JEE-MAIN EXAMINATION-JANUARY 2025

Date: 23/01/2025 **Shift : Morning**

PHYSICS
SECTION-A

Q.1 Regarding self-inductance :

A : The self-inductance of the coil depends on its geometry.

B : Self-inductance does not depend on the permeability of the medium.

C : Self-induced e.m.f. opposes any change in the current in a circuit.

D : Self-inductance is electromagnetic analogue of mass in mechanics.

E: Work needs to be done against self-induced e.m.f. in establishing the current.

Choose the correct answer from the options given below:

(1) A, B, C, D only (2) A, C, D, E only

(3) A, B, C, E only (4) B, C, D, E only

Q.2 A light hollow cube of side length 10 cm and mass 10 g, is floating in water. It is pushed down and released to execute simple harmonic oscillations. The time period of oscillations is $y\pi \times 10^{-2}$ s, where the value of y is (Acceleration due to gravity, g = 10 m/s^2, density of water = 10^3 kg/m^3)

(1) 2 (2) 6 (3) 4 (4) 1

Q.3 Given below are two statements:

Statement-I : The hot water flows faster than cold water.

Statement-II : Soap water has higher surface tension as compared to fresh water.

In the light above statements, choose the correct answer from the options given below

(1) Statement-I is false but Statement II is true

(2) Statement-I is true but Statement II is false

(3) Both Statement-I and Statement-II are true

(4) Both Statement-I and Statement-II are false

Q.4 A sub-atomic particle of mass 10^{-30} kg is moving with a velocity 2.21×10^6 m/s. Under the matter wave consideration, the particle will behave closely like _____. ($h = 6.63 \times 10^{-34}$ J.s)

(1) Infra-red radiation (2) X-rays

(3) Gamma rays (4) Visible radiation

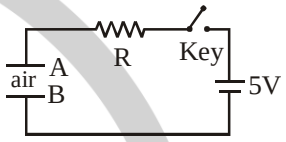
Q.5 A spherical surface of radius of curvature R, separates air from glass (refractive index = 1.5). The centre of curvature is in the glass medium. A point object 'O' placed in air on the optic axis of the surface, so that its real image is formed at 'I' inside glass. The line OI intersects the spherical surface at P and PO = PI. The distance PO equals to-

(1) 5 R (2) 3 R (3) 2 R (4) 1.5 R

Q..6 A radioactive nucleus n_2 has 3 times the decay constant as compared to the decay constant of another radioactive nucleus n_1. If initial number of both nuclei are the same, what is the ratio of number of nuclei of n_2 to the number of nuclei of n_1, after one half-life of n_1 ?

(1) 1/4 (2) 1/8 (3) 4 (4) 8

Q.7 Identify the valid statements relevant to the given circuit at the instant when the key is closed.



A. There will be no current through resistor R.

B. There will be maximum current in the connecting wires.

C. Potential difference between the capacitor plates A and B is minimum.

D. Charge on the capacitor plates is minimum.

Choose the correct answer from the options given below :

(1) C, D only (2) B, C, D only

(3) A, C only (4) A, B, D only

Q.8 The position of a particle moving on x-axis is given by $x(t) = A\sin t + B\cos^2 t + Ct^2 + D$, where t is time. The dimension of $\frac{ABC}{D}$ is-

(1) L (2) L^3T^{-2} (3) L^2T^{-2} (4) L^2

Q.9 Match the List-I with List-II

	List-I		List-II
A.	Pressure varies inversely with volume of an ideal gas.	I.	Adiabatic process
B.	Heat absorbed goes partly to increase internal energy and partly to do work.	II.	Isochoric process
C.	Heat is neither absorbed nor released by a system	III.	Isothermal process
D.	No work is done on or by a gas	IV.	Isobaric process

Choose the correct answer from the options given below :

(1) A-I, B-IV, C-II, D-III

(2) A-III, B-I, C-IV, D-II

(3) A-I, B-III, C-II, D-IV

(4) A-III, B-IV, C-I, D-II

Q.10 Consider a moving coil galvanometer (MCG) :

A : The torsional constant in moving coil galvanometer has dimensions [M L^2 T^{-2}]

B : Increasing the current sensitivity may not necessarily increase the voltage sensitivity.

C : If we increase number of turns (N) to its double (2N), then the voltage sensitivity doubles.

D : MCG can be converted into an ammeter by introducing a shunt resistance of large value in parallel with galvanometer.

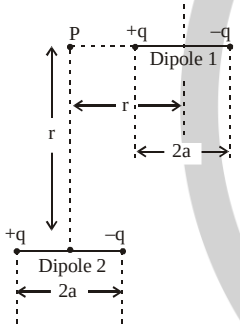
E: Current sensitivity of MCG depends inversely on number of turns of coil.

Choose the correct answer from the options given below:

(1) A, B only (2) A, D, only

(3) B, D, E only (4) A, B, E only

Q.11 A point particle of charge Q is located at P along the axis of an electric dipole 1 at a distance r as shown in the figure. The point P is also on the equatorial plane of a second electric dipole 2 at a distance r. The dipoles are made of opposite charge q separated by a distance 2a. For the charge particle at P not to experience any net force, which of the following correctly describes the situation?



(1) $\frac{a}{r} - 20$ (2) $\frac{a}{r} \sim 10$ (3) $\frac{a}{r} \sim 0.5$ (4) $\frac{a}{r} \sim 3$

Q.12 A gun fires a lead bullet of temperature 300 K into a wooden block. The bullet having melting temperature of 600 K penetrates into the block and melts down. If the total heat required for the process is 625 J, then the mass of the bullet is (grams.)

(Latent heat of fusion of lead = 2.5×10^4 J Kg^{-1} and specific heat capacity of lead = 125 J $Kg^{-1}K^{-1}$)

(1) 20 (2) 15 (3) 10 (4) 5

Q.13 What is the lateral shift of a ray refracted through a parallel-sided glass slab of thickness 'h' in terms of the angle of incidence 'i' and angle of refraction 'r', if the glass slab is placed in air medium ?

(1) $\frac{h\tan(i-r)}{\tan r}$ (2) $\frac{h\cos(i-r)}{\sin r}$

(3) h (4) $\frac{h\sin(i-r)}{\cos r}$

Q.14 A solid sphere of mass 'm' and radius 'r' is allowed to roll without slipping from the highest point of an inclined plane of length 'L' and makes an angle 30° with the horizontal. The speed of the particle at the bottom of the plane is v_1. If the angle of inclination is increased to 45° while keeping L constant. Then the new speed of the sphere at the bottom of the plane is v_2. The ratio of $v_1^2 : v_2^2$ is

(1) $1:\sqrt{2}$ (2) 1 : 3 (3) 1 : 2 (4) $1:\sqrt{3}$

Q.15 Refer to the circuit diagram given in the figure, which of the following observation are correct?

A. Total resistance of circuit is 6Ω.

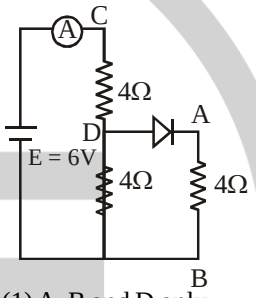
B. Current in Ammeter is 1 A

C. Potential across AB is 4 Volts.

D. Potential across CD is 4 Volts.

E. Total resistance of the circuit is 8Ω.

Choose the correct answer from the options given below:



(1) A, B and D only (2) A, C and D only

(3) B, C and E only (4) A, B and C only

Q.16 The electric flux is $\phi = \alpha\sigma + \beta\lambda$

where λ and σ are linear and surface charge density, respectively, $\left(\frac{\alpha}{\beta}\right)$ represents

(1) charge (2) electric field

(3) displacement (4) area

Q.17 Given a thin convex lens (refractive index μ_2), kept in a liquid (refractive index μ_1, $\mu_1 < \mu_2$) having radii of curvature $|R_1|$ and $|R_2|$. Its second surface is silver polished. Where should an object be placed on the optic axis so that a real and inverted image is formed at the same place?

(1) $\frac{\mu_1|R_1|\cdot|R_2|}{\mu_2(|R_1|+|R_2|)-\mu_1|R_1|}$

(2) $\frac{\mu_1|R_1|\cdot|R_2|}{\mu_2(|R_1|+|R_2|)-\mu_1|R_2|}$

(3) $\frac{\mu_1|R_1|\cdot|R_2|}{\mu_2(2|R_1|+|R_2|)-\mu_1\sqrt{|R_1|\cdot|R_2|}}$

(4) $\frac{(\mu_2+\mu_1)|R_1|}{(\mu_2-\mu_1)}$

Q.18 The electric field of an electromagnetic wave in free space is

$\vec{E} = 57\cos\left[7.5\times10^{6}t - 5\times10^{-3}(3x+4y)\right]$

$\left(4\hat{i} - 3\hat{j}\right)N/C$.

The associated magnetic field in Tesla is-

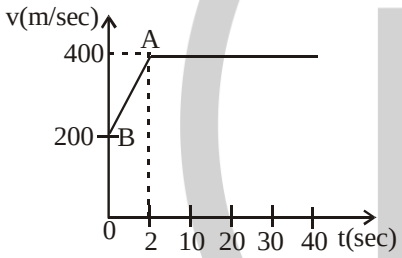
(1) $\vec{B} = \frac{57}{3\times10^{8}}\cos\left[7.5\times10^{6}t - 5\times10^{-3}(3x+4y)\right]\left(5\hat{k}\right)$

(2) $\vec{B} = \frac{57}{3\times10^{8}}\cos\left[7.5\times10^{6}t - 5\times10^{-3}(3x+4y)\right]\left(\hat{k}\right)$

(3) $\vec{B} = -\frac{57}{3\times10^{8}}\cos\left[7.5\times10^{6}t - 5\times10^{-3}(3x+4y)\right]\left(5\hat{k}\right)$

(4) $\vec{B} = -\frac{57}{3\times10^{8}}\cos\left[7.5\times10^{6}t - 5\times10^{-3}(3x+4y)\right]\left(\hat{k}\right)$

Q.19 The motion of an airplane is represented by velocity-time graph as shown below. The distance covered by airplane in the first 30.5 second is _____ km



(1) 9 (2) 6 (3) 3 (4) 12

Q.20 Consider a circular disc of radius 20 cm with centre located at the origin. A circular hole of a radius 5 cm is cut from this disc in such a way that the edge of the hole touches the edge of the disc. The distance of centre of mass of residual or remaining disc from the origin will be-

(1) 2.0 cm (2) 0.5 cm (3) 1.5 cm (4) 1.0 cm

SECTION-B

Q.21 A positive ion A and a negative ion B has charges 6.67×10^{-19} and 9.6×10^{-10} C, and masses 19.2×10^{-27} kg and 9×10^{-27} kg respectively. At an instant, the ions are separated by a certain distance r. At that instant the ratio of the magnitudes of electrostatic force to gravitational force is $P\times10^{-13}$, where the value of P is _____.

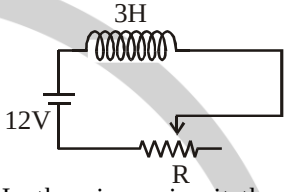
(Take $\frac{1}{4\pi\varepsilon_0} = 9\times10^{9}\,Nm^2C^{-1}$ and universal gravitational constant as $6.67\times10^{-11}\,Nm^2\,kg^{-2}$)

Q.22 Two particles are located at equal distance from origin. The position vectors of those are represented by $\vec{A} = 2\hat{i} + 3n\hat{j} + 2\hat{k}$ and $\vec{B} = 2\hat{i} - 2\hat{j} + 4p\hat{k}$, respectively. If both the vectors are at right angle to each other, the value of n^{-1} is _____.

Q.23 An ideal gas initially at 0°C temperature, is compressed suddenly to one fourth of its volume. If the ratio of specific heat at constant pressure to that at constant volume is 3/2, the change in temperature due to the thermodynamics process is _____ K.

Q.24 A force $f = x^2y\hat{i} + y^2\hat{j}$ acts on a particle in a plane x + y = 10. The work done by this force during a displacement from (0, 0) to (4m, 2m) is Joule (round off to the nearest integer)

Q.25



In the given circuit the sliding contact is pulled outwards such that electric current in the circuit changes at the rate of 8 A/s. At an instant when R is 12 Ω, the value of the current in the circuit will be _____ A.

CHEMISTRY

SECTION-A

Q.26 The element that does not belong to the same period of the remaining elements (modern periodic table) is:

(1) Palladium (2) Iridium
(3) Osmium (4) Platinum

Q.27 Heat treatment of muscular pain involves radiation of wavelength of about 900 nm. Which spectral line of H atom is suitable for this?

Given: Rydberg constant $R_H = 10^5\,cm^{-1}$, $h = 6.6\times10^{-34}$ Js, $c = 3\times10^8$ m/s)

(1) Paschen series, $\infty \rightarrow 3$ (2) Lyman series, $\infty \rightarrow 1$
(3) Balmer series, $\infty \rightarrow 2$ (4) Paschen series, $5 \rightarrow 3$

Q.28 The incorrect statements among the following is

(1) PH_3 shows lower proton affinity than NH_3.
(2) PF_3 exists but NF_5 does not.
(3) NO_2 can dimerise easily.
(4) SO_2 can act as an oxidizing agent, but not as a reducing agent.

Q.29 $CrCl_3\cdot XNH_3$ can exist as a complex. 0.1 molal aqueous solution of this complex shows a depression in freezing point of 0.558°C. Assuming 100% ionisation of this complex and coordination number of Cr is 6, the complex will be (Given $K_f = 1.86\,K\,kg\,mol^{-1}$)

(1) $[Cr(NH_3)_6]Cl_3$ (2) $[Cr(NH_3)_4Cl_2]Cl$
(3) $[Cr(NH_3)_5Cl]Cl_2$ (4) $[Cr(NH_3)_3Cl_3]$

Q.30 $FeO_4^{2-} \xrightarrow{+2.0\ V} Fe^{3+} \xrightarrow{0.8\ V} Fe^{2+} \xrightarrow{-0.5\ V} Fe^0$

In the above diagram, the standard electrode potentials are given in volts (over the arrow).

The value of $E^{\Theta}_{FeO_4^{2-}/Fe^{2+}}$ is

(1) 1.7 V (2) 1.2 V (3) 2.1 V (4) 1.4 V

Q.31 Match the LIST-I with LIST-II

LIST-I Name reaction		LIST-II Product obtainable	
A.	Swarts reaction	I.	Ethyl benzene
B.	Sandmeyer's reaction	II.	Ethyl iodide
C.	Wurtz Fittig reaction	III.	Cyanobenzene
D.	Finkelstein reaction	IV.	Ethyl ?uoride

Choose the correct answer from the options given below:

(1) A-II, B-III, C-I, D-IV (2) A-IV, B-I, C-III, D-II

(3) A-IV, B-III, C-I, D-II (4) A-II, B-I, C-III, D-IV

Q.32 Given below are two statements:

Statement-I: Fructose does not contain an aldehydic group but still reduces Tollen's reagent

Statement-II: In the presence of base, fructose undergoes rearrangement to give glucose.

In the light of the above statements, choose the correct answer from the options given below

(1) Statement I is false but Statement II is true

(2) Both Statement I and Statement II are true

(3) Both Statement I and Statement II are false

(4) Statement I is true but Statement II is false

Q.33 2.8×10^{-3} of CO_2 is left after removing 10^{21} molecules from its 'x' mg sample. The mass of CO_2 taken initially is [Given : $N_A = 6.02 \times 10^{23}\ mol^{-1}$]

(1) 196.2 mg (2) 98.3 mg

(3) 150.4 mg (4) 48.2 mg

Q.34 Ice at –5°C is heated to become vapor with temperature of 110°C at atmospheric pressure. The entropy change associated with this process can be obtained from :

(1) $\int_{268K}^{383K} C_p dT + \frac{\Delta H_{melting}}{273} + \frac{\Delta H_{boiling}}{373}$

(2) $\int_{268K}^{273K} \frac{C_{p,m}}{T} dT + \frac{\Delta H_m,\ fusion}{T_f} + \frac{\Delta H_{m,\ vaporisation}}{T_b} + \int_{273K}^{373K} \frac{C_{p,\ m} dT}{T} + \int_{373K}^{383K} \frac{C_{p,\ m} dT}{T}$

(3) $\int_{268K}^{383K} C_p dT + \frac{q_{rev}}{T}$

(4) $\int_{268K}^{273K} C_{p,m} dT + \frac{\Delta H_m,\ fusion}{T_f} + \frac{\Delta H_{m,\ vaporisation}}{T_b} + \int_{273K}^{373K} C_{p,m} dT + \int_{373K}^{383K} C_{p,m} dT$

Q.35 The d-electronic configuration of an octahedral Co(II) complex having magnetic moment of 3.95 BM is :

(1) $t_{2g}^6 e_g^1$ (2) $t_{2g}^3 e_g^0$ (3) $t_{2g}^5 e_g^2$ (4) $e^4 t_2^3$

Q.36 The complex that shows Facial - Meridional isomerism is

(1) $[Co(NH_3)_3Cl_3]$ (2) $[Co(NH_3)_4Cl_2]^+$

(3) $[Co(en)_3]^{3+}$ (4) $[Co(en)_2Cl_2]^+$

Q.37 The major product of the following reaction is :

$CH_3CH_2CH=O \xrightarrow[\text{reflux}]{\text{excess HCHO alkali}} ?$

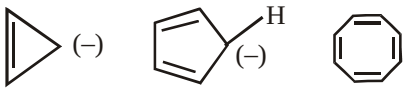
(1) $CH_3-CH_2-CH_2-OH$

(2) $CH_3-\underset{\displaystyle CH_2-OH}{\underset{|}{CH}}-CH=O$

(3) $CH_3-\underset{\displaystyle CH_2-OH}{\overset{\displaystyle CH_2-OH}{\overset{|}{\underset{|}{C}}}}-CH_2-OH$

(4) $CH_3-\underset{\displaystyle CH_2}{\underset{\|}{C}}-CH=O$

Q.38 The correct stability order of the following species/ molecules is :



p q r

(1) q > r > p (2) r > q > p

(3) q > p > r (4) p > q > r

Q.39 Propane molecule on chlorination under photochemical condition gives two di-chloro products, "x" and "y". Amongst " x " and "y", "x" is an optically active molecule. How many tri-chloro products (consider only structural isomers) will be obtained from "x" when it is further treated with chlorine under the photochemical condition?

(1) 4 (2) 2 (3) 5 (4) 3

Q.40 What amount of bromine will be required to convert 2 g of phenol into 2, 4, 6-tribromophenol ? (Given molar mass in g mol^{-1} of C, H, O, Br are 12, 1, 16, 80 respectively)
(1) 10.22 g (2) 6.0 g (3) 4.0 g (4) 20.44 g

Q.41 The correct set of ions (aqueous solution) with same colour from the following is :
(1) V^{2+}, Cr^{3+}, Mn^{3+} (2) Zn^{2+}, V^{3+}, Fe^{3+}
(3) Ti^{4+}, V^{4+}, Mn^{2+} (4) $Sc^{3+}, Ti^{3+}, Cr^{2+}$

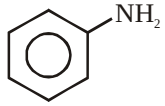
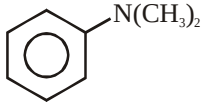
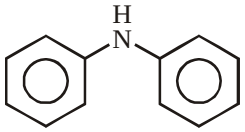
Q.42 Given below are two statements :
Statement I : In Lassaigne's test, the covalent organic molecules are transformed into ionic compounds.
Statement II : The sodium fusion extract of an organic compound having N and S gives prussian blue colour with $FeSO_4$ and $Na_4[Fe(CN)_6]$
In the light of the above statements, choose the correct answer from the options given below
(1) Both Statement I and Statement II are true
(2) Both Statement I and Statement II are false
(3) Statement I is false but Statement II is true
(4) Statement I is true but Statement II is false

Q.43 Which of the following happens when NH_4OH is added gradually to the solution containing 1 MA^{2+} and 1 MB^{3+} ions?
Given : $K_{sp}\left[A(OH)_2\right] = 9\times10^{-10}$ and
$K_{sp}\left[B(OH)_3\right] = 27\times10^{-18}$ at 298 K.
(1) $B(OH)_3$ will precipitate before $A(OH)_2$
(2) $A(OH)_2$ and $B(OH)_3$ will precipitate together
(3) $A(OH)_2$ will precipitate before $B(OH)_3$
(4) Both $A(OH)_2$ and $B(OH)_3$ do not show precipitation with NH_4OH

Q.44 Match the LIST-I with LIST-II

LIST-I (Classi?cation of molecules based on octet rule)		**LIST-II (Example)**	
A.	Molecules obeying octet rule	I.	NO, NO_2
B.	Molecules with incomplete octet	II.	BCl_3, $AlCl_3$
C.	Molecules with incomplete octet with odd electron	III.	H_2SO_4, PCl_5
D.	Molecules with expanded octet	IV.	CCl_4, CO_2

Choose the correct answer from the options given below :
(1) A-IV, B-II, C-I, D-III (2) A-III, B-II, C-I, D-IV
(3) A-IV, B-I, C-III, D-II (4) A-II, B-IV, C-III, D-I

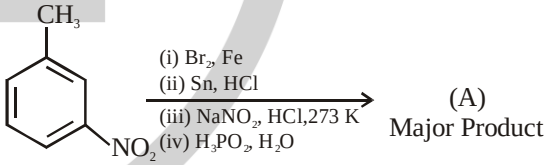
Q.45 Which among the following react with Hinsberg's reagent?
(A)  (B) 
(C) $CH_3—NH_2$ (D) $N(CH_3)_3$
(E) 
Choose the correct answer from the options given below :
(1) B and D only (2) C and D only
(3) A, B and E only (4) A, C and E only

SECTION-B

Q.46 If 1 mM solution of ethylamine produces pH = 9, then the ionization constant (K_b) of ethylamine is 10^{-x}. The value of x is _____ (nearest integer).

Q.47 During "S" estimation, 160 mg of an organic compound gives 466 mg of barium sulphate. The percentage of Sulphur in the given compound is _____ %.
(Given molar mass in g mol^{-1} of Ba : 137, S ; 32, O : 16)

Q.48 Consider the following sequence of reactions to produce major product (A)



Molar mass of product (A) is _____ g mol^{-1}.
(Given molar mass in g mol^{-1} of C : 12, H : 1, O : 16, Br : 80, N : 14, P : 31)

Q.49 For the thermal decomposition of $N_2O_5(g)$ at constant volume, the following table can be formed, for the reaction mentioned below :
$2N_2O_5(g) \rightarrow 2\,N_2O_4(g) + O_2(g)$

S.No.	Time/s	Total pressure / (atm)
1.	0	0.6
2.	100	'x'

Given : Rate constant for the reaction is 4.606×10^{-2} s^{-1}.

Q.50 The standard enthalpy and standard entropy of decomposition of N_2O_4 to NO_2 are 55.0 kJ mol^{-1} and 175.0 J/K/mol respectively. The standard free energy change for this reaction at 25°C in J mol^{-1} is _____ (Nearest integer)

MATHEMATICS
SECTION-A

Q.51 The value of $\int_{e^2}^{e^4} \frac{1}{x}\left(\frac{e^{\left((\log_e x)^2+1\right)^{-1}}}{e^{\left((\log_e x)^2+1\right)^{-1}}+e^{\left((6-\log_e x)^2+1\right)^{-1}}}\right)dx$ is

(1) $\log_e 2$ (2) 2 (3) 1 (4) e^2

Q.52 Let $I(x)=\int \frac{dx}{(x-11)^{\frac{11}{13}}(x+15)^{\frac{15}{13}}}$.

If $I(37)-I(24)=\frac{1}{4}\left(\frac{1}{b^{\frac{1}{13}}}-\frac{1}{c^{\frac{1}{13}}}\right)$, $b, c \in \mathbb{N}$, then

3(b + c) is equal to

(1) 40 (2) 39 (3) 22 (4) 26

Q.53 If the function

$$f(x)=\begin{cases}\frac{2}{x}\{\sin(k_1+1)x+\sin(k_2-1)x\} & , x<0\\ 4 & , x=0\\ \frac{2}{x}\log_e\left(\frac{2+k_1x}{2+k_2x}\right) & , x>0\end{cases}$$

is continuous at x = 0, then $k_1^2 + k_2^2$ is equal to

(1) 8 (2) 20 (3) 5 (4) 10

Q.54 If the line $3x - 2y + 12 = 0$ intersects the parabola $4y = 3x^2$ at the points A and B, then at the vertex of the parabola, the line segment AB subtends an angle equal to

(1) $\tan^{-1}\left(\frac{11}{9}\right)$ (2) $\frac{\pi}{2}-\tan^{-1}\left(\frac{3}{2}\right)$

(3) $\tan^{-1}\left(\frac{4}{5}\right)$ (4) $\tan^{-1}\left(\frac{9}{7}\right)$

Q.55 Let a curve y = f(x) pass through the points (0, 5) and $(\log_e 2, k)$. If the curve satisfies the differential equation $2(3+y)e^{2x}dx-\left(7+e^{2x}\right)dy=0$, then k is equal to

(1) 16 (2) 8 (3) 32 (4) 4

Q.56 Let $f(x) = \log_e x$ and

$$g(x)=\frac{x^4-2x^3+3x^2-2x+2}{2x^2-2x+1}.$$

Then the domain of fog is

(1) R (2) $(0, \infty)$
(3) $[0, \infty)$ (4) $[1, \infty)$

Q.57 Let the arc AC of a circle subtend a right angle at the centre O. If the point B on the arc AC, divides the arc AC such that $\frac{\text{length of arcAB}}{\text{length of arcBC}}=\frac{1}{5}$, and $\overrightarrow{OC}=\alpha\overrightarrow{OA}+\beta\overrightarrow{OB}$, then $\alpha=\sqrt{2}\left(\sqrt{3}-1\right)\beta$ is equal to

(1) $2-\sqrt{3}$ (2) $2\sqrt{3}$
(3) $5\sqrt{3}$ (4) $2+\sqrt{3}$

Q.58 If the first term of an A.P. is 3 and the sum of its first four terms is equal to one-fifth of the sum of the next four terms, then the sum of the first 20 terms is equal to

(1) –1200 (2) –1080 (3) –1020 (4) –120

Q.59 Let P be the foot of the perpendicular from the point Q(10, –3, –1) on the line $\frac{x-3}{7}=\frac{y-2}{-1}=\frac{z+1}{-2}$. Then the area of the right angled triangle PQR, where R is the point (3, –2, 1), is

(1) $9\sqrt{15}$ (2) $\sqrt{30}$ (3) $8\sqrt{15}$ (4) $3\sqrt{30}$

Q.60 Let $\left|\frac{\bar{z}-i}{2\bar{z}+i}\right|=\frac{1}{3}, z \in \mathbb{C}$, be the equation of a circle with center at C. If the area of the triangle, whose vertices are at the points (0, 0), C and $(\alpha, 0)$ is 11 square units, then α^2 equals

(1) 100 (2) 50 (3) $\frac{121}{25}$ (4) $\frac{81}{25}$

Q.61 Let R = {(1, 2), (2, 3), (3, 3)} be a relation defined on the set {1, 2, 3, 4}. Then the minimum number of elements, needed to be added in R so the R becomes an equivalence relation, is :

(1) 10 (2) 8 (3) 9 (4) 7

Q.62 The number of words, which can be formed using all the letters of the word "DAUGHTER", so that all the vowels never come together, is

(1) 34000 (2) 37000 (3) 36000 (4) 35000

Q.63 Let the area of a ΔPQR with vertices P(5, 4), Q(–2, 4) and R(a, b) be 35 square units. If its orthocenter and centroid are $O\left(2, \frac{14}{5}\right)$ and C(c, d) respectively, then c + 2d is equal to

(1) $\frac{7}{3}$ (2) 3 (3) 2 (4) $\frac{8}{3}$

Q.64 If $\frac{\pi}{2} \le x \le \frac{3\pi}{4}$, then $\cos^{-1}\left(\frac{12}{13}\cos x + \frac{5}{13}\sin x\right)$ is equal to

(1) $x - \tan^{-1}\frac{4}{3}$ (2) $x - \tan^{-1}\frac{5}{12}$

(3) $x + \tan^{-1}\frac{4}{5}$ (4) $x + \tan^{-1}\frac{5}{12}$

Q.65 The value of $(\sin 70°)(\cot 10° \cot 70° - 1)$ is
(1) 1 (2) 0 (3) 3/2 (4) 2/3

Q.66 Marks obtains by all the students of class 12 are presented in a frequency distribution with classes of equal width. Let the median of this grouped data be 14 with median class interval 12-18 and median class frequency 12. If the number of students whose marks are less than 12 is 18, then the total number of students is
(1) 48 (2) 44 (3) 40 (4) 52

Q.67 Let the position vectors of the vertices A, B and C of a tetrahedron ABCD be $\hat{i}+2\hat{j}+\hat{k}, \hat{i}+3\hat{j}-2\hat{k}$ and $2\hat{i}+\hat{j}-\hat{k}$ respectively. The altitude from the vertex D to the opposite face ABC meets the median line segment through A of the triangle ABC at the point E. If the length of AD is $\frac{\sqrt{110}}{3}$ and the volume of the tetrahedron is $\frac{\sqrt{805}}{6\sqrt{2}}$, then the position vector of E is

(1) $\frac{1}{2}\left(\hat{i}+4\hat{j}+7\hat{k}\right)$ (2) $\frac{1}{12}\left(7\hat{i}+4\hat{j}+3\hat{k}\right)$

(3) $\frac{1}{6}\left(12\hat{i}+12\hat{j}+\hat{k}\right)$ (4) $\frac{1}{6}\left(7\hat{i}+12\hat{j}+\hat{k}\right)$

Q.68 If A, B and $\left(\text{adj}\left(A^{-1}\right)+\text{adj}\left(B^{-1}\right)\right)$ are non-singular matrices of same order, then the inverse of $A\left(\text{adj}\left(A^{-1}\right)+\text{adj}\left(B^{-1}\right)\right)^{-1}B$, is equal to

(1) $AB^{-1}+A^{-1}B$
(2) $\text{adj}(B^{-1})+\text{adj}(A^{-1})$
(3) $\frac{1}{|AB|}\left(\text{adj}(B)+\text{adj}(A)\right)$
(4) $\frac{AB^{-1}}{|A|}+\frac{BA^{-1}}{|B|}$

Q.69 If the system of equations

$(\lambda-1)x+(\lambda-4)y+\lambda z=5$

$\lambda x+(\lambda-1)y+(\lambda-4)z=7$

$(\lambda+1)x+(\lambda+2)y-(\lambda+2)z=9$

has infinitely many solutions, then $\lambda^2+\lambda$ is equal to
(1) 10 (2) 12 (3) 6 (4) 20

Q.70 One die has two faces marked 1, two faces marked 2, one face marked 3 and one face marked 4. Another die has one face marked 1, two faces marked 2, two faces marked 3 and one face marked 4. The probability of getting the sum of numbers to be 4 or 5, when both the dice are thrown together, is

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

SECTION-B

Q.71 If the area of the larger portion bounded between the curves $x^2+y^2=25$ and $y=|x-1|$ is $\frac{1}{4}(b\pi+c)$, b, c ∈ N, then b + c is equal to _____

Q.72 The sum of all rational terms in the expansion of $\left(1+2^{1/3}+3^{1/2}\right)^6$ is equal to _____

Q.73 Let the circle C touch the line x – y + 1 = 0, have the centre on the positive x-axis, and cut off a chord of length $\frac{4}{\sqrt{13}}$ along the line –3x + 2y = 1. Let H be the hyperbola $\frac{x^2}{\alpha^2}-\frac{y^2}{\beta^2}=1$, whose one of the foci is the centre of C and the length of the transverse axis is the diameter of C. Then $2\alpha^2-3\beta^2$ is equal to _____

Q.74 If the set of all values of a, for which the equation $5x^3 - 15x - a = 0$ has three distinct real roots, is the interval (α, β), then $\beta - 2\alpha$ is equal to _____

Q.75 If the equation $a(b-c)x^2 + b(c-a)x + c(a-b) = 0$ has equal roots, where a + c = 15 and $b=\frac{36}{5}$, then a^2+c^2 is equal to _____