SHIKSHA CLASSES, BHANDARA

TEST-3

CHEMISTRY , PHYSICS, MATHEMATICS

Time : - 3 Hours **Max. Marks:- 300** **Date : .....**

INSTRUCTIONS :

1. The test is of 3 hours duration.
2. The Test Booklet consists of 90 questions. The maximum marks are **300.**
3. There are three parts in the question paper A, B, C consisting of Chemistry, Physics and Mathematics having **30questions** in each part of equal weightage. **20 questions** will be **MCQs** and **10 questions** (**ATTEMPT ANY FIVE QUESTIONS OUT OF 10**)will have answer to be filled as **numerical value**.
   Marking Scheme for MCQs
   Correct Answer Four mark (+4), Incorrect Answer Minus one mark (–1), Unanswered No mark (0)
   Marking Scheme for questions for which answer is a **Numerical value**
   Correct Answer Four mark (+4), Incorrect Answer No mark (0), Unanswered No mark (0)
4. 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.

SYLLABUS

CHEMISTRY : CLASSIFICATION OF ELEMENTS AND PERIODICITY IN PROPERTIES, HYDROGEN, s - BLOCK ELEMENTS, p - BLOCK ELEMENTS - GROUP 13 AND GROUP 14.

PHYSICS : THERMODYNAMICS, KINETIC THEORY OF GASES AND HEAT TRANSFER

MATHEMATICS : TRIGONOMETRIC FUNCTIONS & EQUATIONS, STRAIGHT LINE, CIRCLE

The expert in anything was once a beginner.

The best way to predict the future is to create it.

Name : .....

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Roll No. .....

PART A – CHEMISTRY

SECTION - 1 (Q.1 - Q.20)

Each question has FOUR options (1), (2), (3) and (4). ONLY ONE of these four options is correct.

Q.1 Correct order of acidic strength is :

(1) $Cl_2O_7 > SO_3 > P_4O_{10}$

(2) $CO_2 > N_2O_5 > SO_3$

(3) $Na_2O > MgO > Al_2O_3$

(4) $K_2O > CaO > MgO$

Q.2 Consider the following four elements which are represented according to long form of periodic table -

	Y	
W	X	Z

Here W, Y and Z are left, up & right elements with respect to the element 'X' 'Y' belongs to 16th group and 2nd period. Then according to given information the incorrect statement regarding given element is

(1) Maximum electronegativity : Y

(2) Maximum catenation property : X

(3) Maximum electron affinity : Z

(4) Y Exhibits maximum electron affinity

Q.3 The bond dissociation energy of B–F in BF_3 is 646 kJ mol^{-1} whereas that of C-F in CF_4 is 515 kJ mol^{-1}. The correct reason for higher B-F bond dissociation energy as compared to that of C-F is

(1) Significant pπ – pπ interaction between B and F in BF_3 whereas there is no possibility of such interaction between C and F in CF_4.

(2) Lower degree of pπ – pπ interaction between B and F in BF_3 than that between C and F in CF_4

(3) Smaller size of B atom as compared to that of C atom

(4) Stronger bond between B and F in BF_3 as compared to that between C and F in CF_4

Q.4 The second Ionisation energy of the following elements follows the order

(1) Zn > Cd < Hg (2) Zn > Cd > Hg

(3) Cd > Hg < Zn (4) Zn < Cd < Hg

Q.5 'CH_4' gas is obtained in :-

(a) Hydrolysis of Al_4C_3

(b) Hydrolysis of Be_2C

(c) Hydrolysis of Mg_2C_3

(d) Hydrolysis of CaC_2

(1) only a, b, c (2) only a, b

(3) only a, c (4) only b, c, d

Q.6 100 mL of a water sample contains 0.81 g of calcium bicarbonate and 0.73 of magnesium bicarbonate. The hardness of this water sample expressed in terms of equivalents of $CaCO_3$ is:

(Molar mass of calcium bicarbonate is 162gmol^{-1} and magnesium bicarbonate is 146 gmol^{-1})

(1) 1,000 ppm (2) 10,000 ppm

(3) 100 ppm (4) 5,000 ppm

Q.7 The element that shows greater ability to form pπ-pπ multiple bonds, is :

(1) Si (2) Ge

(3) Sn (4) C

Q.8 The total number of isotopes of hydrogen and number of radioactive isotopes among them, respectively, are :

(1) 2 and 0 (2) 3 and 2

(3) 3 and 1 (4) 2 and 1

Q.9 The INCORRECT statement is :

(1) Lithium is least reactive with water among the alkali metals.

(2) LiCl crystallises from aqueous solution as $LiCl.2H_2O$.

(3) Lithium is the strongest reducing agent among the alkali metals.

(4) $LiNO_3$ decomposes on heating to give $LiNO_2$ and O_2.

SPACE FOR ROUGH WORK

Q.10 The group number, number of valence electrons, and valency of an element with atomic number 15, respectively, are
(1) 16, 5 and 2 (2) 16, 6 and 3
(3) 15, 5 and 3 (4) 15, 6 and 2

Q.11 C_{60}, an allotrope of carbon contains :
(1) 20 hexagons and 12 pentagons.
(2) 12 hexagons and 20 pentagons.
(3) 18 hexagons and 14 pentagons.
(4) 16 hexagons and 16 pentagons.

Q.12 A compound A is used in preparation of washing soda to recover ammonia in Solvay's process. When CO_2 is bubbled through an aqueous solution of A, the solution turns milky. It is used in white washing due to disinfectant nature. What is the chemical formula of A ?
(1) $Ca(HCO_3)_2$ (2) CaO
(3) $Ca(OH)_2$ (4) $CaCO_3$

Q.13 Which of the following salt is insoluble in water
(1) $CuSO_4$ (2) $CdSO_4$
(3) $PbSO_4$ (4) $Bi_2(SO_4)_3$

Q.14 The species that does not contain peroxide ion is
(1) PbO_2 (2) H_2O_2
(3) SrO_2 (4) BaO_2

Q.15 The critical temperature of water is higher than that of O_2 because H_2O molecule has
(1) Fewer electrons than oxygen
(2) Two covalent bonds
(3) V-shape
(4) Dipole moment

Q.16 CO_2 gas along with solid (Y) is obtained when sodium salt (X) is heated. (X) is again obtained when CO_2 gas is passed (X) and (Y) are –
(1) Na_2CO_3, Na_2O (2) Na_2CO_3, NaOH
(3) $NaHCO_3$, Na_2CO_3 (4) Na_2CO_3, $NaHCO_3$

Q.17 Identify the correct statement –
(1) The percentage of calcium is lower in gypsum in comparison to plaster of Paris.
(2) Gypsum is not a natural product. It is obtained by heating of plaster of Paris.
(3) Plaster of Paris is obtained by hydration of gypsum.
(4) Plaster of Paris is formed by oxidation of gypsum.

Q.18 Water obtained by purification with organic ion exchange resins is
(1) Pure water.
(2) Free from only Ca^{2+}, Mg^{2+} ions.
(3) Free from HCO_3^-, SO_4^{2-} and Cl^- ions only.
(4) None of these

Q.19 The critical temperature of water is higher than that of O_2 because H_2O molecule has –
(1) Fewer electrons than oxygen.
(2) Two covalent bonds
(3) V-shape
(4) Dipole moment

Q.20 The amount of H_2O_2 present in 1 L of 1.5 N H_2O_2 solution is –
(1) 2.5 g (2) 25.5 g
(3) 3.0 g (4) 8.0 g

SECTION - 2 (Q.21 - Q.30)

This section contains TEN (10) questions. ATTEMPT ANY FIVE (05) QUESTIONS. The answer to each question is NUMERICAL VALUE. If the numerical value has more than two decimal places truncate/round-off the value upto TWO decimal places.

Q.21 Hydrogen has three isotopes, the number of possible diatomic molecules will be:

Q.22 How many of the following oxo salts of alkali metals and alkaline earth metals are considered thermally unstable ?
Na_2CO_3, $Ca(HCO_3)_2$, Li_2CO_3, $CaCO_3$, K_2CO_3, $NaHCO_3$, $SrCO_3$, $BaCO_3$, $BeCO_3$ & $KHCO_3$.

Q.23 The number of R_2 Si $(OH)_2$ units required to prepare a silicone polymer containing 10 Si–O– Si linkages is

SPACE FOR ROUGH WORK

Q.24 Consider the statements for the graphite –
(a) good conductor of electricity
(b) delocalised π electrons are present
(c) allotrope of carbon
(d) poor conductor of electricity
Number of correct statements are –

Q.25 Consider the statements for Al_2Cl_6 –
(a) Four Al – Cl bonds are of same length and two of different length.
(b) Six Al – Cl bonds are of same length and two of different length.
(c) The angle Cl – Al – Cl is 110º and 93º.
(d) The angle Al – Cl – Al is 87º.
The number of correct statements are –

Q.26 Boron exist in different allotropic forms. All allotropic form contains icosahedral units (icosahedral is a regular shape with 12 corners & 20 faces) with boron atoms at all 12 corners and all bonds are equivalent.

B (g) → (g)

Calculate heat evolved at constant pressure (in KJ) per mole of boron atoms undergoing above change if ΔH_{BE} (B – B) = 200 KJ/mol. Report you answer after dividing by 100.

Q.27 How many of the following can dissolve in aqueous HCl as well as in NaOH solution to liberate H_2?

B, Al, B_2H_6, B_2O_3, $NaAlH_4$, Al_2O_3, $AlCl_3$, BF_3

Q.28 The electronic configuration of an element is $1s^2$, $2s^22p^6$,$3s^23p^4$. The atomic number of the element present just below the above element in the periodic table is x. Find the value of x/17.

Q.29 The energy needed to convert three moles of sodium atoms in the gaseous state to sodium ions is 148.5×10^x J. [Given : The ionization energy of sodium is 495 kJ mol^{-1}]

Q.30 The coordination number of Al in the crystalline state of $AlCl_3$ is

PART B – PHYSICS

SECTION - 1 (Q.31 - Q.50)

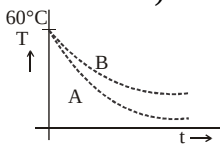
Each question has FOUR options (1), (2), (3) and (4). ONLY ONE of these four options is correct.

Q.31 The coefficient of apparent expansion of liquid when determined using two different vessels A & B are γ_1 & γ_2 respectively. If the coefficient of linear expansion of the vessel A is α, then coefficient of linear expansion of B :

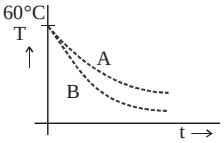
(1) $\frac{\alpha\gamma_1\gamma_2}{\gamma_1+\gamma_2}$ (2) $\frac{\gamma_1-\gamma_2}{2\alpha}$

(3) $\frac{\gamma_1-\gamma_2+\alpha}{3}$ (4) $\frac{\gamma_1-\gamma_2}{3}+\alpha$

Q.32 Two identical breakers A and B contain equal volumes of two different liquids at 60°C each and left to cool down. Liquid in A has density of 8×10^2 kg/m^3 and specific heat of 2000 J kg^{-1} K^{-1} while liquid in B has density of 10^3 kg m^{-3} and specific heat of 4000 J kg^{-1} K^{-1}. Which of the following best describes their temperature versus time graph schematically? (Assume the emissivity of both the beakers to be the same)



(1)



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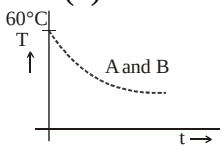

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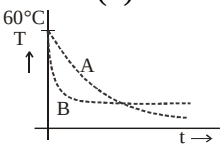


(4)

Q.33 Ice at –20° C is added to 50 g of water at 40°C. When the temperature of the mixture reaches 0°C, it is found that 20 g of ice is still unmelted. The amount of ice added to the water was close to
(Specific heat of water = 4.2 J/g/°C)
Specific heat of Ice = 2.1 J/g/°C
Heat of fusion of water at 0°C = 334 J/g)

SPACE FOR ROUGH WORK

(1) 50 g (2) 40 g
(3) 60 g (4) 100 g

Q.34 For a given gas at 1 atm pressure, rms speed of the molecule is 200 m/s at 127°C. At 2 atm pressure and at 227°C, rms speed of the molecules will be :

(1) 80 m/s (2) 100 $\sqrt{5}$ m/s
(3) 80 $\sqrt{5}$ m/s (4) 100 m/s

Q.35 A solar cooker consist of a curved aluminium mirror which focuses the heat energy on collector plate. Calculate how long (in minutes) it will take to raise the temperature of 3 litre of water from 20°C to boiling point. Assume that the radius of aperture of mirror is $\frac{1m}{\sqrt{\pi}}$ and efficiency h = 50%. Take J = 4.2 and solar intensity to be 5.6×10^2 W/m^2.

(1) 20 min. (2) 40 min.
(3) 60 min. (4) 80 min.

Q.36 Two identical blocks of ice move in opposite directions with equal speed and collide with each other. What will be the minimum speed required to make both the blocks melt completely, if the initial temperatures of the blocks were –8°C each? (Specific heat of ice is 2100 Jkg^{-1}K^{-1} and Latent heat of fusion of ice is 3.36×10^5 J kg^{-1})

(1) 840 m/s (2) 420 m/s
(3) 8.4 m/s (4) 84 m/s

Q.37 A calorimeter contains 0.2 kg of water at 30°C, 0.1kg of water at 60°C is added to it, the mixture is well stirred and the resulting temperature is found to be 35°C. The thermal capacity of calorimeter is

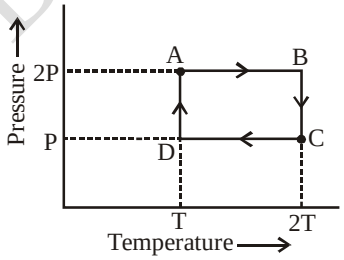
(1) 6300 J/K (2) 1260 J/K
(3) 4200 J/K (4) 8400 J/K

Q.38 The initial pressure and volume of a given mass of an ideal gas (with $C_p / C_v = \gamma$), taken in a cylinder fitted with a piston, are P_0 and V_0 respectively. At this stage the gas has the same temperature as that of the surrounding medium which is T_0. It is adiabatically compressed to a volume equal to $V_0/2$. Subsequently the gas is allowed to come to thermal equilibrium with the surroundings. What is the heat released to the surroundings ?

(1) 0 (2) $(2^{\gamma-1}-1)\frac{P_0V_0}{\gamma-1}$

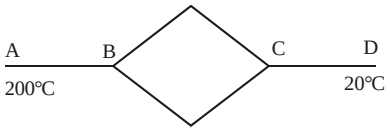
(3) $\gamma P_0V_0 \ln 2$ (4) $\frac{P_0V_0}{2(\gamma-1)}$

Q.39 An ideal monoatomic gas is taken through the thermodynamic states A $\rightarrow$ B $\rightarrow$ C $\rightarrow$ D via the paths shown in the figure. If U_A, U_B, U_C and U_D represent the internal energy of the gas in state A, B, C and D respectively, then which of the following is not true?



(1) $U_A - U_D = 0$ (2) $U_B - U_C = 0$
(3) $U_C - U_D > 0$ (4) $U_B - U_A < 0$

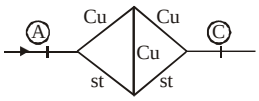
Q.40 Six identical conducting rods are joined as shown. The ends A and D are maintained at 200°C and 20°C respectively. No heat is lost to surroundings. The temperature of the junction C will be



(1) 60°C (2) 80°C
(3) 100°C (4) 120°C

Q.41 Five wires each of cross-sectional area A and length ℓ are combined as shown. The thermal conductivity of copper & steel are k_1 and k_2 respectively. The equivalent thermal resistance between A and C is

SPACE FOR ROUGH WORK



(1) $\frac{\ell}{(k_1+k_2)\,A}$ (2) $\frac{2\ell}{(k_1+k_2)\,A}$

(3) $\frac{\ell\,(k_1+k_2)}{k_1k_2\,A}$ (4) $\frac{\ell\,k_1k_2}{k_1^2+k_2^2}$

Q.42 A sample of an ideal gas is contained in a cylinder. The volume of the gas is suddenly decreased. A student makes the following statements to explain the change in pressure of the gas.

I. The average kinetic energy of the gas atoms increases.

II. The atoms of the gas hit the walls of the cylinder more frequently.

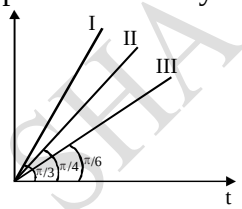
III. Temperature of the gas remains unchanged.

Which of these statements is true?

(1) I and II only (2) I and III only

(3) II and III only (4) I, II and III

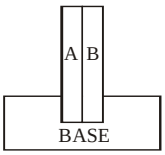
Q.43 Three bodies A, B and C of masses m, m and $\sqrt{3}$m respectively are supplied heat at a constant rate. The change in temperature θ versus time t graph for A, B and C are shown by I, II and III respectively. If their specific heat capacities are S_A, S_B and S_C respectively then which of the following relation is correct ? (Initial temperature of body is 0°C) :



(1) $S_A > S_B > S_C$ (2) $S_B = S_C < S_A$

(3) $S_A = S_B = S_C$ (4) $S_B = S_C > S_A$

Q.44 A bimetallic strip consists of metals A and B. It is mounted rigidly at the base as shown. The metal A has a higher coefficient of expansion to that for metal B. When bimetallic strip is placed in a cold bath it will



(1) bend towards the right.

(2) bend towards the left.

(3) not bend but shrink.

(4) neither bend nor shrink.

Q.45 1 mole gas expand with temperature according to the relation $V= KT^{2/3}$. When the temperature changes by 30°C, the work done will be :

(1) 10 R (2) 20 R

(3) 30 R (4) 40 R

Q.46 Consider a carnot's cycle operating between T_1 = 500 K and T_2 = 300 K producing 1 kJ of mechanical work per cycle. Find the heat transferred to the engine by the reservoirs.

(1) 2000 J (2) 2500 J

(3) 1500 J (4) 1000 J

Q.47 At what absolute temperature T is the root mean square speed of a hydrogen molecule equal to its escape velocity from the surface of the moon? The radius of moon is R, g is the acceleration due to gravity on moon's surface, m is the mass of hydrogen molecule and k is the Boltzmann constant

(1) $\frac{mgR}{2k}$ (2) $\frac{2mgR}{k}$

(3) $\frac{3mgR}{2k}$ (4) $\frac{2mgR}{3k}$

Q.48 Find the wavelength (in mm) corresponding to the maximum radiation energy emitted by a bulb. It is given that the filament lamp of the bulb has a length l = 16/17 cm and a diameter d = 0.14mm. The power consumed by the lamp is P = 100 W. Filament lamp is a body with absorption coefficient a = 0.6, 12% of the energy received is transferred to other bodies by conduction and convection. Assume that body follows Wein's displacement law.

$\left(\pi = \frac{22}{7}, \sigma = \frac{17}{3}\times10^{-8}\frac{W}{m^2-K^4}, b = 3\times10^{-3}\ mK\right)$

SPACE FOR ROUGH WORK

(1) 300 (2) 900
(3) 200 (4) 600

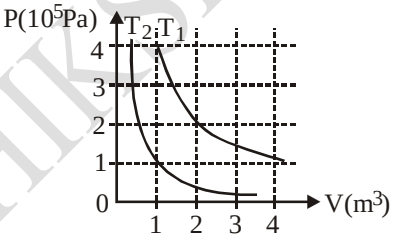
Q.49 The container contains an ideal gas, but we do not know which gas it is. To raise the temperature 1 kg of this gas by one degree at a constant pressure 958.4 J is required and at constant volume 704.6J. Which gas is it?
(1) Oxygen (2) Hydrogen
(3) Argon (4) Helium

Q.50 A copper sphere is suspended in an evacuated chamber maintained at 300 K. The sphere is maintained at a constant temperature of 500 K by heating it electrically. A total of 300W of electric power is needed to do it. When half of the surface of the copper sphere is completely blackened, 600W is needed to maintain the same temperature of the sphere. Calculate the emissivity of copper.
(1) 1/3 (2) 1/2
(3) 1/4 (4) 3/4

SECTION - 2 (Q.51 - Q.60)

This section contains TEN (10) questions. ATTEMPT ANY FIVE (05) QUESTIONS. The answer to each question is NUMERICAL VALUE. If the numerical value has more than two decimal places truncate/round-off the value upto TWO decimal places.

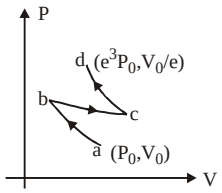
Q.51 The following graphs shows two isotherms for a fixed mass of an ideal gas. The ratio of r.m.s. speed of the molecules at temperatures T_1 and T_2 is



Q.52 The molar heat capacity of a diatomic ideal gas undergoing the process PV^2 = constant, is (xR/2) then, the value of x is :

Q.53 Two ice blocks each of mass M = 6.3 kg are moving towards each other with 20m/sec. Initial temperature of the each ice block is 0°C. The head on collision between them is perfectly inelastic. Assume that heat generated due to collision is completely used for melting some quantity of ice. Latent heat of ice for fusion is 80 cal/gm and 1 cal = 4.2 Joule. Total mass of water formed due to melting is (2.5 x) gm then find value of x.

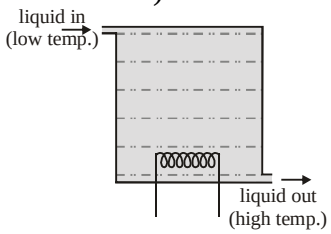
Q.54 One mole of ideal monoatomic gas at initial state a with pressure P_0 and volume V_0 is taken to a final state d with pressure e^3P_0 and volume V_0/e through the path $a \to b \to c \to d$ (figure). $a \to b$ and $c \to d$ are adiabatic paths where as $b \to c$ is isothermal with temperature T_0. If the work done by the gas in the process $b \to c$ is YRT_0 then find Y.



Q.55 A black plane surface at a constant high temperature T_h, is parallel to another black plane surface at constant lower temperature T_ℓ. Between the plates is vacuum. A heat shield consisting of a thin black plate is placed between the warm and the cold surfaces and parallel to these. After some time stationary conditions are obtained. By what factor η is the stationary heat flow between the plane surface reduced due to the presence of the heat shield? Neglect end effects due to the finite size of the surfaces.

SPACE FOR ROUGH WORK

Q.56 A liquid of density 0.8 gm/cm^3 flows through a thermally insulated container at the rate of 5 cm^3/sec. Heat is added to the liquid by means of a 210W heating coil and a temperature difference of 15°C is established in steady state between inflow and outflow. If specific heat of liquid is (x/6) cal/gm-°C. Then find the value of x ? (1 cal = 4.2 J)



Q.57 For a monoatomic ideal gas undergoing an adiabatic change, the relation between temperature and volume is TV^x = constant then find the value of (3/2) x.

Q.58 The quantity of gas in a closed vessel is halved and the velocities of its molecules are doubled. The final pressure of the gas will be xP. Find the value of x.

Q.59 The room heater can maintain only 16°C in the room when the temperature outside is –20°C. It is not warm and comfortable, that is why the electric stove with power of 1kW is also plugged in. Together these two devices maintain the room temperature of 22°C. The thermal power (in kW) of the heater is –

Q.60 Certain perfect gas is found to obey $PV^{3/2}$ = constant during an adiabatic process. If such a gas at initial temperature T is adiabatically compressed to half the initial volume, its final temperature is $\sqrt{x}$ T . Find the value of x.

PART C – MATHEMATICS

SECTION - 1 (Q.61 - Q.80)

Each question has FOUR options (1), (2), (3) and (4). ONLY ONE of these four options is correct.

Q.61 The tangent and the normal lines at the point $(\sqrt{3}, 1)$ to the circle $x^2 + y^2 = 4$ and the x-axis form a triangle. The area of this triangle (in square units) is :

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

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

Q.62 The angle of elevation of the top of vertical tower standing on a horizontal plane is observed to be 45° from a point A on the plane. Let B be the point 30 m vertically above the point A. If the angle of elevation of the top of the tower from B be 30°, then the distance (in m) of the foot of the tower from the point A is:

(1) $15(3-\sqrt{3})$ (2) $15(3+\sqrt{3})$

(3) $15(1+\sqrt{3})$ (4) $15(5-\sqrt{3})$

Q.63 The value of $\cos^2 10° - \cos 10° \cos 50° + \cos^2 50°$ is

(1) $\frac{3}{2}$ (1 cos 20°) (2) 3/4

(3) $\frac{3}{4}$ + cos 20° (4) 3/2

Q.64 If a circle of constant radius 3k passes through the origin 'O' and meets co-ordinate axes at A and B then the locus of the centroid of the triangle OAB is -

(1) $x^2 + y^2 = (2k)^2$ (2) $x^2 + y^2 = (3k)^2$

(3) $x^2 + y^2 = (4k)^2$ (4) $x^2 + y^2 = (6k)^2$

Q.65 If the circle $x^2 + y^2 = 9$ touches the circle $x^2 + y^2 + 6y + c = 0$, then c is equal to -

(1) –27 (2) 36

(3) –36 (4) 27

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Q.66 If the straight lines joining the origin and the points of intersection of the curve $5x^2 + 12xy - 6y^2 + 4x - 2y + 3 = 0$ and $x + ky - 1 = 0$ are equally inclined to the co-ordinate axis, then the value of k -
(1) is equal to 1
(2) is equal to –1
(3) is equal to 2
(4) does not exist in the set of real numbers

Q.67 The solutions of the equation $\sin x + 3\sin 2x + \sin 3x = \cos x + 3\cos 2x + \cos 3x$ in the interval $0 \le x \le 2\pi$, are ;
(1) $\frac{\pi}{8}, \frac{5\pi}{8}, \frac{2\pi}{3}$ (2) $\frac{\pi}{8}, \frac{5\pi}{8}, \frac{9\pi}{8}, \frac{13\pi}{8}$
(3) $\frac{4\pi}{3}, \frac{9\pi}{3}, \frac{2\pi}{3}, \frac{13\pi}{8}$ (4) $\frac{\pi}{8}, \frac{5\pi}{8}, \frac{9\pi}{3}, \frac{4\pi}{3}$

Q.68 Points A & B are in the first quadrant ; point 'O' is the origin. If the slope of OA is 1, slope of OB is 7 and OA = OB, then the slope of AB is -
(1) –1/5 (2) –1/4
(3) –1/3 (4) –1/2

Q.69 A circle is drawn touching the x-axis and centre at the point which is the reflection of (a, b) in the line $y - x = 0$. The equation of the circle is -
(1) $x^2 + y^2 - 2bx - 2ay + a^2 = 0$
(2) $x^2 + y^2 - 2bx - 2ay + b^2 = 0$
(3) $x^2 + y^2 - 2ax - 2by + b^2 = 0$
(4) $x^2 + y^2 - 2ax - 2by + a^2 = 0$

Q.70 $\ell = \left(\frac{\cot^2 x.\cos^2 x}{\cot^2 x - \cos^2 x}\right)^2$ and $m = a^{\log_{\sqrt{a}}\left[2\cos\frac{y}{2}\right]}$
at $y = 4\pi$, then $\ell^2 + m^2$ is equal to -
(1) 4 (2) 16
(3) 17 (4) none of these

Q.71 B and C are fixed points having co-ordinates (3, 0) and (–3, 0) respectively. If the vertical angle BAC is 90°, then the locus of the centroid of the ΔABC has the equation -
(1) $x^2 + y^2 = 1$ (2) $x^2 + y^2 = 2$
(3) $9(x^2 + y^2) = 1$ (4) $9(x^2 + y^2) = 4$

Q.72 The equation of the circle having the lines $y^2 - 2xy + 4x - 2xy = 0$ as its normals & passing through the point (2,1) is -
(1) $x^2 + y^2 - 2x - 4y + 3 = 0$
(2) $x^2 + y^2 - 2x + 4y - 5 = 0$
(3) $x^2 + y^2 + 2x + 4y - 13 = 0$
(4) none

Q.73 Set of values of x in $(-\pi, \pi)$ for which $|4\sin x - 1| < \sqrt{5}$ is given by -
(1) $\left(\frac{\pi}{10}, \frac{3\pi}{10}\right)$ (2) $\left(-\frac{\pi}{10}, \frac{3\pi}{10}\right)$
(3) $\left(\frac{\pi}{10}, -\frac{3\pi}{10}\right)$ (4) $\left(-\frac{\pi}{10}, -\frac{3\pi}{10}\right)$

Q.74 Given $\sin B = \frac{1}{5}\sin(2A + B)$ then, $\tan(A + B) = k \tan A$, where k has the value equal to -
(1) 1 (2) 2
(3) 2/3 (4) 3/2

Q.75 The locus of the centers of the circles which cut the circles $x^2 + y^2 + 4x - 6y + 9 = 0$ and $x^2 + y^2 - 5x + 4y - 2 = 0$ orthogonally is -
(1) $9x + 10y - 7 = 0$ (2) $x - y + 2 = 0$
(3) $9x - 10y + 11 = 0$ (4) $9x + 10y + 7 = 0$

Q.76 If one diagonal of a square is along the line $x = 2y$ and one of its vertex is (3, 0), then its sides through this vertex are given by the equations -
(1) $y - 3x + 9 = 0, x - 3y - 3 = 0$
(2) $y - 3x + 9 = 0, x - 3y - 3 = 0$
(3) $y + 3x - 9 = 0, x + 3y - 3 = 0$
(4) $y - 3x + 9 = 0, x + 3y - 3 = 0$

Q.77 The sum of all values of $\theta \in (0, \pi/2)$ satisfying $\sin^2 2\theta + \cos^4 2\theta = 3/4$ is
(1) $\pi/2$ (2) π
(3) $3\pi/8$ (4) $5\pi/4$

Q.78 If the line $3x + 4y - 24 = 0$ intersects the x-axis at the point A and the y-axis at the point B,

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then the incentre of the triangle OAB, where O is the origin, is

(1) (3, 4) (2) (2, 2)

(3) (4, 4) (4) (4, 3)

Q.79 With the usual notation, in Δ ABC, if $\angle A + \angle B = 120^o$, a = +1 and b = $\sqrt{3} - 1$, then the ratio $\angle A : \angle B$, is :

(1) 7 : 1 (2) 5 : 3

(3) 9 : 7 (4) 3 : 1

Q.80 If a straight line passing through the point P(–3, 4) is such that its intercepted portion between the coordinate axes is bisected at P, then its equation is :

(1) x – y + 7 = 0 (2) 3x – 4y + 25 = 0

(3) 4x + 3y = 0 (4) 4x – 3y + 24 = 0

SECTION - 2 (Q.81 - Q.90)

This section contains TEN (10) questions. ATTEMPT ANY FIVE (05) QUESTIONS. The answer to each question is NUMERICAL VALUE. If the numerical value has more than two decimal places truncate/round-off the value upto TWO decimal places.

Q.81 Distance of the point (2, 5) from the line 3x + y + 4 = 0 measured parallel to the line 3x – 4y + 8 = 0 is -

Q.82 $y = \sqrt{3}x + c_1$ & $y = \sqrt{3}x + c_2$ are two parallel tangents of a circle of radius 2 units, then $|c_1 - c_2|$ is equal to -

Q.83 Exact value of $\cos 20° + 2\sin^2 55° - \sqrt{2}\sin 65°$ is -

Q.84 In a triangle, the sum of lengths of two sides is x and the product of the lengths of the same two sides is y. If $x^2 - c^2 = y$, where c is the length of the third side of the triangle, then the circumradius of the triangle is $c/\sqrt{A}$. Find the value of A.

Q.85 The straight line x + 2y = 1 meets the coordinate axes at A and B. A circle is drawn through A, B and the origin. Then the sum of perpendicular distances from A and B on the tangent to the circle at the origin is $\frac{\sqrt{A}}{2}$. Find the value of A.

Q.86 The number of integral solutions of $|\sin^2 x + 17 - x^2| = |16 - x^2| + 2\sin^2 x + \cos^2 x$ is equal to

Q.87 In a triangle ABC, D is the mid-point of side BC, AB = 7, AC = 3 and BC = 6. The length AD = $p\sqrt{q}$, where p and q are both prime, then (p + q) is equal to

Q.88 If the x – 3y + 7 = 0 intersect the pair of straight lines $x^2 + 2y^2 - 3xy + 2x - 5y + 3 = 0$ in two points A and B. Mid point of AB is (p, q), then find the value of p – q.

Q.89 The vertices B and C of a triangle ABC lie on the lines 3y = 4x and y = 0 respectively and the side BC passes through the point (2/3, 2/3). If ABOC is a rhombus, O being the origin. If co-ordinates of vertex A is (α, β) then find the value of (5 (α + β) – 6)

Q.90 Circle C_1 and C_2 touches externally and circles C_1 and C_2 touches internally to the circle C_3. The radii of C_1 and C_2 are 4 and 10 respectively and the centres of the three circles are collinear. A chord of C_3 is also a common transverse tangent of C_1 and C_2. Given that the length of the chord is $\frac{m\sqrt{n}}{p}$, where m, n and p are positive integers, m and p are relatively prime and n is not divisible by the square of any prime, then find the value of $\frac{(m+n+p)}{19}$.

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