

JEE (MAIN)

TEST PAPER

SUBJECT : PHYSICS, CHEMISTRY, MATHEMATICS

TEST CODE : TSJMT213

QUESTION PAPER

TIME : 3 HRS

MARKS : 300

INSTRUCTIONS

GENERAL INSTRUCTIONS :

1. This test consists of 75 questions.
2. There are three parts in the question paper A, B, C consisting of Physics, Chemistry and Mathematics having 25 questions in each part
3. 20 questions will be Multiple choice questions & 5 questions will have answer to be filled as numerical value.
4. Marking scheme :

Type of Questions	Total Number of Questions	Correct Answer	Incorrect Answer	Unanswered
MCQ's	20	+4	Minus One Mark(-1)	No Mark (0)
Numerical Values	5	+4	No Mark (0)	No Mark (0)

5. There is only one correct response for each question. Filling up more than one response in each question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 4 above.

OPTICAL MARK RECOGNITION (OMR) :

6. The OMR will be provided to the students.
7. Darken the appropriate bubbles on the OMR sheet by applying sufficient pressure.
8. The OMR sheet will be collected by the invigilator at the end of the examination.
9. Do not tamper with or mutilate the OMR. Do not use the OMR for rough work.
10. Write your name, Batch name, name of the center, Test Code, roll number and signature with pen in the space provided for this purpose on the OMR. Do not write any of these details anywhere else on the OMR.

DARKENING THE BUBBLES ON THE OMR :

11. Use a BLACK BALL POINT PEN to darken the bubbles on the OMR.
12. Darken the bubble COMPLETELY.
13. Darken the bubbles ONLY IF you are sure of the answer. There is NO WAY to erase or "un-darken" a darkened bubble.

Part A - PHYSICS

- Q.1 A bob mass m attached to an inextensible string of length L is suspended from a vertical support. The bob rotates in a horizontal circle with an angular speed ω rad/s about the the vertical. About the point of suspension:
- (a) Angular momentum changes in direction but not in magnitude.
 (b) Angular momentum changes both in direction and magnitude.
 (c) Angular momentum is conserved.
 (d) Angular momentum changes in magnitude but not in direction.

- Q.2 An open glass tube is immersed in mercury in such a way that a length of 8 cm extends above the mercury level. The open end of the tube is then closed and sealed and the tube is raised vertically up by additional 46 cm. What will be length of the air column above mercury in the tube now? (Atmospheric pressure = 76 cm of Hg).
- (a) 38 cm (b) 6 cm (c) 16 cm (d) 22 cm

- Q.3 Match List-I (Electromagnetic wave type) with List-II (Its association/application) and select the correct option from the choices given below the lists:

	List-I		List-II
(a)	Infrared waves	(i)	To treat muscular strain
(b)	Radio waves	(ii)	For broadcasting
(c)	X-rays	(iii)	To detect fracture of bones
(d)	Ultraviolet rays	(iv)	Absorbed by the ozone layer of the atmosphere.

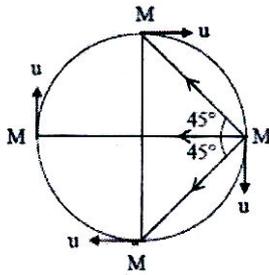
- (a) (iii), (ii), (i), (iv) (b) (i), (ii), (iii), (iv)
 (c) (iv), (iii), (ii), (i) (d) (i), (ii), (iv), (iii)

- Q.4 A parallel plate capacitor is made of two circular plates separated by a distance of 5 nm and with a dielectric of dielectric constant 2.2 between them. When the field in the dielectric 3×10^4 V/m is the charge density of the positive plate will be close to:
- (a) 3×10^4 C/m² (b) 6×10^4 C/m² (c) 6×10^{-7} C/m² (d) 3×10^{-7} C/m²

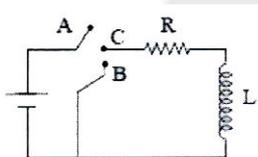
- Q.5 A student measured the length of a rod and wrote it as 3.5 cm. which instrument did he use to measure it?
- (a) A screw gauge having 100 divisions in the circular scale and pitch as 1 mm.
 (b) A screw gauge having 50 divisions in the circular scale and pitch as 1 mm.
 (c) A meter scale.
 (d) A vernier calliper where the 10 divisions in vernier scale matches with 9 divisions in main scale and main scale has 10 divisions in 1 cm.

- Q.6 Four particles, each of mass M and equidistant from each other. move along a circle of radius R under the action of their mutual gravitational attraction. The speed of each particle is :

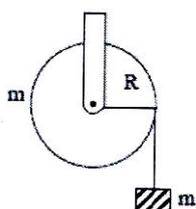
- (a) $\sqrt{\frac{GM}{R}}(1 + 2\sqrt{2})$ (b) $\frac{1}{2}\sqrt{\frac{GM}{R}}(1 + 2\sqrt{2})$
 (c) $\sqrt{\frac{GM}{R}}$ (d) $\sqrt{2\sqrt{2}}\frac{GM}{R}$



- Q.7 In a large building, there are 15 bulbs of 40 W, 5 bulbs of 100 W, 5 fans of 80 W and 1 heater of 1 kW. The voltage of the electric mains is 220 V. The minimum capacity of the main fuse of the building will be:
 (a) 12 A (b) 14 A (c) 8 A (d) 10 A
- Q.8 A particle moves with simple harmonic motion in a straight line. In first τ s, after from it travels a distance a , and in next τ s it travels $2a$, in same direction, then:
 (a) amplitude of motion is $4a$ (b) time period of oscillations is 6τ
 (c) amplitude of motion is $3a$ (d) time period of oscillations is 8τ
- Q.9 The coercivity of a small magnet where the ferromagnet gets demagnetized is $3 \times 10^3 \text{ Am}^{-1}$. The current required to be passed in a solenoid of length 10 cm and number of turns 100, so that the magnet gets demagnetized when inside the solenoid, is:
 (a) 3A (b) 6A (c) 30 mA (d) 60 mA
- Q.10 During the propagation of electromagnetic waves in medium :
 (a) Electric energy density is equal to the magnetic energy density.
 (b) Both electric and magnetic energy densities are zero.
 (c) Electric energy density is double of the magnetic energy density.
 (d) Electric energy density is half of the magnetic energy density.
- Q.11 In the circuit shown here, the point 'C' is kept connected to point 'A' till the current flowing through the circuit becomes constant. Afterward, suddenly, point 'C' is disconnected from point 'A' and connected to point 'B' at time $t = 0$. Ratio of the voltage across resistance and the inductor at $t = L/R$ will be equal to :



- (a) -1 (b) $\frac{1-e}{e}$ (c) $\frac{e}{1-e}$ (d) 1
- Q.12 A mass 'm' is supported by a massless string wound around a uniform hollow cylinder of mass m and radius R. If the string does not slip on the cylinder, with what acceleration will the mass fall on release ?



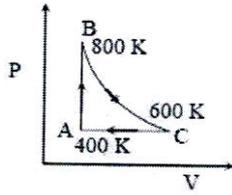
(a) $\frac{5g}{6}$

(b) g

(c) $\frac{2g}{2}$

(d) $\frac{8g}{2}$

Q.13 One mole of diatomic ideal gas undergoes a cyclic process ABC as shown in figure. The process BC is adiabatic. The temperatures at A, B and C are 400 K, 800 K and 600 K respectively. Choose the correct statement:



- (a) The change in internal energy in the process AB is $-350R$.
- (b) The change in internal energy in the process BC is $-500R$.
- (c) The change in internal energy in whole cyclic process is $250R$.
- (d) The change in internal energy in the process CA is $700R$.

Q.14 From a tower of height H , a particle is thrown vertically upwards with a speed u . The time taken by the particle, to hit the ground, is n times that taken by it to reach the highest point of its path. The relation between H , u and n is:

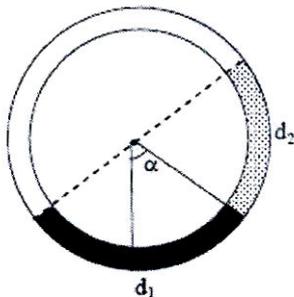
- (a) $2gH = nu^2(n - 2)$
- (b) $gH = (n - 2)u^2$
- (c) $2gH = n^2u^2$
- (d) $gH = (n - 2)^2u^2$

Q.15 A thin convex lens made from crown glass ($\mu = \frac{3}{2}$) has focal length f . When it is measured in two different liquids having refractive indices $\frac{4}{3}$ and $\frac{5}{3}$, it has the focal lengths f_1 and f_2 respectively. The correct relation between the focal lengths is:

- (a) $f_2 > f$ and f_1 becomes negative
- (b) f_1 and f_2 both become negative
- (c) $f_1 = f_2 < f$
- (d) $f_1 > f$ and f_2 becomes negative

Q.16 There is a circular tube in a vertical plane. Two liquids which do not mix and of densities d_1 and d_2 are filled in the tube. Each liquid subtends 90° angle at centre. Radius joining their interface makes an angle α with vertical. ratio d_1/d_2 is

- (a) $\frac{1 + \tan \alpha}{1 - \tan \alpha}$
- (b) $\frac{1 + \sin \alpha}{1 - \cos \alpha}$
- (c) $\frac{1 + \sin \alpha}{1 - \sin \alpha}$
- (d) $\frac{1 + \cos \alpha}{1 - \cos \alpha}$

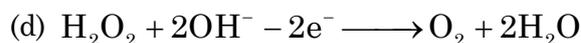
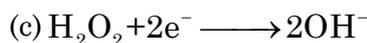


- Q.17 A green light is incident from the water to the air - water interface at the critical angle (θ). Select the correct statement.
- The spectrum of visible light whose frequency is more than that of green light will come out to the air medium.
 - The entire spectrum of visible light will come out of the water at an angle of 90° to the normal
 - The entire spectrum of visible light will come out of the water at an angle
 - The spectrum of visible light whose frequency is less than that of green light will come out to the air medium.
- Q.18 Hydrogen ($1H_1$), Deuterium ($1H_2$), singly ionised Helium ($2He_4$)⁺ and double ionised lithium ($3Li_5$)⁺ all have one electron around the nucleus. Consider an electron transition from $n = 2$ to $n = 1$. If the wave lengths of emitted radiation are $\lambda_1, \lambda_2, \lambda_3$ and λ_4 respectively then approximately which one of the following is correct?
- $\lambda_1 = \lambda_2 = 4\lambda_3 = 9\lambda_4$
 - $\lambda_1 = 2\lambda_2 = 3\lambda_3 = 4\lambda_4$
 - $4\lambda_1 = 2\lambda_2 = 2\lambda_3 = \lambda_4$
 - $\lambda_1 = 2\lambda_2 = 2\lambda_3 = \lambda_4$
- Q.19 A block of mass m is placed on a surface with a vertical cross section given by $y = x^3 / 6$. If the coefficient of friction is 0.5, the maximum height above the ground at which the block can be placed without slipping is :
- $\frac{1}{3}m$
 - $\frac{1}{2}m$
 - $\frac{1}{6}m$
 - $\frac{2}{3}m$
- Q.20 When a rubber-band is stretched by a distance x , it exerts a restoring force of magnitude $F = ax + bx^2$ where a and b are constants. The work done in stretching the unstretched rubber b and by L is :
- $\frac{aL^2}{2} + \frac{bL^2}{3}$
 - $\frac{1}{2} \left(\frac{aL^2}{2} + \frac{bL^3}{3} \right)$
 - $aL^2 + bL^3$
 - $\frac{1}{2} (aL^2 + bL^3)$
- Q.21 The pressure that has to be applied to the ends of a steel wire of length 10 cm to keep its length constant when its temperature is raised by 100°C is :
(For steel Young's modulus is $2 \times 10^{11} \text{Nm}^{-2}$ and coefficient of thermal expansion is $1.1 \times 10^{-5} \text{K}^{-1}$)
- Q.22 A conductor lies along the z -axis at $-1.5 \leq z < 1.5$ m and carries a fixed current of 10.0 A in $-\hat{a}_z$ direction (see figure). For a field $\vec{B} = 3.0 \times 10^{-4} e^{-0.0x} \hat{a}_y$ find the power required to move the conductor at constant speed to $x = 2.0\text{m}$, $y = 0\text{m}$ in 5×10^{-3} s. Assume parallel motion along the x -axis.
- Q.23 The current voltage relation of diode is given by $I = (e^{1000V/T} - 1)\text{mA}$, where the applied voltage V is in volts and the temperature T is in degree Kelvin. If a student makes an error measuring while measuring ± 0.01 V the current of 5 mA at 300 K, what will be the error in the value of current in mA?

- Q.24 A pipe of length 85 cm is closed from one end. Find the number of possible natural oscillations of air column in the pipe whose frequencies lie below 1250 Hz. The velocity of sound in air is 340 m/s.
- Q.25 The radiation corresponding to $3 \rightarrow 2$ transition of hydrogen atom falls on a metal surface to produce photoelectrons. These electrons are made to enter a magnetic field of $3 \times 10^{-4} \text{ T}$. If the radius of the largest circular path followed by these electrons is 10.0 mm, the work function of the metal is close to :

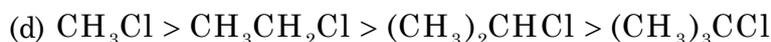
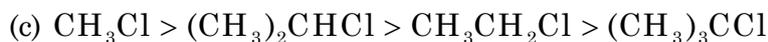
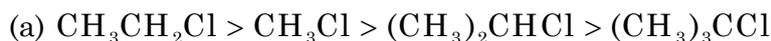
Part - B - CHEMISTRY

- Q.26 Which one of the following properties is not shown by NO ?
 (a) It combines with oxygen to form nitrogen dioxide.
 (b) Its bond order is 2.5
 (c) It is diamagnetic in gaseous state
 (d) It is a neutral oxide
- Q.27 If Z is a compressibility factor, van der Waals equation at low pressure can be written as:
 (a) $Z = 1 - \frac{Pb}{RT}$ (b) $Z = 1 + \frac{Pb}{RT}$ (c) $Z = 1 + \frac{RT}{Pb}$ (d) $Z = 1 - \frac{a}{VRT}$
- Q.28 The metal that cannot be obtained by electrolysis of an aqueous solution of its salts is :
 (a) Cu (b) Cr (c) Ag (d) Ca
- Q.29 Resistance of 0.2 M solution of an electrolyte is 50Ω . The specific conductance of the solution is 1.4 S m^{-1} . The resistance of 0.5 M solution of the same electrolyte is 280Ω . The molar conductivity of 0.5 M solution of the electrolyte in S m^2 is :
 (a) 5×10^3 (b) 5×10^2 (c) 5×10^{-4} (d) 5×10^{-3}
- Q.30 CsCl crystallises in body centred cubic lattice. If 'a' is its edge then which of the following expressions is correct?
 (a) $r_{\text{Cs}^+} + r_{\text{Cl}^-} = \frac{\sqrt{3}}{2} a$ (b) $r_{\text{Cs}^+} + r_{\text{Cl}^-} = \sqrt{3} a$
 (c) $r_{\text{Cs}^+} + r_{\text{Cl}^-} = 3a$ (d) $r_{\text{Cs}^+} + r_{\text{Cl}^-} = \frac{3a}{2}$
- Q.31 Consider separate solutions $\text{C}_2\text{H}_5\text{OH}(\text{aq})$, $0.100 \text{ M Mg}_3(\text{PO}_4)_2$, $0.250 \text{ M KBr}(\text{aq})$ and $0.125 \text{ M Na}_3\text{PO}_4(\text{aq})$ at 25°C of 0.500 M . Which statement is true about these solutions, assuming all salts to be strong electrolytes?
 (a) $0.125 \text{ M Na}_3\text{PO}_4(\text{aq})$ has the highest osmotic pressure.
 (b) $0.500 \text{ C}_2\text{H}_5\text{OH}(\text{aq})$ has the highest osmotic pressure.
 (c) They all have the same osmotic pressure.
 (d) $0.100 \text{ M Mg}_3(\text{PO}_4)_2(\text{aq})$ has the highest osmotic pressure.
- Q.32 In which of the following reactions H_2O_2 acts as a reducing agent?
 (a) $\text{H}_2\text{O}_2 + 2\text{H}^+ + 2\text{e}^- \longrightarrow 2\text{H}_2\text{O}$ (b) $\text{H}_2\text{O}_2 - 2\text{e}^- \longrightarrow \text{O}_2 + 2\text{H}^+$

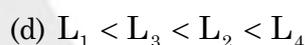
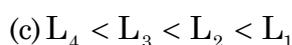
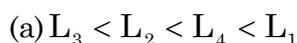


Q.33 In $\text{S}_{\text{N}}2$ reactions, the correct order of reactivity for the following compounds :

CH_3Cl , $\text{CH}_3\text{CH}_2\text{Cl}$, $(\text{CH}_3)_2\text{CHCl}$ and $(\text{CH}_3)_3\text{CCl}$ is :



Q.34 The octahedral complex of a metal ion M_3^+ with four monodentate ligands L_1 , L_2 , L_3 and L_4 absorb wavelengths in the region of red, green, yellow and blue, respectively. The increasing order of ligand strength of four ligands is :



Q.35 For the estimation of nitrogen, 1.4 g of organic compound was digested by Kjeldahl method and

the evolved ammonia was absorbed in 60 mL of $\frac{\text{M}}{10}$ sulphuric acid. The unreacted acid required 20

ml of $\frac{\text{M}}{10}$ sodium hydroxide for complete neutralization. The percentage of nitrogen in the compound is :

(a) 3%

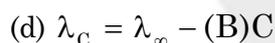
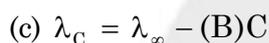
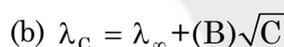
(b) 5%

(c) 6%

(d) 10%

Q.36 The equivalent conductance of NaCl at concentration C and at infinite are λ_C and λ_∞

respectively. The correct relationship between λ_C and λ_∞ is given as: (where the constant B is positive)



Q.37 For the reaction, $\text{SO}_{2(g)} + \frac{1}{2}\text{O}_{2(g)} \rightleftharpoons \text{SO}_{3(g)}$, if $K_p = K_C(\text{RT})^x$ where the symbols have usual meaning then the value of x is : (assuming ideality)

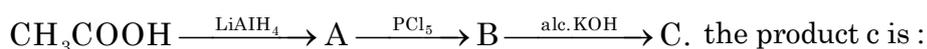
(a) $\frac{1}{2}$

(b) 1

(c) -1

(d) $-\frac{1}{2}$

Q.38 In the reaction,



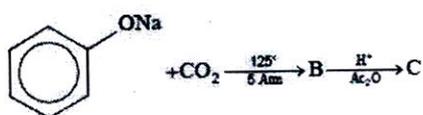
(a) Ethylene

(b) Acetyl chloride

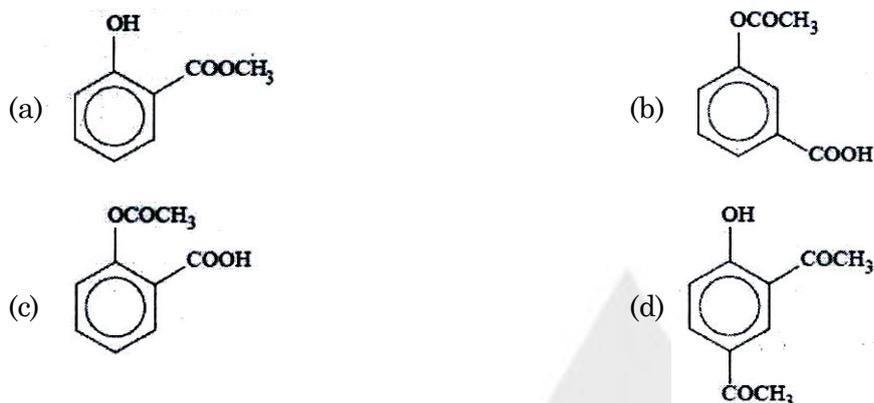
(c) Acetaldehyde

(d) Acetylene

Q.39 Sodium phenoxide when heated with CO_2 under pressure at 125°C yields a product which on acetylation produces C .



The major product C would be :



Q.40 On heating an aliphatic primary amine with chloroform and ethanolic potassium hydroxide, the organic compound formed is :

- (a) an alkyl cyanide (b) an alkyl isocyanide
(c) an alkanol (d) an alkanediol

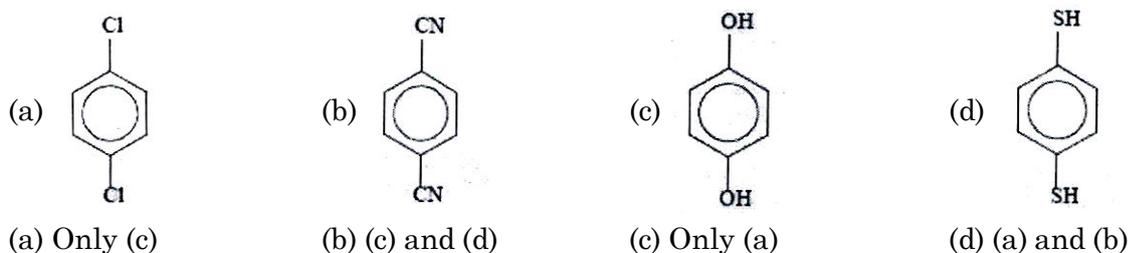
Q.41 The correct statement for the molecule, CsI_3 is :

- (a) it contains Cs^{3+} and I^- ions.
(b) it contains Cs^+ , I^- and lattice I_2 molecule.
(c) it is a covalent molecule.
(d) it contains Cs^+ and I_3^-

Q.42 The equation which is balanced and represents the correct product (s) is :

- (a) $[\text{Mg}(\text{H}_2\text{O})_8]^{2+} + (\text{EDTA})^{4-} \xrightarrow{\text{excess NaOH}} [\text{Mg}(\text{EDTA})]^{2-} + 6\text{H}_2\text{O}$
(b) $\text{CuSO}_4 + 4\text{KCN} \longrightarrow \text{K}_2[\text{Cu}(\text{CN})_4] + \text{K}_2\text{SO}_4$
(c) $\text{Li}_2\text{O} + 2\text{KCl} \longrightarrow 2\text{LiCl} + \text{K}_2\text{O}$
(d) $[\text{CoCl}(\text{NH}_3)_5]^{2+} + 5\text{H}^+ \longrightarrow \text{Co}^{2+} + 5\text{NH}_4^+ + \text{Cl}^-$

Q.43 For which of the following molecule significant $\mu \neq 0$?



Q.44 For the non-stoichiometric reaction $2\text{A} + \text{B} \longrightarrow \text{C} + \text{D}$ the following kinetic data were obtained in three separate experiments all at 298 K.

Initial concentration (A)	Initial concentration (B)	Initial rate of formation of C (mol L ⁻¹ S ⁻¹)
0.1 M	0.1 M	1.2×10^{-3}
0.1 M	0.2 M	1.2×10^{-3}
0.2 M	0.1 M	2.4×10^{-3}

The rate law for the formation of C is :

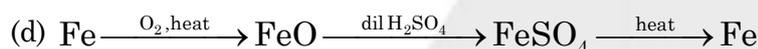
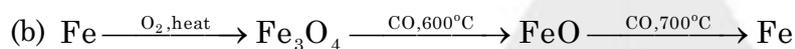
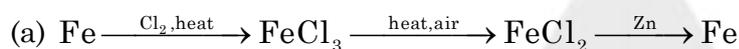
(a) $\frac{dc}{dt} = k[A][B]^2$

(b) $\frac{dc}{dt} = k[A]$

(c) $\frac{dc}{dt} = k[A][B]$

(d) $\frac{dc}{dt} = k[A]^2[B]$

Q.45 Which series of reactions correctly represents chemical reactions related to iron and its compound?



Q.46 The osmotic pressure of blood is 7.65 atm at 37° C. How much glucose should be used per litre for an intravenous injection that is to have the same osmotic pressure as blood?

Q.47 A system is provided 50 J of heat and work done on the system is 10 J. The change in internal energy during the process is :

Q.48 What is the maximum mass (in grams) of NO that could be obtained from 15.5 g of N₂ O₄ and 4.68 g of N₂ H₄ when they react? The balanced equation is _____?

Q.49 What is likely to be principal quantum number for a circular orbit of diameter 20 nm of the hydrogen atom if we assume Bohr orbit to be the same as that represented by the principal quantum number?

Q.50 What volume of 6.0 M H₂SO₄ should be mixed with 10 L of 1.0 M H₂SO₄ to make 20.0 L of 3.0 M H₂SO₄ upon dilution to volume?

Part - C - MATHEMATICS

Q.51 The image of the line $\frac{x-1}{3} = \frac{y-3}{1} = \frac{z-4}{-5}$ in the plane $2x - y + z + 3 = 0$ is the line

(a) $\frac{x+3}{3} = \frac{y-5}{1} = \frac{z-2}{-5}$

(b) $\frac{x+3}{-3} = \frac{y-5}{-1} = \frac{z+2}{5}$

(c) $\frac{x-3}{3} = \frac{y+5}{1} = \frac{z-2}{-5}$

(d) $\frac{x-3}{-3} = \frac{y+5}{-1} = \frac{z-2}{5}$

Q.52 If the coefficients of x^3 and x^4 in the expansion of in powers of x are both zero, then (a, b) is equal to

(a) $\left(6, \frac{251}{3}\right)$

(b) $\left(14, \frac{251}{3}\right)$

(c) $\left(14, \frac{272}{3}\right)$

(d) $\left(16, \frac{272}{3}\right)$

Q.53 If $a \in \mathbb{R}$ and the equation $-3(x - [x])^2 + 2(x - [x]) + a^2 = 0$ (where $[x]$ denotes the greatest integer integer $\leq x$) has no integral solution, then all possible values of a lie in the interval

(a) $(-1, 0) \cup (0, 1)$

(b) $(1, 2)$

(c) $(-2, -1)$

(d) $(-\infty, -2) \cup (2, \infty)$

Q.54 If $[\vec{a} \times \vec{b} \cdot \vec{b} \times \vec{c} \cdot \vec{c} \times \vec{a}] = \lambda [\vec{a} \cdot \vec{b} \cdot \vec{c}]$ then λ is equal to

(a) 2

(b) 3

(c) 0

(d) 1

Q.55 A bird is sitting on the top of a vertical pole 20 m high and its elevation from a point O on the ground is 45° . It flies off horizontally straight away from the point O. After one second, the elevation of the bird from O is reduced to 30° . Then the speed (in m/s) of the bird is

(a) $40(\sqrt{2} - 1)$

(b) $40(\sqrt{3} - \sqrt{2})$

(c) $20\sqrt{2}$

(d) $20(\sqrt{3} - 1)$

Q.56 The statement $\sim (P \leftrightarrow \sim q)$ is

(a) equivalent to $p \leftrightarrow q$ (b) equivalent to $\sim P \leftrightarrow q$

(c) a tautology

(d) a fallacy

Q.57 The integral $\int \left(1 + x - \frac{1}{x}\right) e^{x + \frac{1}{x}} dx$ is equal to

(a) $(x-1)e^{x + \frac{1}{x}} + c$

(b) $xe^{x + \frac{1}{x}} + c$

(c) $(x+1)e^{x + \frac{1}{x}} + c$

(d) $-xe^{x + \frac{1}{x}} + c$

Q.58 If z is a complex number such that $|z| \geq 2$, then the minimum value of $\left|z + \frac{1}{z}\right|$

(a) is equal to $\frac{5}{2}$

(b) lies in the interval $(1, 2)$

(c) is strictly greater than $\frac{5}{2}$

(d) is strictly greater than $\frac{3}{2}$ but less than $\frac{5}{2}$

Q.59 If A is a non-singular matrix such that $AA' = A'A$ and $B = A^{-1}A'$, then BB' equals

(a) $I + B$

(b) I

(c) B^{-1}

(d) $(B^{-1})'$

Q.60 If g is the inverse of a function f and $f'(x) = \frac{1}{1+x^5}$. then $g'(x)$

- (a) $1+x^5$ (b) $5x^4$ (c) $\frac{1}{1+\{g(x)\}^5}$ (d) $1+\{g(x)\}^5$

Q.61 If $\alpha, \beta \neq 0$, and

$$f(n) = \alpha^n + \beta^n \text{ and } \begin{vmatrix} 3 & 1+f(1) & 1+f(2) \\ 1+f(1) & 1+f(2) & 1+f(3) \\ 1+f(2) & 1+f(3) & 1+f(4) \end{vmatrix} = K(1-\alpha)^2(1-\beta)^2(\alpha-\beta)^2 \text{ and then}$$

K is equal to

- (a) $\alpha\beta$ (b) $\frac{1}{\alpha\beta}$ (c) 1 (d) -1

Q.62 Let $f_k(x) = \frac{1}{k}(\sin^k x + \cos^k x)$ where $x \in \mathbb{R}$ and $k \geq 1$. Then $f_4(x) - f_6(x)$ equals

- (a) $\frac{1}{6}$ (b) $\frac{1}{3}$ (c) $\frac{1}{4}$ (d) $\frac{1}{12}$

Q.63 Let α and β be the roots of equation $px^2 + qx + r = p \neq 0$. are in A.P. and $\frac{1}{\alpha} + \frac{1}{\beta} = 4$, then the value of $|\alpha - \beta|$ is

- (a) $\frac{\sqrt{61}}{9}$ (b) $\frac{2\sqrt{17}}{9}$ (c) $\frac{\sqrt{34}}{9}$ (d) $\frac{2\sqrt{13}}{9}$

Q.64 Let the population of rabbits surviving at a time t be governed by the differential equation

$$\frac{dp(t)}{dt} = \frac{1}{2}p(t) - 200. \text{ If } p(0) = 100, \text{ then } p(t) \text{ equals}$$

- (a) $400 - 300e^{t/2}$ (b) $300 - 200e^{-t/2}$ (c) $600 - 500e^{t/2}$ (d) $400 - 300e^{-t/2}$

Q.65 Let C be the circle with centre at $(1, 1)$ and radius - 1. If T is the circle centred at $(0, y)$, passing through origin and touching the circle C externally, then the radius of T is equal to

- (a) $\frac{\sqrt{3}}{\sqrt{2}}$ (b) $\frac{\sqrt{3}}{2}$ (c) $\frac{1}{2}$ (d) $\frac{1}{4}$

Q.66 The area of the region described by $A = \{(x, y) : x^2 + y^2 \leq 1 \text{ and } y^2 \leq 1 - x\}$ is

- (a) $\frac{\pi}{2} + \frac{4}{3}$ (b) $\frac{\pi}{2} - \frac{4}{3}$ (c) $\frac{\pi}{2} - \frac{2}{3}$ (d) $\frac{\pi}{2} + \frac{2}{3}$

Q.67 Let a, b, c and d be non-zero numbers. If the point of intersection of the lines $4ax + 2ay + c = 0$ and $5bx + 2by + d = 0$ lies in the fourth quadrant and its equidistant from the two axes then

- (a) $2bc - 3ad = 0$ (b) $2bc + 3ad = 0$
 (c) $3bc - 2ad = 0$ (d) $3bc + 2ad = 0$

Q.68 Let PS be the median of the triangle with vertices P(2, 2), Q(6, -1) and R(7, 3). The equation of the line passing through (1, -1) and parallel to PS is

- (a) $4x - 7y - 11 = 0$ (b) $2x + 9y + 7 = 0$
 (c) $4x + 7y + 3 = 0$ (d) $2x - 9y - 11 = 0$

Q.69 $\lim_{x \rightarrow 0} \frac{\sin(\pi \cos^2 x)}{x^2}$ is equal to

- (a) $\frac{\pi}{2}$ (b) 1 (c) $-\pi$ (d) π

Q.70 If $X = \{4^n - 3n - 1 : n \in \mathbb{N}\}$ and $Y = \{9(n - 1) : n \in \mathbb{N}\}$, where \mathbb{N} is the set of natural numbers, then $X \cup Y$ is equal to?

- (a) \mathbb{N} (b) $Y - X$ (c) X (d) Y

Q.71 A five digit number divisible by 3 is to be formed using the digits 0, 1, 2, 3, 4 and 5 without repetition. The total number of ways this can be done is

Q.72 The value of $\lim_{x \rightarrow 0} \frac{\int_0^{x^2} \cos^2 t dt}{x \sin x}$ is _____?

Q.73 If $f(x) = \begin{cases} 1 + |x|, & x < 1 \\ |x|, & x \geq -1 \end{cases}$, where $[\cdot]$ denotes the greatest integer function, Then $f(f(-3, 3))$ is _____?

Q.74 The greatest value of a non-negative real number λ for which both the equations $2x^2 + (\lambda - 1)x + 8 = 0$ and $x^2 - 8x + \lambda + 4 = 0$ have real roots is _____?

Q.75 The number of integral values of m, for which the x-coordinate of the point of intersection of the lines $3x + 4y = 9$ and $y = mx + 1$ is also integer is _____?
