JEE (MAIN)

TEST PAPER

SUBJECT : PHYSICS,CHEMISTRY, MATHEMATICS   **TEST CODE : TEST** PAPER-2

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 Electric conduction in a semiconductor takes place due to
(a) Electrons only (b) Holes only
(c) Both electrons and holes (d) Neither electrons nor holes

Q.2 Two bodies at different temperatures are mixed in a calorimeter. Which of the following quantities remain conserved ?
(a) Sum of the temperature of the two bodies
(b) Total heat of the two bodies
(c) Total internal energy of the two bodies
(d) Internal energy of each body

Q.3 The dimensional formula for torque is $[ML^2T^{-2}]$, same as that of work or energy, its proper SI unit is
(a) Must be joule only (b) Either N-m or joule
(c) N-m (d) None of the above

Q.4 An alternating current having peak value 14 A is used to heat a metal wire. To produce the same heating effect, a constant current i can be used where i is
(a) 14 A (b) about 20 A (c) 7 A (d) about 10 A

Q.5 The statement " current is defined as rate of flow of electrons through any cross-section" is

(a) Always true (b) Always false
(c) True in some cases (d) None of these

Q.6 Which of the following has more heat ?
(a) Sun (b) A hot cup of tea
(c) A red hot iron (d) Question is irrevalant

Q.7 The graph between stopping potential versus frequency is given for two different metals. Then choose the most appropriate statement.
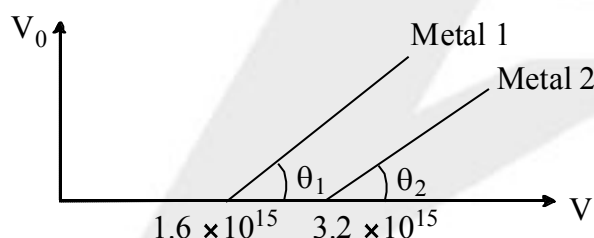
(a) $v_{01} = v_{02}$ and $\theta_1 = \theta_2$ (b) $v_{01} > v_{02}$ and $\theta_1 > \theta_2$

(c) $v_{01} < v_{02}$ and $\theta_1 < \theta_2$ (d) $v_{01} < v_{02}$ and $\theta_1 = \theta_2$

Q.8 A charged solid conductor having a cavity is a shown in figure. If a charg +q is placed asymmetrically within the cavity, then charge induced on outer surface of conductor would be
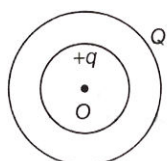

(a) -q (b) +q (c) q - Q (d) Q - q

Q.9   A body of mass m is moving in a circle of radius r with a constant speed v. The force on the body is $\dfrac{mv^2}{r}$ and is directed towards the centre. What is the work done by this force in moving the body over half the circumference of the circle ?

(a) $\dfrac{mv^2}{r} \times \pi r$ (b) Zero   (c) $\dfrac{mv^2}{r^2}$ (d) $\dfrac{\pi r^2}{mv^2}$

Q.10   A solid sphere of steel has been dipped in a liquid. If the temperature is increased, then the force of buoyancy will
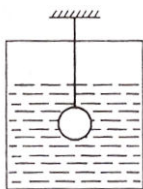

(a) Increase   (b) Decrease
(c) May increase or Decrease   (d) Will remain constant

Q.11   The muscles of a normal eye are least strained when the eye is focused on an object
(a) Far away from the eye   (b) Very close to the eye
(c) At about 25 cm from the eye   (d) At about 1 m from the eye.

Q.12   A potentiometer wire AB shown in figure is 40 cm long. Where should the free end of the galvanometer be connected on AB so that the galvanometer may show zero deflection ?
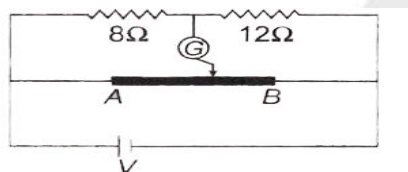
(a) 16 cm from B   (b) 20 cm from B   (c) 16 cm from A   (d) 20 cm from A

Q.13   The magnetic field existing in a region is given by $B = B0 \; [1 + x/l] \; \hat{k}$, A square loop of edge l and carrying a current, I is placed with its edges parallel to the x - y axis. Find the magnitude of the net magnetic force experienced by the loop.
(a) $3l\mathrm{B}_0 I$ (b) $2l\mathrm{B}_0 I$ (c) $l\mathrm{B}_0 I$ (d) None of the above

Q.14   A body cool from 100^0C to 90^0C in 20 min, it will cool down from 110^0C to 100^0C in [assume same surroundings]
(a) 20 min   (b) Less than 20 min
(c) More than 20 min   (d) 30 min

Q.15 N moles of an ideal diatomic gas are in a cylinder at temperature T. If we supply some heat to it, then $N/3$ moles of gas dissociates into atoms while temperature remains constant, Heat supplied to the gas is
(a) $NRT/6$ (b) 5 $NRT/2$ (c) 5.6 NRT (d) 8 $NRT/3$

Q.16   A point source of light is taken away from the experimental set up of photoelectric effect, then which is the most appropriate statement ?
(a) Saturation photo current remains same, while stopping potential increases
(b) Saturation photo current and stopping potential both decreases
(c) Saturation photo current decreases while stopping potential remains same
(d) Saturation photo current decreases and stopping potential increases.

Q.17 A man in an empty swimming pool has a telescope focused at 4'O clock sun. When the swimming pool is filled with water, the man (now inside the water with his telescope undisturbed) observes the setting sun. Find the refrective index of water, if sun rises and sets at 6'O clock.

(a) $\dfrac{4}{3}$ (b) $\dfrac{2}{\sqrt{3}}$ (c) $\dfrac{8}{5}$ (d) $\dfrac{2}{5}$

Q.18 A pistol fires a 3g bullet with a speed of 400 m/s. The pistol barrel is 13 cm long. How much energy is given to the bullet ? Also, calculate the average force acted on the bullet while it was moving down the barrel.
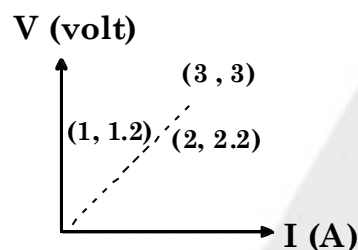(a) 140 J, 1846 N   (b) 240 J, 184.6 N
(c) 240 J, 1846 N   (d) 240 J, 1746 N

Q.19 For the given combination of gates, if the logic states of inputs A, B, C are as follows A = B = C = 0 and A = B = 1,   C = 0, then the logic states of output D are
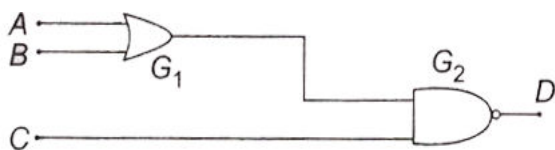
(a) 0, 0   (b) 0, 1   (c) 1, 0   (d) 1, 1

Q.20 In the measurement of resistance of a wire using Ohm's law, the plot between V and I is drawn as shown.

The resistance of the wire is
(a) $0.833\,\Omega$ (b) $0.9\,\Omega$
(c) $1\,\Omega$ (d) None of these

Q.21 The equation of motion for a mass at the end of particular spring is y = 0.30 cos 0.50 t metre. Find the displacement, velocity and acceleration of the mass at t = 0.

Q.22 A pole standing in a pond stands 1m above the water surface, the pond is 2m deep. What is the length of the shadow thrown by the pole on the bottom of the pond, if the sun is 30^0 over the horizon ? [Refractive index for water is 4/3]

Q.23 The electric field associated with a monochromatic beam becomes zero 2.4×10^{15} times per second. Find the maximum KE of the photoelectrons when this light falls on a metal surface whose work function is 2 eV.

Q.24 The average kinetic energy of a gas molecule at 27^0C is 6.21×10^{-21} J. Its average kinetic energy at 227°C will be ?

Q.25 In meter bridge the balancing length from left and when standard resistance of 1 Ω is in right gap is found to be 20 cm. The value of unknown resistance is?
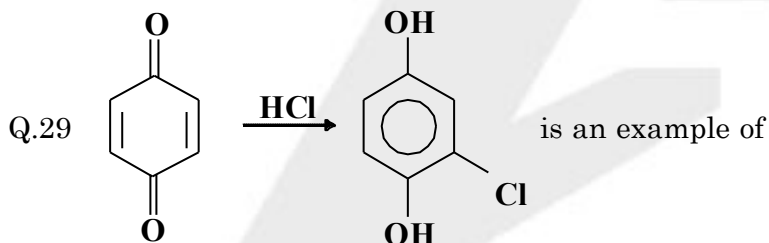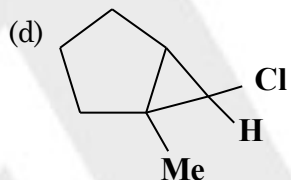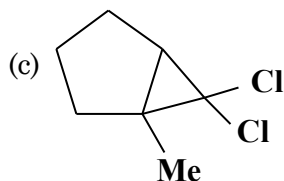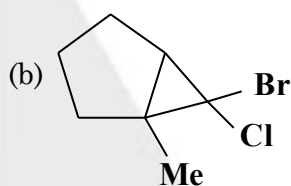
Part - B - CHEMISTRY

Q.26 $RCONH_2 + 4\,NaOH + Br_2 \longrightarrow RNH_2 + 2NaBr + Na_2CO_3 + 2H_2O$
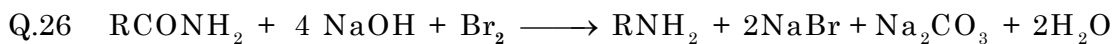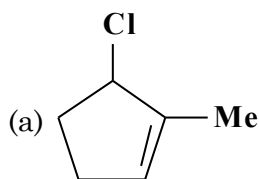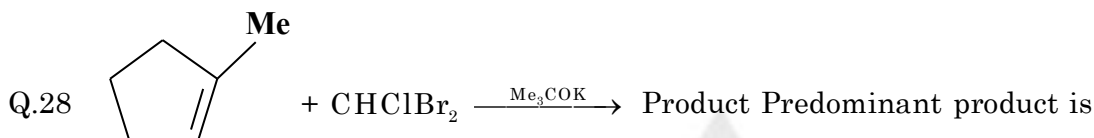
Reaction is said
(a) Hofmann-bromamide reaction   (b) Schmidt reaction
(c) Curtius reaction   (d) Beckmann reaction

Q.27   Which of the following does not contain $P-O-P$ bond ?
(a) Isohypophosphoric acid   (b) Diphosphorous acid
(c) Diphosphoric acid   (d) Hypophosphoric acid

Q.28   + CHClBr$_2$ $\xrightarrow{\text{Me}_3\text{COK}}$ Product Predominant product is

(a)

(b)

(c)

(d)

Q.29   is an example of

(a) 1, 2 addition of HCl followed by tautomerism
(b) 1, 2 addition followed by reaction
(c) 1, 4 addition followed by tautomerism
(d) 1, 4 addition followed by oxidation

Q.30   At 20^0C and 1.00 atm partial pressure of hydrogen, 18 mL of hydrogen, measured at STP, dissolves in 1L of water. If water at 20^0C is exposed to a gaseous mixture having a total pressure of 1400 Torr (excluding the vapour pressure of water) and containing 68.5% H$_2$ by volume, find the volume of H$_2$, measured at STP, which will dissolve in 1L of water
(a) 18 mL   (b) 12 mL   (c) 23 mL   (d) 121 mL

Q.31   Which of the following reaction takes place at the cathode in the electrolytic cell used for the cell extraction of aluminium from alumina ?
(a) $12\,F^- \rightarrow 12F + 12e^-$ (b) $Al^{3+} + 3e^- \rightarrow Al$
(c) $2C(s) + O_2 \rightarrow 2CO(g)$ (d) $2Al_2O_3 + 12F \rightarrow 4Al^{3+} + 3O_2 + 12F^-$

Q.32   Which of the following molecule is optically inactive ?

(a)

(b)

(c)

(d)
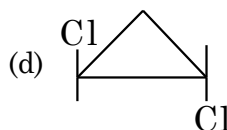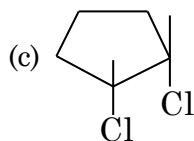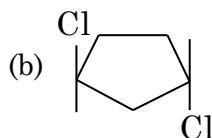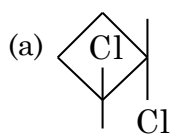
Q.33 When concentrated solution of KCl is shaken with wood charcoal, concentration decreases . This is
(a) Chemisortion
(b) Positive adosorption
(c) Negative adsorption
(d) Occlusion

Q.34 The addition of sodium acetate in the solution of acetic acid
(a) Produces anhydride
(b) Increases acetate concetration
(c) Increases undissociated acid
(d) Increases K_a (CH_3COOH)

Q.35 Mark out the most nucleophilic species at aliphatic trigonal carbon during substitution
(a) H_2O
(b) NH_3
(c) H_2S
(d) H_2Se

Q.36 Which of the following does not undergo benzoin condensation ?
(a) Benzene carbaldehyde
(b) p-toluene carbaldehyde
(c) Phenylethanal
(d) 4-methoxybenzaldehyde

Q.37 Which of the following combination of solute would result in the formation of a buffer solution ?
(a) HCl + NaCl
(b) HCl + $HC_2H_3O_2$
(c) NaOH + $HC_2H_3O_2$ (1 : 1 ratio) respectively
(d) NH_3 + HCl (2 : 1 ratio) respectively.

Q.38 A compound X on heating gives a colourless gas. The residue is dissolved in water to obtain Y. Excess CO_2 is passed through aqueous solution of Y when Z is formed, Z on gentle heating gives back X. The compound X is
(a) $NaHCO_3$
(b) Na_2CO_3
(c) $Ca(HCO_3)_2$
(d) $CaCO_3$

Q.39 To observe the effect of concentration on the conductivity, electrolytes of different nature were taken in two vessels A and B. ' A' contains weak electrolyte NH_4OH and B contains strong electrolyte NaCl. In both container concentration of respective electrolyte was increased and conductivity observed.
(a) In A conductivity increase, In B conductivity decreases
(b) In A conductivity decreases, while in B conductivity increases
(c) In both A and B conductivity increases
(d) In both A and B conductivity decreases.

Q.40 The correct IUPAC name of complex Fe $(C_5H_5)_2$ is
(a) Cyclopentadienyl iron (II)
(b) Bis (cyclopentadienyl) iron (II)
(c) Dicyclopentadienyl ferrate (II)
(d) Ferrocene

Q.41 An ore of tin containing $FeCrO_4$ is concentrated by
(a) Froth floatation process
(b) Magnetic separation method
(c) Electrostatic method
(d) Gravity separation method

Q.42 AgCl is colourless whereas AgI is yellow because of
(a) Ag^+ possess 18 electrons shell to screen the nuclear charge
(b) Ag^+ shows pseudo inert gas configuration

(c) distortion of I^- is more pronounced then Cl^- ion
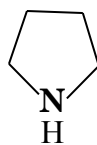
(d) existance of d-d transition

Q.43 Which of the following is the correct order of basicity for these molecules ?

N	N	N	NH_3
	H	H	
	I	II	III
IV			
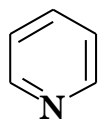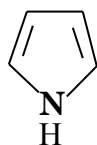
(a) IV > II > I > III   (b) III > IV > I > II

(c) I > IV > III > II   (d) III > I > II > IV

Q.44 The salt of which one of the following weak acids will be the most hydrolysed ?

(a) HA : $K_a = 1 \times 10^{-8}$ (b) HB : $K_a = 2 \times 10^{-6}$

(c) HC : $K_a = 3 \times 10^{-8}$ (d) HD : $K_a = 4 \times 10^{-10}$

Q.45 When 2g of a gaseous substance A is introduced into an initially evacuated flask at 25^0C, the pressure was found to be 1.0 atm. 3 g of another gaseous substance B is added to it at the same temperature and pressure. The final pressure is found to be 1.5 atm. Assuming ideal gas behaviour, which of the following is the correct ratio of molecular weight of A and B ?

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

Q.46 Molar conductance of a 1.5 M solution of an electrolyte is found to be 138.9 S cm^2. The specific conductance of this solution is_____?

Q.47 In a certain polluted atmosphere containing O_3 at a steady state concentration of 2.0×10^{-8} mol / L , the hourly production of O_3 by all sources was estimated as 7.2×10^{-15} mol / L, If the only mechanism for the destruction of O_3 is the second order reaction $2O_3 \longrightarrow 3O_2$. What is the rate constant for the destruction reaction ?

Q.48 $MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O \ \ E^0 = 1.51V$

$MnO_2 + 4H^+ + 2e^- \longrightarrow Mn^{2+} + 2H_2O \ \ E^0 = 1.23\,V$

$E^0_{MnO_4^-} \mid MnO_2$ is

Q.49 A litre of CO_2 gas at 15^0C and 1.00 atm dissolves in 1.00 L of water at the same temperature when the pressure of CO_2 is 1.00 atm. Compute the molar concentration of CO_2 in a solution over which the partial pressure of CO_2 is 150 Torr at this temperature

Q.50 The vapour pressure of pure liquid solvent A is 0.80 atm. When a non- volatile substance B is added to the solvent, it's vapour pressure drops to 0.60 atm. What is the mole-fraction of component B in the solution ?

Part - C - MATHEMATICS

Q.51 The locus of the point z satisfying Re $\left(\dfrac{1}{z}\right)$ = k, Where k is a non-zero real number, is

(a) A straight line   (b) A circle
(c) An ellipse   (d) A hyperbola

Q.52 The distance between the origin and the tangent to the curve $y = e^{2x} + x^2$ drawn at the point $x = 0$, is

(a) $\dfrac{1}{\sqrt{5}}$ (b) $\dfrac{2}{\sqrt{5}}$ (c) $-\dfrac{1}{\sqrt{5}}$ (d) $\dfrac{2}{\sqrt{3}}$

Q.53 If $\dfrac{3\pi}{2} \le x \le \dfrac{5\pi}{2}$, then $\sin^{-1}(\sin x)$ is equal to

(a) x (b) $x - 2\pi$ (c) $2\pi - x$ (d) $-x$

Q.54 $\displaystyle\int \cos^3 x \; e^{\log(\sin x)} \, dx$ is equal to

(a) $-\dfrac{\sin^4 x}{4} + C$ (b) $-\dfrac{\cos^4 x}{4} + C$ (c) $\dfrac{e^{\sin x}}{4} + C$ (d) None of these

Q.55 The area of the quadrilateral formed by the tangents at the end points of latusrectum to the ellipse $\dfrac{x^2}{9} + \dfrac{y^2}{5} = 1$ is

(a) $\dfrac{27}{4}$ sq units   (b) 9 sq units   (c) $\dfrac{27}{2}$ sq units   (d) 27 sq units

Q.56 It is known that $\displaystyle\sum_{r=1}^{\infty} \dfrac{1}{(2r-1)^2} = \dfrac{\pi^2}{8}$, then $\displaystyle\sum_{r=1}^{\infty} \dfrac{1}{r^2}$

(a) $\dfrac{\pi^2}{24}$ (b) $\dfrac{\pi^2}{3}$ (c) $\dfrac{\pi^2}{6}$ (d) None of these

Q.57 If The sum of the roots of the quadratic equation $ax^2 + bx + c = 0$ $(a,b,c \ne 0)$ is equal to sum of square of their reciprocals, then $\dfrac{c}{a}, \dfrac{a}{b}, \dfrac{b}{c}$ are in

(a) AP   (b) GP   (c) AGP   (d) None of these

Q.58 The shortest distance between the lines $r = (4\hat{i} - \hat{j}) + \lambda\,(\hat{i} + 2\hat{j} - 3\hat{k})$ and

$r = (\hat{i} - \hat{j} + 2\hat{k}) + \mu\,(2\hat{i} + 4\hat{j} - 5\hat{k})$ is

(a) $\dfrac{6}{5}$ (b) $\dfrac{1}{\sqrt{5}}$ (c) $\dfrac{6}{\sqrt{5}}$ (d) None of these

Q.59 The number of tangents to the curve $x^{3/2} + y^{3/2} = a^{3/2}$, where the tangents are equally inclined to the axes, is

(a) 2   (b) 1   (c) 0   (d) 4

Q.60   Out of 800 boys in a school, 224 played cricket, 240 played hockey and 336 played basketball of the total, 64 played both basketball and hockey, 80 played cricket and basketball and 40 played cricket and hockey, 24 played all the three games. The number of boys who did not play any game is
(a) 216   (b) 240   (c) 128   (d) 160

Q.61   The area of the region bounded by the curves $y = 2^x$, $y = 2x - x^2$ and $x = 0$ is

(a) $\left(\dfrac{3}{\log 2} - \dfrac{4}{3}\right)$ sq unit

(b) $\left(\dfrac{3}{\log 2} + \dfrac{4}{3}\right)$ sq unit

(c) $\left(\dfrac{1}{\log 2} - \dfrac{4}{3}\right)$ sq unit

(d) None of these

Q.62   The value of $\int_0^{1/2} \sin^{-1}\left(\dfrac{1}{x}\right) dx$ is

(a) $\pi/2$ (b) $\pi/4$ (c) $-\pi/2$ (d) None of these

Q.63   Given that the equation $z^2 + (p+iq)z + r + is = 0$, where p, q, r, s are real has non-zero root, then.
(a) $pqr = r^2 + p^2 s$

(b) $prs = q^2 + r^2 p$

(c) $qrs = p^2 + s^2 q$

(d) $pqs = s^2 + q^2 r$

Q.64   If a, b, c are the sides of a triangle, then $\dfrac{1}{b+c}, \dfrac{1}{c+a}, \dfrac{1}{a+b}$ are also the sides of the triangle, is
(a) Always true

(b) Sometimes true

(c) Cannot be discussed

(d) Never true

Q.65   The solution of the differential equation $xdy - ydx = \sqrt{x^2 + y^2}\, dx$ is
(a) $x + \sqrt{x^2 + y^2} = Cx^2$

(b) $y - \sqrt{x^2 + y^2} = Cx$

(c) $x - \sqrt{x^2 + y^2} = Cx$

(d) $y + \sqrt{x^2 + y^2} = Cx^2$

Q.66 $\lim\limits_{x\to 1} \dfrac{\sqrt{1 - \cos 2(x-1)}}{x-1}$ is equal to

(a) exists and it equal $\sqrt{2}$

(b) exists and it equals $-\sqrt{2}$

(c) does not exist becuase $x - 1 \to 0$

(d) does not exist because left hand limt is not equal to right hand limit.

Q.67   If $a > 2\, b > 0$, then positive value of m for which $y = mx - b\sqrt{1 + m^2}$ is a common tangent to $x^2 + y^2 = b^2$ and $(x-a)^2 + y^2 = b^2$, is

(a) $\dfrac{2b}{\sqrt{a^2 - 4b^2}}$

(b) $\dfrac{\sqrt{a^2 - 4b^2}}{2b}$

(c) $\dfrac{2b}{a-2b}$

(d) $\dfrac{b}{a-2b}$

Q.68 If $a_r > 0$, $r \in N$ and $a_1, a_2 \ldots \ldots a_{2n}$ are in AP, then

$$\dfrac{a_1 + a_{2n}}{\sqrt{a_1} + \sqrt{a_2}} + \dfrac{a_2 + a_{2n-1}}{\sqrt{a_2} + \sqrt{a_3}} + \dfrac{a_3 + a_{2n-2}}{\sqrt{a_3} + \sqrt{a_4}} + \ldots + \dfrac{a_n + a_{n+1}}{\sqrt{a_n} + \sqrt{a_{n+1}}} \text{ is equal to}$$

(a) $n-1$

(b) $\dfrac{n(a_1 + a_{2n})}{\sqrt{a_1} + \sqrt{a_{n+1}}}$

(c) $\dfrac{n-1}{\sqrt{a_1} + \sqrt{a_{n+1}}}$

(d) None of these

Q.69 A flag is standing vertically on a tower of height b on a point at a distance a from the foot of the tower, the flat and the tower subtend equal angles, The height of the flag is

(a) $b \cdot \dfrac{a^2 + b^2}{a^2 - b^2}$

(b) $a \cdot \dfrac{a^2 - b^2}{a^2 + b^2}$

(c) $b \cdot \dfrac{a^2 - b^2}{a^2 + b^2}$

(d) $a \cdot \dfrac{a^2 + b^2}{a^2 - b^2}$

Q.70 If a vertex of a triangle is (1 ,1) and the mid-points of two sides through this vertex are (-1, 2) and (3, 2), then the centroid of the triangle is

(a) $\left(\dfrac{1}{3}, \dfrac{7}{3}\right)$

(b) $\left(1, \dfrac{7}{3}\right)$

(c) $\left(-\dfrac{1}{3}, \dfrac{7}{3}\right)$

(d) $\left(-1, \dfrac{7}{3}\right)$

Q.71 The circumcentre of the triangle whose vertices are $(-2, -3)$, $(-1, 0)$, $(7, -6)$, is____?

Q.72 If $\cos \dfrac{\pi}{7}$, $\cos \dfrac{3\pi}{7}$, $\cos \dfrac{5\pi}{7}$ are the roots of the equation $8x^3 - 4x^2 - 4x + 1 = 0.$ then find the

value of $\sec \dfrac{\pi}{7} + \sec \dfrac{3\pi}{7} + \sec \dfrac{5\pi}{7}$.

Q.73 If P $= \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 4 \\ 3 & 4 & 5 \end{bmatrix} \begin{bmatrix} -1 & -2 \\ -2 & 0 \\ 0 & -4 \end{bmatrix} \begin{bmatrix} -4 & -5 & -6 \\ 0 & 0 & 1 \end{bmatrix}$, then P_{22} is equal to ?

Q.74 The number of arrangements of the letters of the word BANANA in which the two N's do not appear adjacently, is____?

Q.75 If 25% of the items are less than 20 and 25% are more than 40, the quartile deviation is____?

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