Q.No.15: If the charge on a capacitor is increased by 2 C, the energy stored in it increases by 44%. The original charge on the capacitor is (in C)

A.		10
B.		20
C.		30
D.		40

Marks:[4.00]

Q.No.16: A long cylindrical volume contains a uniformly distributed charge of density ρ. The radius of cylindrical volume is *R*. A charge particle (*q*) revolves around the cylinder in a circular path. The kinetic energy of the particle is:

A.		$\frac{\rho q R^2}{4\varepsilon_0}$
B.		$\frac{\rho q R^2}{2\varepsilon_0}$
C.		$\frac{q\rho}{4\varepsilon_0 R^2}$
D.		$\frac{4\varepsilon_0 R^2}{q\rho}$

Marks:[4.00]

Q.No.17: An electric bulb is rated as 200 W. What will be the peak magnetic field at 4 m distance produced by the radiations coming from this bulb? Consider this bulb as a point source with 3.5% efficiency.

A.		1.19×10^{-8}T
B.		1.71×10^{-8}T
C.		0.84×10^{-8}T
D.		3.36×10^{-8}T

Marks:[4.00]

Q.No.18: The light of two different frequencies whose photons have energies 3.8 eV and 1.4 eV respectively, illuminate a metallic surface whose work function is 0.6 eV successively. The ratio of maximum speeds of emitted electrons for the two frequencies respectively will be

A.		1 : 1

B.	2 : 1
C.	4 : 1
D.	1 : 4

Marks:[4.00]

Q.No.19: Two light beams of intensities in the ratio of 9 : 4 are allowed to interfere. The ratio of the intensity of maxima and minima will be:

A.	2 : 3
B.	16 : 81
C.	25 : 169
D.	25 : 1

Marks:[4.00]

Q.No.20: In Bohr's atomic model of hydrogen, let *K*, *P* and *E* are the kinetic energy, potential energy and total energy of the electron respectively. Choose the correct option when the electron undergoes transitions to a higher level:

A.	All *K*, *P* and *E* increase
B.	*K* decreases, *P* and *E* increase
C.	*P* decreases, *K* and *E* increase
D.	*K* increases, *P* and *E* decrease

Marks:[4.00]

Q.No.21: A body is projected from the ground at an angle of 45° with the horizontal. Its velocity after 2 s is 20 ms^{-1}. The maximum height reached by the body during its motion is _____ m. (use g = 10 ms^{-2}) **Marks:[4.00]**

Q.No.22: An antenna is placed in a dielectric medium of dielectric constant 6.25. If the maximum size of that antenna is 5.0 mm, it can radiate a signal of minimum frequency of _____GHz.
(Given μ_r = 1 for dielectric medium) **Marks:[4.00]**

Q.No.23: A potentiometer wire of length 10 m and resistance 20 Ω is connected in series with a 25 V battery and an external resistance 30 Ω. A cell of emf *E* in secondary circuit is balanced by 250 cm long potentiometer wire. The value of *E* (in volt) is $\frac{x}{10}$. The value of *x* is ___. **Marks:[4.00]**

Q.No.24: Two travelling waves of equal amplitudes and equal frequencies move in opposite directions along a string. They interfere to produce a stationary wave whose equation is given by

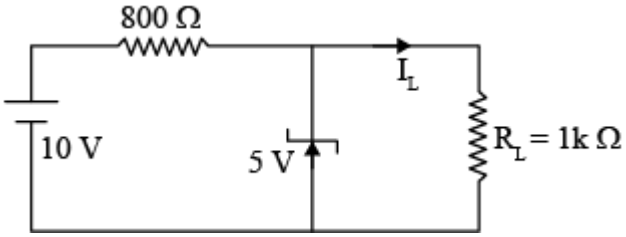
$y = \left(10 \cos \pi x \sin \frac{2\pi t}{T}\right)$ cm

The amplitude of the particle at $x = \frac{4}{3}$ cm will be _____ cm.

Marks:[4.00]

Q.No.25: In the given circuit, the value of current I_L will be _____ mA. (When R_L = 1 kΩ)

Marks:[4.00]



Q.No.26: A sample contains 10^{-2} kg each of two substances *A* and *B* with half lives 4 s and 8 s respectively. The ratio of their atomic weights is 1 : 2. The ratio of the amounts of *A* and *B* after 16 s is $\frac{x}{100}$. The value of *x* is _____.

Marks:[0.00]

Q.No.27: A ray of light is incident at an angle of incidence 60º on the glass slab of refractive index $\sqrt{3}$. After refraction, the light ray emerges out from other parallel faces and lateral shift between incident ray and emergent ray is $4\sqrt{3}$ cm. The thickness of the glass slab is _____ cm.

Marks:[0.00]

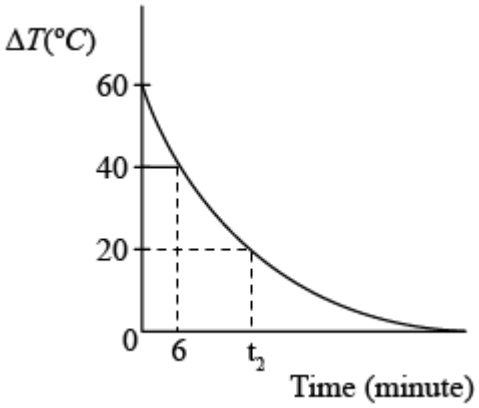
Q.No.28: A circular coil of 1000 turns each with area 1 m^2 is rotated about its vertical diameter at the rate of one revolution per second in a uniform horizontal magnetic field of 0.07 T. The maximum voltage generation will be _____ *V*.

Marks:[0.00]

Q.No.29: A monoatomic gas performs a work of $\frac{Q}{4}$ where Q is the heat supplied to it. The molar heat capacity of the gas will be _____ R during this transformation.
Where R is the gas constant. **Marks:[0.00]**

Q.No.30: In an experiment to verify Newton's law of cooling, a graph is plotted between, the temperature difference (ΔT) of the water and surroundings and time as shown in figure. The initial temperature of water is taken as 80ºC. The value of t_2 as mentioned in the graph will be _____.

Marks:[0.00]



Chemistry

Q.No.31: 120 g of an organic compound that contains only carbon and hydrogen gives 330 g of CO_2 and 270 g of water on complete combustion. The percentage of carbon and hydrogen, respectively are

A.	25 and 75
B.	40 and 60
C.	60 and 40
D.	75 and 25

Marks:[4.00]

Q.No.32: The energy of one mole of photons of radiation of wavelength 300 nm is (Given h = 6.63 × 10^{-34}Js, N_A = 6.02 × 10^{23} mol^{-1}, c = 3 × 10^8 ms^{-1})

A.	235 kJ mol^{-1}
B.	325 kJ mol^{-1}
C.	399 kJ mol^{-1}
D.	435 kJ mol^{-1}

Marks:[4.00]

Q.No.33: The correct order of bond orders of C_2^{2-}, N_2^{2-}, O_2^{2-} is, respectively

A.	$C_2^{2-} < N_2^{2-} < O_2^{2-}$
B.	$O_2^{2-} < N_2^{2-} < C_2^{2-}$
C.	$C_2^{2-} < O_2^{2-} < N_2^{2-}$
D.	$N_2^{2-} < C_2^{2-} < O_2^{2-}$

Marks:[4.00]

Q.No.34: At 25°C and 1 atm pressure, the enthalpies of combustion are as given below :

Substance	H_2	C(graphite)	$C_2H6(g)$
$\frac{D_C H^{\ominus}}{\text{kJmol}^{-1}}$	–286.0	–394.0	–1560.0

The enthalpy of formation of ethane is

A.	+54.0 kJ mol^{-1}
B.	–68.0 kJ mol^{-1}
C.	–86.0 kJ mol^{-1}
D.	+97.0 kJ mol^{-1}

Marks:[4.00]

Q.No.35: For a first order reaction, the time required for completion of 90% reaction is ' *x*' times the half life of the reaction. The value of ' *x*' is (Given: In 10 = 2.303 and log 2 = 0.3010)

A.	1.12
B.	2.43
C.	3.32
D.	33.31

Marks:[4.00]

Q.No.36: Metals generally melt at very high temperature. Amongst the following, the metal with the highest melting point will be

A.	Hg
B.	Ag
C.	Ga
D.	Cs

Marks:[4.00]

Q.No.37: Which of the following chemical reactions represents Hall-Heroult Process?

A.	$Cr_2O_3 + 2Al \rightarrow Al2O_3 + 2Cr$
B.	$2Al2O_3 + 3C \rightarrow 4Al + 3CO_2$
C.	$FeO + CO \rightarrow Fe + CO_2$
D.	$\left[2\,\mathrm{Au}\,(\mathrm{CN})_2\right]^-_{(aq)} + \mathrm{Zn}\,(s) \rightarrow 2\,\mathrm{Au}\,(s) + \left[\mathrm{Zn}\,(\mathrm{CN}_4)\right]^{2-}$

Marks:[4.00]

Q.No.38: In the industrial production of which of the following, molecular hydrogen is obtained as a byproduct?

A.	NaOH
B.	NaCl
C.	Na metal
D.	Na_2CO_3

Marks:[4.00]

Q.No.39: Which one of the following compounds is used as a chemical in certain type of fire extinguishers?

A.	Baking soda
B.	Soda ash
C.	Washing soda
D.	Caustic Soda

Marks:[4.00]

Q.No.40: PCl_5 is well known, but NCl_5 is not. Because,

A.	nitrogen is less reactive than phosphorous
B.	nitrogen doesn't have *d*-orbitals in its valence shell.
C.	catenation tendency is weaker in nitrogen than phosphorous.
D.	size of phosphorous is larger than nitrogen

Marks:[4.00]

Q.No.41: Transition metal complex with highest value of crystal field splitting (Δ_0) will be

A.	$[Cr(H_2O)_6]^{3+}$
B.	$[Mo(H_2O)_6]^{3+}$
C.	$[Fe(H_2O)_6]^{3+}$

D.	$[Os(H_2O)_6]^{3+}$

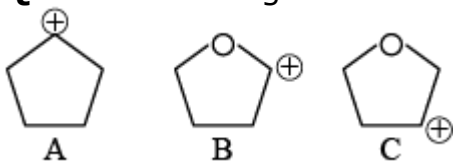
Marks:[4.00]

Q.No.42: Some gases are responsible for heating of atmosphere (green house effect). Identify from the following the gaseous species which does not cause it.

A.	CH_4
B.	O_3
C.	H_2O
D.	N_2

Marks:[4.00]

Q.No.43: Arrange the following carbocations in decreasing order of stability.



A.	A > C > B
B.	A > B > C
C.	C > B > A
D.	C > A > B

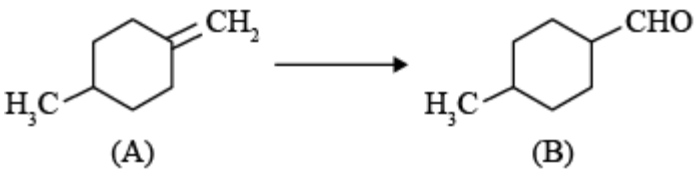
Marks:[4.00]

Q.No.44: Given below are two statements.
Statement I: The presence of weaker π-bonds make alkenes less stable than alkanes.
Statement II: The strength of the double bond is greater than that of carbon-carbon single bond.
In the light of the above statements, choose the *correct* answer from the options given below.

A.	Both Statement I and Statement II are correct.
B.	Both Statement I and Statement II are incorrect.
C.	Statement I is correct but Statement II is incorrect.
D.	Statement I is incorrect but Statement II is correct.

Marks:[4.00]

Q.No.45: Which of the following reagents/reactions will convert 'A' to 'B'?



(A) (B)

A.	PCC oxidation
B.	Ozonolysis
C.	BH_3, $H_2O_2/^-OH$ followed by PCC oxidation
D.	HBr, hydrolysis followed by oxidation by $K_2Cr_2O_7$.

Marks:[4.00]

Q.No.46: Hex-4-ene-2-ol on treatment with PCC gives 'A' on reaction with sodium hypoiodite gives 'B', which on further heating with soda lime gives 'C'. The compound 'C' is

A.	2-pentene
B.	Proponaldehyde
C.	2-butene
D.	4-methylpent-2-ene

Marks:[4.00]

Q.No.47: The conversion of propan-1-ol to *n*-butylamine involves the sequential addition of reagents. The correct sequential order of reagents is

A.	(i) $SOCl_2$ (ii) KCN (iii) H_2/Ni, Na(Hg)/C_2H_5OH
B.	(i) HCl (ii) H_2/Ni, Na(Hg)/C_2H_5OH
C.	(i) $SOCl_2$ (ii) KCN (iii) CH_3NH_2
D.	(i) HCl (ii) CH_3NH_2

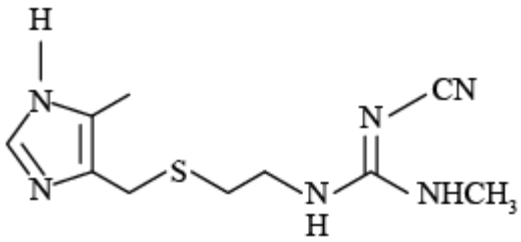
Marks:[4.00]

Q.No.48: Which of the following is not an example of a condensation polymer?

A.	Nylon 6,6
B.	Dacron
C.	Buna-N
D.	Silicone

Marks:[4.00]

Q.No.49: The structure shown below is of which well-known drug molecule?



A.	Ranitidine
B.	Seldane
C.	Cimetidine
D.	Codeine

Marks:[4.00]

Q.No.50: In the flame test of a mixture of salts, a green flame with blue centre was observed. Which one of the following cations may be present?

A.	Cu^{2+}
B.	Sr^{2+}
C.	Ba^{2+}
D.	Ca^{2+}

Marks:[4.00]

Q.No.51: At 300 K, a sample of 3.0 g of gas A occupies the same volume as 0.2 g of hydrogen at 200 K at the same pressure. The molar mass of gas A is _____ g mol^{-1}. (nearest integer) Assume that the behaviour of gases as ideal. (Given: The molar mass of hydrogen (H_2) gas is 2.0 g mol^{-1}). **Marks:[4.00]**

Q.No.52: A company dissolves '*x*' amount of CO_2 at 298 K in 1 litre of water to prepare soda water. X = _____ $\times 10^{-3}$ g. (nearest integer)
(Given: partial pressure of CO_2 at 298 K = 0.835 bar. Henry's law constant for CO_2 at 298 K = 1.67 kbar. Atomic mass of H, C and O is 1, 12, and 6 g mol^{-1}, respectively) **Marks:[4.00]**

Q.No.53: PCl_5 dissociates as
$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$
5 moles of PCl_5 are placed in a 200 litre vessel which contains 2 moles of N_2 and is maintained at 600 K. The equilibrium pressure is 2.46 atm. The equilibrium constant K_p for the dissociation of PCl_5 is _____ $\times 10^{-3}$. (nearest integer)
(Given: R = 0.082 L atm K^{-1} mol^{-1}; Assume ideal gas behaviour)
Marks:[4.00]

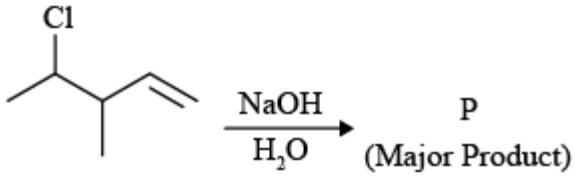
Q.No.54: The resistance of a conductivity cell containing 0.01 M KCl solution at 298 K is 1750 Ω. If the conductivity of 0.01 M KCl solution at 298 K is 0.152 $\times 10^{-3}$ S cm^{-1}, then the cell constant of the conductivity cell is _____ $\times 10^{-3}$ cm^{-1}. **Marks:[4.00]**

Q.No.55: 5. When 200 mL of 0.2 M acetic acid is shaken with 0.6 g of wood charcoal, the final concentration of acetic acid after adsorption is 0.1 M. The mass of acetic acid adsorbed per gram of carbon is _____g. **Marks:[4.00]**

Q.No.56: (a) Baryte, (b) Galena, (c) Zinc blende and (d) Copper pyrites. How many of these minerals are sulphide based? **Marks:[0.00]**

Q.No.57: Manganese (VI) has ability to disproportionate in acidic solution. The difference in oxidation states of
two ions it forms in acidic solution is _____. **Marks:[0.00]**

Q.No.58: 0.2 g of an organic compound was subjected to estimation of nitrogen by Duma's method in which volume of N_2 evolved (at STP) was found to be 22.400 mL. The percentage of nitrogen in the compound is _____. [nearest integer]
(Given : Molar mass of N_2 is 28 g mol^{-1}, Molar volume of N_2 at STP : 22.4L)
Marks:[0.00]



Q.No.59:
Consider the above reaction. The number of π electrons present in the product 'P' is_____. **Marks:[0.00]**

Q.No.60: In alanylglycylleucylalanyvaline, the number of peptide linkages is _____., **Marks:[0.00]**

Mathematics

Q.No.61: Let $x * y = x^2 + y^3$ and $(x * 1) * 1 = x * (1 * 1)$. Then a value of $2\sin^{-1}\left(\frac{x^4+x^2-2}{x^4+x^2+2}\right)$ is

A.		$\frac{\pi}{4}$
B.		$\frac{\pi}{3}$
C.		$\frac{\pi}{2}$
D.		$\frac{\pi}{6}$

Marks:[4.00]

Q.No.62: The sum of all the real roots of the equation $(e^{2x} - 4)(6e^{2x} - 5e^x + 1) = 0$ is

A.		$\log_e 3$
B.		$-\log_e 3$
C.		$\log_e 6$
D.		$-\log_e 6$

Marks:[4.00]

Q.No.63: Let the system of linear equations
$x + y + az = 2$
$3x + y + z = 4$
$x + 2z = 1$
have a unique solution (x^*, y^*, z^*). If (α, x^*), (y^*, α) and $(x^*, -y^*)$ are collinear points, then the sum of absolute values of all possible values of α is

A.		4
B.		3

C.		2
D.		1

Marks:[4.00]

Q.No.64: Let $x, y > 0$. If $x^3y^2 = 2^{15}$, then the least value of $3x + 2y$ is

A.		30
B.		32
C.		36
D.		40

Marks:[4.00]

Q.No.65: Let $f(x) = \begin{cases} \frac{\sin(x-[x])}{x-[x]}, & x \in (-2,-1) \\ \max\{2x,\ 3[|x|]\}, & |x| < 1 \\ 1, & \text{otherwise} \end{cases}$

Where $[t]$ denotes greatest integer $\leq t$. If m is the number of points where f is not continuous and n is the number of points where f is not differentiable, then the ordered pair (m, n) is

A.		(3, 3)
B.		(2, 4)
C.		(2, 3)
D.		(3, 4)

Marks:[4.00]

Q.No.66: The value of the integral $\int_{\frac{-\pi}{2}}^{\frac{\pi}{2}} \frac{dx}{(1+e^x)\left(\sin^6 x+\cos^6 x\right)}$ is equal to

A.		2п
B.		0
C.		п
D.		$\frac{\pi}{2}$

Marks:[4.00]

Q.No.67: $\lim_{n\to\infty} \left(\frac{n^2}{(n^2+1)(n+1)} + \frac{n^2}{(n^2+4)(n+2)} + \frac{n^2}{(n^2+9)(n+3)} + \ldots + \frac{n^2}{(n^2+n^2)(n+n)}\right)$ is equal to

A.		$\frac{\pi}{8} + \frac{1}{4}\log_e 2$

B.	$\frac{\pi}{4}+\frac{1}{8}\log_e 2$
C.	$\frac{\pi}{4}-\frac{1}{8}\log_e 2$
D.	$\frac{\pi}{8}+\frac{1}{8}\log_e \sqrt{2}$

Marks:[4.00]

Q.No.68: A particle is moving in the *xy*-plane along a curve *C* passing through the point (3, 3). The tangent to the curve *C* at the point *P* meets the *x*-axis at *Q*. If the *y*-axis bisects the segment *PQ*, then *C* is a parabola with

A.	Length of latus rectum 3
B.	Length of latus rectum 6
C.	Focus $\left(\frac{4}{3},\ 0\right)$
D.	Focus $\left(0,\ \frac{3}{4}\right)$

Marks:[4.00]

Q.No.69: Let the maximum area of the triangle that can be inscribed in the ellipse $\frac{x^2}{a^2}+\frac{y^2}{4}=1,\ a>2$, having one of its vertices at one end of the major axis of the ellipse and one of its sides parallel to the *y*-axis, be $6\sqrt{3}$. Then the eccentricity of the ellipse is

A.	$\frac{\sqrt{3}}{2}$
B.	$\frac{1}{2}$
C.	$\frac{1}{\sqrt{2}}$
D.	$\frac{\sqrt{3}}{4}$

Marks:[4.00]

Q.No.70: Let the area of the triangle with vertices *A*(1, α), *B*(α, 0) and *C*(0, α) be 4 sq. units. If the points (α, –α), (–α, α) and (α^2 , β) are collinear, then β is equal to

A.	64
B.	–8
C.	–64
D.	512

Marks:[4.00]

Q.No.71: The number of distinct real roots of the equation $x^7 - 7x - 2 = 0$ is

A.		5
B.		7
C.		1
D.		3

Marks:[4.00]

Q.No.72: A random variable X has the following probability distribution :

X	0	1	2	3	4
$P(X)$	k	$2k$	$4k$	$6k$	$8k$

The value of $P(1 < X < 4 | x \leq 2)$ is equal to

A.		$\frac{4}{7}$
B.		$\frac{2}{3}$
C.		$\frac{3}{7}$
D.		$\frac{4}{5}$

Marks:[4.00]

Q.No.73: The number of solutions of the equation $\cos\left(x+\frac{\pi}{3}\right)\cos\left(\frac{\pi}{3}-x\right)=\frac{1}{4}\cos^2 2x,\ x\in[-3\pi,\ 3\pi]$ is:

A.		8
B.		5
C.		6
D.		7

Marks:[4.00]

Q.No.74: If the shortest distance between the lines $\frac{x-1}{2}=\frac{y-2}{3}=\frac{z-3}{\lambda}$ and $\frac{x-2}{1}=\frac{y-4}{4}=\frac{z-5}{5}$ is $\frac{1}{\sqrt{3}}$, then the sum of all possible values of λ is:

A.		16
B.		6
C.		12
D.		15

Marks:[4.00]

Q.No.75: Let the points on the plane *P* be equidistant from the points (–4, 2, 1) and (2, –2, 3). Then the acute angle between the plane *P* and the plane $2x + y + 3z = 1$ is

A.		$\frac{\pi}{6}$
B.		$\frac{\pi}{4}$
C.		$\frac{\pi}{3}$
D.		$\frac{5\pi}{12}$

Marks:[4.00]

Q.No.76: Let $\hat{a}$ and $\hat{b}$ be two unit vectors such that $\left|\left(\hat{a}+\hat{b}\right)+2\left(\hat{a}\times\hat{b}\right)\right|=2$. If θ ∈ (0, π) is the angle between $\hat{a}$ and $\hat{b}$, then among the statements:

(S1) : $2\left|\hat{a}\times\hat{b}\right|=\left|\hat{a}-\hat{b}\right|$

(S2) : The projection of $\hat{a}$ on $\left(\hat{a}+\hat{b}\right)$ is $\frac{1}{2}$

A.	Only (S1) is true
B.	Only (S2) is true
C.	Both (S1) and (S2) are true
D.	Both (S1) and (S2) are false

Marks:[4.00]

Q.No.77: If $y=\tan^{-1}\left(\sec\ x^3-\tan\ x^3\right), \frac{\pi}{2}<x^3<\frac{3\pi}{2}$, then

A.	$xy\text{ '' }+2y\text{'}=0$
B.	$x^2y\text{''}-6y+\frac{3\pi}{2}=0$
C.	$x^2y\text{''}-6y+3\pi=0$
D.	$xy\text{''}-4y\text{'}=0$

Marks:[4.00]

Q.No.78: Consider the following statements:
A : Rishi is a judge.
B : Rishi is honest.
C : Rishi is not arrogant.
The negation of the statement "if Rishi is a judge and he is not arrogant, then he is honest" is

A.	$B \rightarrow (A \vee C)$
B.	$(\sim B) \wedge (A \wedge C)$

C.	$B \rightarrow ((\sim A) \vee (\sim C))$
D.	$B \rightarrow (A \wedge C)$

Marks:[4.00]

Q.No.79: The slope of normal at any point (x, y), $x > 0$, $y > 0$ on the curve $y = y(x)$ is given by $\frac{x^2}{xy - x^2y^2 - 1}$. If the curve passes through the point (1, 1), then $e \cdot y(e)$ is equal to

A.	$\frac{1-\tan(1)}{1+\tan(1)}$
B.	tan(1)
C.	1
D.	$\frac{1+\tan(1)}{1-\tan(1)}$

Marks:[4.00]

Q.No.80: Let λ^* be the largest value of λ for which the function $f_\lambda(x) = 4\lambda x^3 - 36\lambda x^2 + 36x + 48$ is increasing for all $x \in \mathbb{R}$. Then $f_{\lambda^*}(1) + f_{\lambda^*}(-1)$ is equal to :

A.	36
B.	48
C.	64
D.	72

Marks:[4.00]

Q.No.81: Let $S = \{z \in \mathbb{C} : |z - 3| \leq 1 \text{ and } z(4 + 3i) + \bar{z}(4 - 3i) \leq 24\}$. If $\alpha + i\beta$ is the point in S which is closest to $4i$, then $25(\alpha + \beta)$ is equal to _____.

Marks:[4.00]

Q.No.82: Let $S = \left\{ \begin{pmatrix} -1 & a \\ 0 & b \end{pmatrix};\ a,\ b \in \{1,\ 2,\ 3,\ \ldots,\ 100\} \right\}$ and let $T_n = \{A \in S : A^{n(n+1)} = I\}$. Then the number of elements in $\bigcap_{n=1}^{100} T_n$ is _____.

Marks:[4.00]

Q.No.83: The number of 7-digit numbers which are multiples of 11 and are formed using all the digits 1, 2, 3, 4, 5, 7 and 9 is _____. **Marks:[4.00]**

Q.No.84: The sum of all the elements of the set $\{\alpha \in \{1, 2, \ldots, 100\} : \text{HCF}(\alpha, 24) = 1\}$ is **Marks:[4.00]**

Q.No.85: The remainder on dividing $1 + 3 + 3^2 + 3^3 + \ldots + 3^{2021}$ by 50 _____ is **Marks:[4.00]**

Q.No.86: The area (in sq. units) of the region enclosed between the parabola $y^2 = 2x$ and the line $x + y = 4$ is _____. **Marks:[0.00]**

Q.No.87: Let a circle $C : (x - h)^2 + (y - k)^2 = r^2$, $k > 0$, touch the x-axis at (1, 0). If the line $x + y = 0$ intersects the circle C at P and Q such that the length of the chord PQ is 2, then the value of $h + k + r$ is equal to _____.**Marks:[0.00]**

Q.No.88: In an examination, there are 10 true-false type questions. Out of 10, a student can guess the answer of 4 questions correctly with probability $\frac{3}{4}$ and the remaining 6 questions correctly with probability $\frac{1}{4}$. If the probability that the student guesses the answers of exactly 8 questions correctly out of 10 is $\frac{27k}{4^{10}}$, then k is equal to **Marks:[0.00]**

Q.No.89: Let the hyperbola $H : \frac{x^2}{a^2} - y^2 = 1$ and the ellipse $E : 3x^2 + 4y^2 = 12$ be such that the length of latus rectum of H is equal to the length of latus rectum of E. If e_H and e_E are the eccentricities of H and E respectively, then the value of $12\left(e_H^2 + e_E^2\right)$ is equal to ___. **Marks:[0.00]**

Q.No.90: Let P_1 be a parabola with vertex (3, 2) and focus (4, 4) and P_2 be its mirror image with respect to the line $x + 2y = 6$. Then the directrix of P_2 is $x +$

$2y$ = _____. **Marks:[0.00]**