A Division of Aggarwal Educare
Aggarwal CLASSES™

JEE (MAIN)

TEST PAPER

SUBJECT : PHYSICS,CHEMISTRY, MATHEMATICS ***TEST CODE : TSJMT214***

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 quetions 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 responce for each question. Filling up more than one responce 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 :

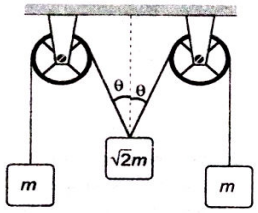
11. Use a BLACK BALL POINT PEN to darken the bubbles on the OMR.
12. Darken the bubble COMPLETELY.
13. Darken the bubbles ONLY IF you are sure of the answer. There is NO WAY to erase or "un- darken" a darkened bubble.

Part A - PHYSICS

Q.1 A projectile is given an initial velocity of $(i + 2j)m/s$ where i is along the ground and j is along the vertical. If $g = 10m/s^2$ then the equation of its trajectory is

(a) $y = x - 5x^2$ (b) $y = 2x - 5x^2$ (c) $4y = 2x - 5x^2$ (d) $4y = 2x - 25x^2$

Q.2 The pulleys and strings shown in the figure are smooth and of negligible mass. For the system to remain in equilibrium, the angle θ should be



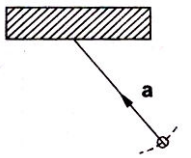
(a) 0^o (b) 30^o (c) 45^o (d) 60^o

Q.3 Which of the following sets have different dimensions?
(a) Pressure, Young's modulus, Stress
(b) Emf, Potential difference, Electric potential
(c) Heat, Work done, Energy
(d) Dipole moment, Electric flux, Elecric field

Q.4 A boat which has a speed of 5 km/h in still water crosses a river of width 1 km along the shortest possible path in 15 min. The velocity of the river water in km/h is

(a) 1 (b) 3 (c) 4 (d) $\sqrt{41}$

Q.5 A simple pendulum is oscillating without damping. When the displacement of the bob is less than maximum, its acceleration vector a is correctly shown in

(a)


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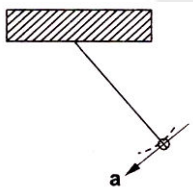

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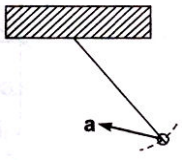

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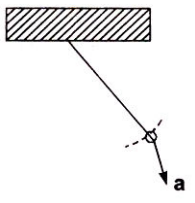
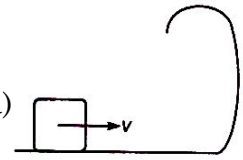
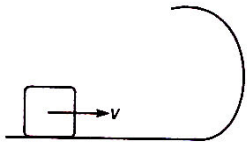
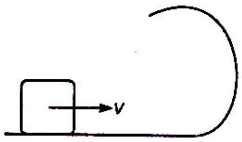
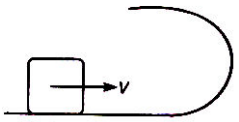


Q.6 A small block is shot into each of the four tracks as shown below. Each of the tracks rises to the same height. The speed with which the block enters the track is the same in all cases. At the highest point of the track, the normal reaction is maximum in

(a) 

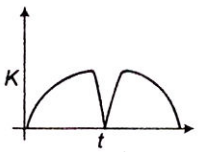
(b) 

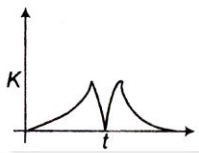
(c) 

(d) 

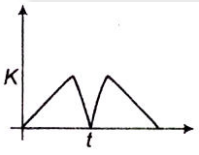
Q.7 Two blocks of masses 10 kg and 4 kg are connected by a spring of negligible mass and placed on a frictionless horizontal surface. An impulse gives a velocity of 14 m/s to the heavier block in the direction of the lighter block. The velocity of the centre of mass is
(a) 30 m/s (b) 20 m/s (c) 10 m/s (d) 5 m/s

Q.8 A tennis ball is dropped on a horizontal smooth surface. It bounces back to its original position after hitting the surface. The force on the ball during the collision is proportional to the length of compression of the ball. Which one of the following sketches described the variation of its kinetic energy K with time t most appropriately? The figures are only illustrative and not to the scale.

(a) 

(b) 

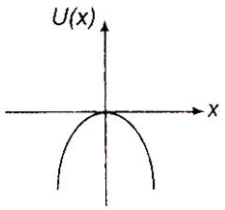
(c) 

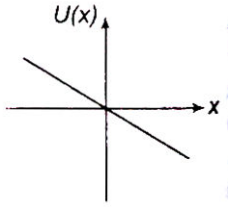
(d) 

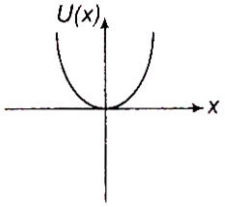
Q.9 A quantity X is given by $\varepsilon_0 L\frac{\Delta V}{\Delta t}$, where is the permittivity of free space, L is a length, ΔV is a potential difference and Δt is a time interval. The dimensional formula for X is the same as that of
(a) resistance (b) charge (c) voltage (d) current

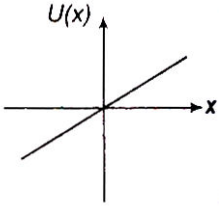
Q.10 A cylinder rolls up an inclined plane, reaches some height and then rolls down (without slipping throught these motions). The directions of the frictional force acting on the cylinder are
(a) up the incline while ascending and down the incline while descending
(b) up the incline while ascending as well as descending
(c) down the incline while ascending and up the incline while descending
(d) down the incline while ascending as well as descending

Q.11 A particle is placed at the origin and a force $F = kx$ is acting on it (where, k is a positive constant). $U(0) = 0$, If the graph of U (x) versus x will be (where, U is the potential energy function).

(a) 

(b) 

(c) 

(d) 

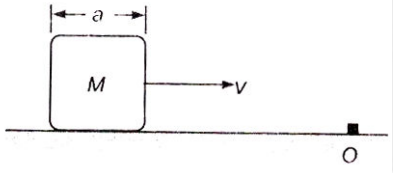
Q.12 The moment of inertia of a uniform cylinder of length l and radius R about its perpendicular bisector is I. What is the ratio l/R such that the moment of inertia is minimum?

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

Q.13 A small block slides without friction down an inclined plane starting from rest. Let s_n be the distance travelled from $t = n-1$ to $t = n$. Then, $\frac{s_n}{s_{n+1}}$ is

(a) $\frac{2n-1}{2n}$ (b) $\frac{2n+1}{2n-1}$ (c) $\frac{2n-1}{2n-1}$ (d) $\frac{2n}{2n+1}$

Q.14 A cubical block of side a moving with velocity v on a horizontal smooth plane as shown. It hits a ridge at point O. The angular speed of the block after it hits O is



(a) $3v/4a$ (b) $3v/2a$ (c) $\sqrt{3}\sqrt{2}\,a$ (d) zero

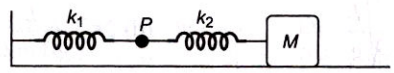
Q.15 A simple pendulum has a time period T_1 when on the earth's surface and T_2 when taken to a height R above the earth's surface, where R is the radius of the earth.
The value of T_2/T_1 is

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

Q.16 Assume tha a drop of liquid evaporates by decreases in its surface energy, so that its temperature remains unchanged. What should be the minimum radius of the drop for this to be possible? The surface tension is T, density of liquid is S and L is its latent heat of vaporisation.

(a) $\frac{\rho L}{T}$ (b) $\sqrt{\frac{T}{\rho L}}$ (c) $\frac{T}{\rho L}$ (d) $\frac{2T}{\rho L}$

Q.17 The mass M shown in the figure oscillates in simple harmonic motion with amplitude A. The amplitude of the point P is



(a) $\frac{k_1 A}{k_2}$ (b) $\frac{k_2 A}{k_1}$ (c) $\frac{k_1 A}{k_1 + k_2}$ (d) $\frac{k_2 A}{k_1 + k_2}$

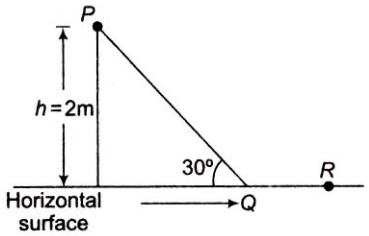
Q.18 $Y(x,t) = \frac{0.8}{\left[(4x + 5t)^2 + 5\right]}$ represents a moving pulse where x and y are in metre and t is in second. Then,
(a) pulse is moving in positive x-direction.
(b) in 2 s it will travel a distance of 2.5 m
(c) its maximum displacement is 0.16 m
(d) it is a symmertric pulse

Q.19 Steam at 100°C is passed into 1.1 kg of water contained in a calorimeter of water equivalent 0.02 kg at 15°C till the temperature of the calorimeter and its contents rises to 80°C.
The mass of the steam condensed in kg is
(a) 0.1230 (b) 0.065 (c) 0.260 (d) 0.135

Q.20 Spherical aberration in athin lens can be reduced by
(a) using a monochromatic light (b) using a doublet combination
(c) using a circular annular mark over the lens (d) increasing the size of the lens

Q.21 The work, function of a substance is 4.0 eV. The longest wavelength of light that can cause photoelectron emission from this substance is approximately?

Q.22 A point particle of mass m, moves along the uniformly rough track PQR as shown in the figure, the coefficient of friction, between the particle and the rough track equals μ . The particle is released from rest, from the point O and it comes to rest at a point R. The energies lost by the ball, over the parts *PQ* and *QR* of the track, are equal to each other, and no energy is lost when particle changes direction from *PQ* to QR. The values of the coefficient of friction μ and the distance $x(= QR)$, are respectively close to?



Q.23 A satellite is launched into a circular orbit of radius R around the earth. A second satellite is launched into an orbit of radius (1.03)R. The period of the second satellite is larger than that of the first one by approximately?

Q.24 A capacitance of 2μF is required in an electrical circuit across a potential difference of 1.0 kV. A large number of 1μF capacitors are available which can withstand a potential difference of not more than 300V.The minimum number of capacitors required to achive this is

Q.25 The molecules of a gas have 5 degrees of freedom. The heat absorbed by the gas if it performs 30 J of work while expanding at constant pressure is_____?

Part - B - CHEMISTRY

Q.26 The hydration energy of Mg^{2+} is larger than that of

(a) Al^{3+} (b) Na^{+} (c) Be^{2+} (d) Mg^{3+}

Q.27 According to kinetic theory of gases, for a diatomic molecule
(a) the pressure exerted by the gas is proportional to mean square velocity of the molecule.
(b) the pressure exerted by the gas is proporational to the root mean velocity of the molecule.
(c) the root mean square velocity of the molecule is inversely proporational to the temperature.
(d) the mean translational kinetic energy of the molecule is propoational to the absolute temperature.

Q.28 When the temperature is increased, surface tension of water
(a) increases (b) decreases
(c) remains constant (d) shows irregular behaviour

Q.29 The following acids have been arranged in the order of decreasing acidic strength. Identify the correct order.
ClOH (I), BrOH (II), IOH (III)
(a)I > II > III (b) II > I > III (c) III > II > I (d) I > III > II

Q.30 $CH_3NH_2(0.1 \text{ mole}, K_b = 5\times10^{-4})$ is added to 0.08 mole of HCl and the solution is diluted to one litre, resulting hydrogen ion concentration is

(a)1.6×10^{-11} (b) 8×10^{-11} (c) 5×10^{-5} (d) 8×10^{-2}

Q.31 Galvanisation is applying a coating of
(a)Cr (b) Cu (c) Zn (d) Pb

Q.32 Which series of reactions correctly represents chemical relations related to iron and its compound?

(a) $Fe \xrightarrow{\text{Dil. } H_2SO_4} FeSO_4 \xrightarrow{H_2SO_4, O_2} Fe_2(SO_4)_3 \xrightarrow{\text{Heat}} Fe$

(b) $Fe \xrightarrow{O_2, \text{Heat}} FeO \xrightarrow{\text{Dil. } H_2SO_4} FeSO_4 \xrightarrow{\text{Heat}} Fe$

(c) $Fe \xrightarrow{Cl_2, \text{Heat}} FeCl_3 \xrightarrow{\text{Heat,air}} FeCl_2 \xrightarrow{Zn} Fe$

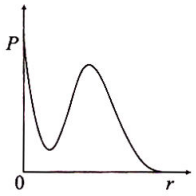
(d) $Fe \xrightarrow{O_2, \text{Heat}} Fe_3O_4 \xrightarrow{CO, 600^\circ C} FeO \xrightarrow{CO, 700^\circ C} Fe$

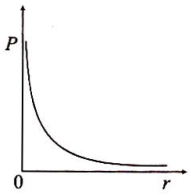
Q.33 The rate constant of a reaction depends on
(a) temperature (b) initial concentration of the reactants
(c) time of reaction (d) extent of reaction

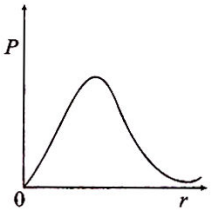
Q.34 The molecular weight of benzoic acid in benzene as determined by depression in freezing point method corresponds to
(a) ionisation of benzoic acid (b) dimerisation of benzoic acid
(c) trimerisation of benzoic acid (d) solvation of benzoic acid

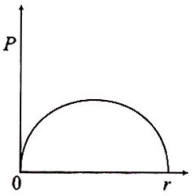
Q.35 If two compounds have the same empirical formula but different molecular formulae, they must have
(a) different percentage composition (b) different molecular weight
(c) same velocity (d) same vapour density

Q.36 P is the probability of finding the 1s electron of hydrogen atom in a spherical shell of infinitesimal thickness, *dr*, at a distance r from the nucleus. The volume of this shell is $4\pi r^2 dr$. The qualitative sketch of the dependence of *P* on *r* is

(a) 

(b) 

(c) 

(d) 

Q.37 According to MO theory,

(a) O_2^+ is paramagnetic and bond order grater than O_2

(b) O_2^+ is paramagnetic and bond order less than O_2

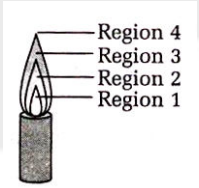
(c) O_2^+ is damagnetic and bond order is less than O_2

(d) O_2^+ is damagnetic and bond order is more than O_2

Q.38 A monoatomic ideal gas undergoes a process in which the ratio of *p* to *V* at any instant is constant and equals to 1. What is the molar heat capacity of the gas.

(a) $\frac{4R}{2}$ (b) $\frac{3R}{2}$ (c) $\frac{5R}{2}$ (d) 0

Q.39 The hottest region of Bunsen flame shown in the figure given below is



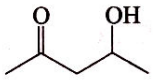
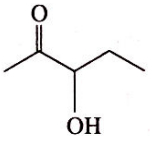
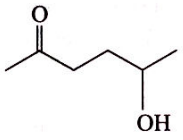
(a) region 2 (b) region 3 (c) region 4 (d) region 1

Q.40 A metal nitrate reacts with KI to give a black precipitate which on addition of excess of KI convert into orange colour solution. The cation of metal nitrate is

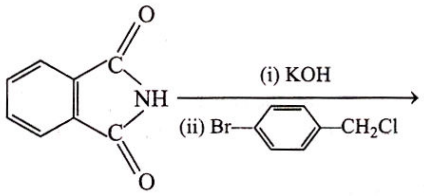
(a) Hg^{2+} (b) Bi^{3+} (c) Sn^{2+} (d) Pb^{2+}

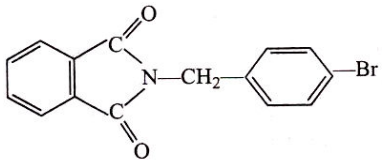
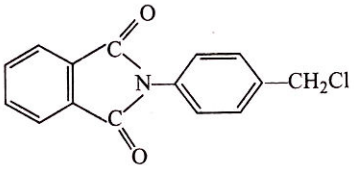
Q.41 The geometry of $Ni(CO)_4$ and $Ni(PPh_3)_2Cl_2$ are
(a) both square planar
(b) tetrahedral and square planar, respectively
(c) both tetrahedral
(d) square planar and tetrahedral, respectively

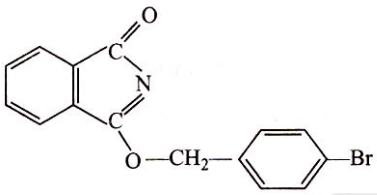
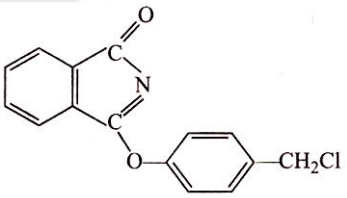
Q.42 Which one of the following will most readily be dehydrated in acidic condition?

(a)  (b)  (c)  (d) 

Q.43 The major product of the following reaction is



(a)  (b) 

(c)  (d) 

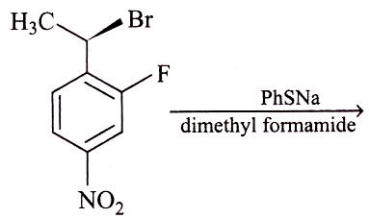
Q.44 In the following sequence of reaction

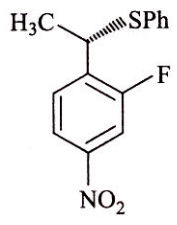
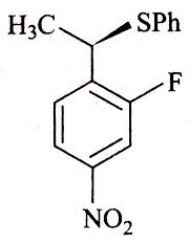
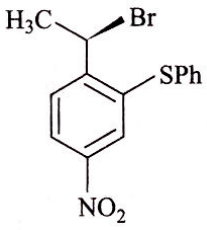
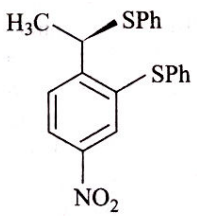
Toluene $\xrightarrow{KMnO_4}$ A $\xrightarrow{SOCl_2}$ B $\xrightarrow[BaSO_4]{H_2/Pd}$ C

(a) C_6H_5COOH (b) $C_6H_5CH_3$

(c) $C_6H_5CH_2OH$ (d) C_6H_5CHO

Q.45 The major product of the following reaction is



(a)  (b)  (c)  (d) 

Q.46 How many chiral compounds are possible on mono chlorination of 2-methyl butane?

Q.47 The molarity of a solution obtained by mixing 750 mL of 0.5 M GCl with 250 mL of 2 M HCl will be?

Q.48 For the coagulation of 100 mL of cadmium sulphide solution, 5 mL of 1 M NaCl is required. Flocculation value of NaCl is____?

Q.49 What volume of 6.0 M H_2SO_4 should be mixed with 10 L of 1.0 M H_2SO_4 to make 20.0 L of 3.0 M H_2SO_4 upon dilution to volume ?

Q.50 Hydrogen has three isotopes, the number of possible diatomic molecules will be?

Part - C - MATHEMATICS

Q.51 If the coefficients of x^3 and x^4 in the expansion of $(1+ax+bx^2)(1-2x)^{18}$ in powers of are both zero, then is equal to

(a) $\left(16, \frac{251}{3}\right)$ (b) $\left(14, \frac{251}{3}\right)$ (c) $\left(14, \frac{272}{3}\right)$ (d) $\left(16, \frac{272}{3}\right)$

Q.52 The number of 3×3 matrices A whose entries are either 0 or 1 and for which the system

$A\begin{vmatrix} x \\ y \\ z \end{vmatrix} = \begin{vmatrix} 1 \\ 0 \\ 0 \end{vmatrix}$ has exactly two distinct solutions, is

(a) 0 (b) 2^9-1 (c) 168 (d) 2

Q.53 If $\int_{\sin x}^{1} t^2 f(t)dt = 1-\sin x, \forall x \in (0,\pi/2)$, then $f\left(\frac{1}{\sqrt{3}}\right)$ is

(a) 3 (b) $\sqrt{3}$ (c) 1/3 (d) None of these

Q.54 $\lim\limits_{x\to\pi/2} \frac{\cot x - \cos x}{(\pi-2x)^3}$ equals

(a) $\frac{1}{24}$ (b) $\frac{1}{16}$ (c) $\frac{1}{8}$ (d) $\frac{1}{4}$

Q.55 Consider an infinite geometric series with first team a and common ratio r. If its sum is 4 and the second term is 3/4, then

(a) $a = 4/7, r = 3/7$

(b) $a = 2,\ r = 3/8$

(c) $a = 3/2, r = 1/2$

(d) $a = 3, r = 1/4$

Q.56 Let $f(x) = \int e^x (x-1)(x-2)dx$. Then, f decreases in the interval

(a) $(-\infty,-2)$ (b) $(-2-1)$ (c) (1, 2) (d) $(2,\infty)$

Q.57 Area of triangle formed by the lines $x+y=3$ and angle bisectors of the pair of straight lines $x^2-y^2+2y=1$ is

(a) 2 sq units (b) 4 sq units (c) 6 sq units (d) 8 sq units

Q.58 The normal at a point P on the ellipse $x^2 + 4y^2 = 16$ meets the X-axis at Q. If M is the mid-point of the line segment PQ, then the locus of M intersects the latusrectum of the given ellipse at the points

(a) $\left(\pm\frac{3\sqrt{5}}{2}, \pm\frac{2}{7}\right)$ (b) $\left(\pm\frac{3\sqrt{5}}{2}, \pm\frac{\sqrt{19}}{4}\right)$

(c) $\left(\pm 2\sqrt{3}, \pm\frac{1}{7}\right)$ (d) $\left(\pm 2\sqrt{3}, \pm\frac{4\sqrt{3}}{7}\right)$

Q.59 If $\arg(z) < 0$, then $\arg(-z) - \arg(z)$ equals

(a) π (b) $-\pi$ (c) $-\pi/2$ (d) $\pi/2$

Q.60 For the three events A, B and C, P (exactly one of the events A or B occurs) = P (exactly one of the events B or C occurs) = (exactly one of the events C or A occurs)

= P and P (all the three events occurs simultaneously) = p^2, where $0 < p < \frac{1}{2}$.

Then, the probability of atleast one of the three events A, B and C occurring is

(a) $\frac{3p + 2p^2}{2}$ (b) $\frac{p + 3p^2}{4}$ (c) $\frac{p + 3p^2}{2}$ (d) $\frac{3p + 2p^2}{4}$

Q.61 The equation of the common tangent touching the circle $(x-3)^2 + y^2 = 9$ and the parabola $y^2 = 4x$ above the X-axis is

(a) $\sqrt{3}y = 3x + 1$ (b) $\sqrt{3}y = -(x + 3)$

(c) $\sqrt{3}y = x + 3$ (d) $\sqrt{3}y = -(3x + 1)$

Q.62 Let $P(a\sec\theta, b\tan\theta)$ and $Q(a\sec\phi, b\tan\phi)$, where $\theta + \phi = \frac{\pi}{2}$, be two points on the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$.

If (h, k) is the point of the intersection of the normals at P and Q, then k is equal to

(a) $\frac{a^2 + b^2}{a}$ (b) $-\left(\frac{a^2 + b^2}{a}\right)$ (c) $\frac{a^2 + b^2}{b}$ (d) $-\left(\frac{a^2 + b^2}{b}\right)$

Q.63 The sides of a traingle are in the ratio $1 : \sqrt{3} : 2$, then the angles of the triangle are in the ratio

(a) 1 : 3 : 5 (b) 2 : 3 : 2 (c) 3 : 2 : 1 (d) 1 : 2 : 3

Q.64 Two adjacent sides of a parallelogram ABCD are given by The side AD is rotated by

$\overrightarrow{AB} = 2\hat{i} + 10\hat{j} + 11\hat{k}$ and $\overrightarrow{AD} = -\hat{i} + 2\hat{j} + 2\hat{k}$.. an acute angle α in the plane of the parallelogram so that AD becomes

AD' If AD' makes a right angle with the side AB, then the cosine of the angle is given by

(a) $\frac{8}{9}$ (b) $\frac{\sqrt{17}}{9}$ (c) $\frac{1}{9}$ (d) $\frac{4\sqrt{5}}{9}$

Q.65 If $f:[0,\infty)\to[0,\infty)]$ and $f(x)=\frac{x}{1+x'}$ then f is

(a) one-one and onto (b) one-one but not onto
(c) onto but not one-one (d) one-one and onto

Q.66 The area (in sq units) bounded by the curves $y=\sqrt{x}, 2y-x+3=0,$ X-axis and lying in the first quadrant, is

(a) 9 (b) 6 (c) 18 (d) $\frac{27}{4}$

Q.69 The smallest postive root of the equation $x-x=0$ lies in

(a) $\left(0,\frac{\pi}{2}\right)$ (b) $\left(\frac{\pi}{2},\pi\right)$ (c) $\left(\pi,\frac{3\pi}{2}\right)$ (d) $\left(\frac{3\pi}{2},2\pi\right)$

Q.70 Two circles $x^2+y^2=6$ and $x^2+y^2-6x+8=0$ are given. Then the equation of the circle through their points of intersection and the point (1, 1) is

(a) $x^2+y^2-6x+4=0$ (b) $x^2+y^2-3x+1=0$
(c) $x^2+y^2-4y+2=0$ (d) None of the above

Q.71 If $x\,dy=y(dx+ydy)$, $y(1)=1$ and $y(x)>0$. then, $y(-3)$ is equal to ?

Q.72 The letters of the word COCHIN are permuted and all the permutation are arranged in an alphabetical order as in an English dictionary. The number of words that appear before the word COCHIN, is_____?

Q.73 If $P=(x,y)$, $F_1=(3,0), F_2=(-3,0)$ and $16^2+25y^2=400$, then PF_1+PF_2 equals

Q.74 Let $a_1,a_2,...,a_{10}$ be in Ap and h_1,h_2 equal to....,
h_{10} *be* in HP. If $a_1=h_1=2$ and $a_{10}=3$, then a_4h_7 is

Q.75 Total number of solutions of $|\cot x|=\cot x+\frac{1}{\sin x}$, $x\in[0,3\pi]$ is equal to

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ROUGH WORK