SHIKSHA CLASSES, BHANDARA

FULL TEST-2

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.

Always desire to learn something Useful.

Wake up every morning with the thought that something Wonderful is about to happen.

The difference between ordinary and eXtraordinary is that little extra.

Name : .....

Address : .....

.....

Phone/Mobile No. .....

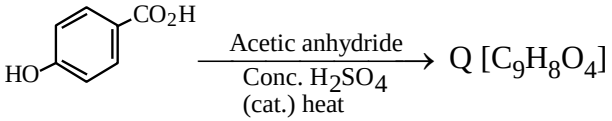
Roll No. .....

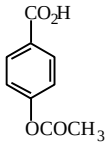
PART A – CHEMISTRY

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

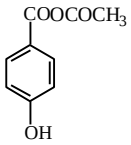
Each question has FOUR options (1), (2), (3) and (4). ONLY ONE of these four options is correct.

Q.1 For the reaction below, the product is Q.





(1)



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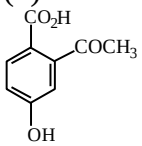

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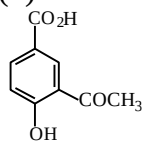


(4)

Q.2 Identify the correct statement(s):

(a) The oxidation number of Cr in CrO_5 is +6.

(b) $\Delta H > \Delta U$ for the reaction
$N_2O_4(g) \rightarrow 2NO_2(g)$.
Provided both gases behave ideally.

(c) pH of 0.1N H_2SO_4 is less than that of 0.1 N HCl at 25ºC.

(d) $\left(\frac{RT}{F}\right)$ = 0.0591 volt at 25ºC.

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

Q.3 Give the IUPAC name for methyl salicylate.

(1) Methoxy benzoic acid
(2) 2-Hydroxy benzoic acid
(3) Methyl-2-hydroxy benzoate
(4) Methyl-3-hydroxy benzoate

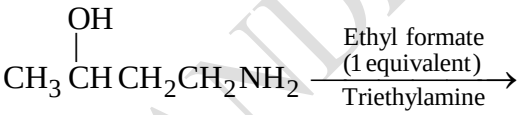
Q.4 The first electron affinity of C, N and O will be of the order

(1) C < N < O (2) N < C < O
(3) C < O < N (4) O < N < C

Q.5 For any given series of spectral lines of atomic hydrogen, let $\Delta\bar{\nu} = \bar{\nu}_{max} - \bar{\nu}_{min}$ be the difference in maximum and minimum frequencies in cm^{-1}. The ratio $\Delta\bar{\nu}_{Lyman} / \Delta\bar{\nu}_{Balmer}$ is

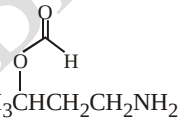
(1) 27 : 5 (2) 4 : 1
(3) 5 : 4 (4) 9 : 4

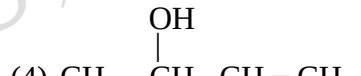
Q.6 The major product of the following reaction is :



(1) 

(2) $CH_3CH = CH - CH_2NH_2$

(3) 

(4) 

Q.7 The correct statement is :

(1) zincite is a carbonate ore.
(2) aniline is a froth stabilizer.
(3) zone refining process is used for the refining of titanium.
(4) sodium cyanide cannot be used in the metallurgy of silver.

Q.8 Consider the following table :

Gas	a / (k Pa $dm^6 mol^{-1}$)	b / ($dm^3 mol^{-1}$)
A	642.32	0.05196
B	155.21	0.04136
C	431.91	0.05196
D	155.21	0.4382

a and b are vander waals constant. The correct statement about the gases is :

(1) Gas C will occupy lesser volume than gas A; gas B will be lesser compressible than gas D

(2) Gas C will occupy more volume than gas A; gas B will be lesser compressible than gas D

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(3)Gas C will occupy more volume than gas A; gas B will be more compressible than gas D

(4)Gas C will occupy lesser volume than gas A; gas B will be more compressible than gas D

Q.9 Given : $Co^{3+} + e^- \rightarrow Co^{2+}$; $E^o = + 1.81$ V

$Pb^{4+} + 2e^- \rightarrow Pb^{2+}$; $E^o = + 1.67$ V

$Ce^{4+} + e^- \rightarrow Ce^{3+}$; $E^o = + 1.61$ V

$Bi^{3+} + 3e^- \rightarrow Bi$; $E^o = + 0.20$ V

Oxidizing power of the species will increase in the order :

(1) $Ce^{4+} < Pb^{4+} < Bi^{3+} < Co^{3+}$

(2) $Co^{3+} < Pb^{4+} < Ce^{4+} < Bi^{3+}$

(3) $Co^{3+} < Ce^{4+} < Bi^{3+} < Pb^{4+}$

(4) $Bi^{3+} < Ce^{4+} < Pb^{4+} < Co^{3+}$

Q.10 The correct match between Item-I and Item-II is:

Item-I	**Item-II**
(a) High density polythene	(I) Peroxide catalyst
(b) Polyacrylonitrile	(II) Condensation at high temperature & pressure
(c) Novolac	(III) Ziegler-Natta catalyst
(d) Nylon 6	(IV) Acid or base catalyst

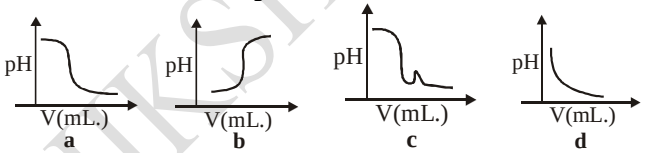
(1) (a) – (III), (b) – (I), (c) – (II), (d) – (IV)

(2) (a) – (IV), (b) – (II), (c) – (I), (d) – (III)

(3) (a) – (II), (b) – (IV), (c) – (I), (d) – (III)

(4) (a) – (III), (b) – (I), (c) – (IV), (d) – (II)

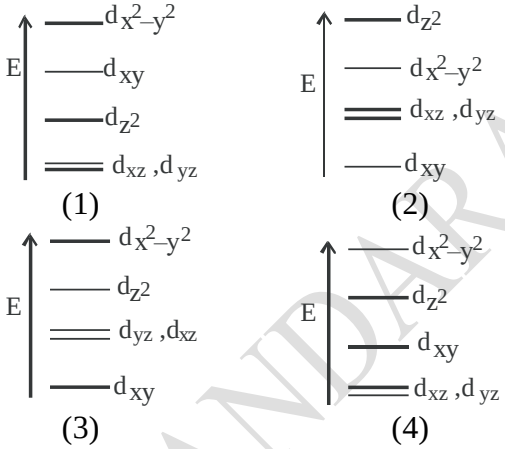
Q.11 In an acid-base titration, 0.1 M HCl solution was added to the NaOH solution of unknown strength. Which of the following correctly shows the change of pH of the titraction mixture in this experiment?



(1) a (2) c

(3) d (4) b

Q.12 Complete removal of both the axial ligands (along the z-axis) from an octahedral complex leads to which of the following splitting patterns? (relative orbital energies not on scale).



Q.13 Liquids A and B form an ideal solution in the entire composition range. At 350 K, the vapour pressures of pure A and pure B are 7×10^3Pa & 12×10^3 Pa, respectively. The composition of the vapour in equilibrium with a solution containing 40 mole percent of A at this temperature is :

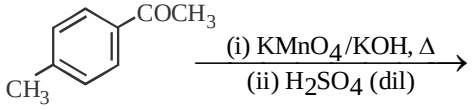
(1) $x_A = 0.37$; $x_B = 0.63$

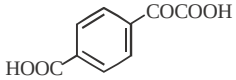
(2) $x_A = 0.28$; $x_B = 0.72$

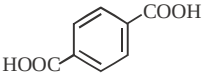
(3) $x_A = 0.76$; $x_B = 0.24$

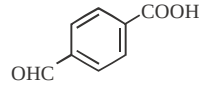
(4) $x_A = 0.4$; $x_B = 0.6$

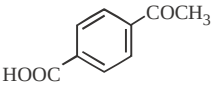
Q.14 The major product of the following reaction is :



(1) 

(2) 

(3) 

(4) 

Q.15 The element that does NOT show catenation is:

(1) Sn (2) Ge

(3) Si (4) Pb

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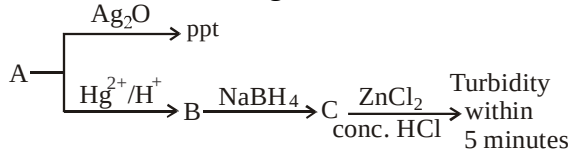
Q.16 The reaction $2X \rightarrow B$ is a zeroth order reaction. If the initial concentration of X is 0.2 M, the half-life is 6 h. When the initial concentration of X is 0.5 M, the time required to reach its final concentration of 0.2 M will be :

(1) 18.0 h (2) 7.2 h

(3) 9.0 h (4) 12.0 h

Q.17 Consider the following reactions :



'A' is :

(1) $CH \equiv CH$ (2) $CH_3 - C \equiv CH$

(3) $CH_2 = CH_2$ (4) $CH_3 - C \equiv C - CH_3$

Q.18 The principle of column chromatography is :

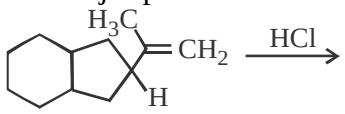
(1) Capillary action.

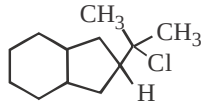
(2) Gravitational force.

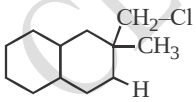
(3) Differential adsorption of the substances on the solid phase.

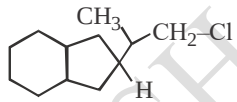
(4) Differential absorption of the substances on the solid phase.

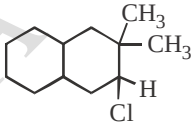
Q.19 The major product of the following reaction is:



(1) 

(2) 

(3) 

(4) 

Q.20 Match the following items in column I with the corresponding items in column II.

Column I	**Column II**
(i) $Na_2CO_3 \cdot 10\ H_2O$	(P) Portland cement ingredient
(ii) $Mg(HCO_3)_2$	(Q) Castner-Keller process
(iii) NaOH	(R) Solvay process
(iv) $Ca_3Al_2O_6$	(S) Temporary hardness

(1) (i)-(R); (ii)-(Q); (iii)-(S); (iv)-(P)

(2) (i)-(R); (ii)-(S); (iii)-(Q); (iv)-(P)

(3) (i)-(S); (ii)-(P); (iii)-(Q); (iv)-(R)

(4) (i)-(Q); (ii)-(R); (iii)-(P); (iv)-(S)

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 Find the number of compounds where $d_{x^2-y^2}$ orbitals will not take part in hybridisation.

(1) $[Pt(NH_3)Cl(H_2O)Br]$ (2) SF_4

(3) $[Cu(NH_3)_4]^{2+}$ (4) $[XeO_3F_2]$

(5) $[XeO_2F_2]$ (6) $[Co(en_3)]^{3+}$

(7) $[Fe(CO)_5]$ (8) $POCl_3$

(9) XeF_4 (10) XeO_6^{4-}

Q.22 Consider a reaction :

$A(g) + B(g) \rightleftharpoons C(g) + D(g)$ ..... (1)

A(g), B(g) and C(g) are taken in a container at 1bar partial pressure each and adequate amount of liquid 'D' is added. From the data given below. Calculate a + b + c + d

Given : ΔG^o_f A(g) = 30 kJ/mole

ΔG^o_f B(g) = 20 kJ/mole

ΔG^o_f C(g) = 50 kJ/mole

ΔG^o_f D(g) = 100 kJ/mole.

Vapour pressure of D(ℓ) at 300 K = (1/6) bar (All data at 300K)

where, a = Equilibrium constant of reaction (ℓ)

b = Twice the partial pressure of A at equilibrium

c = Twice the partial pressure of B at equilibrium

d = Twice the partial pressure of C at equilibrium

Q.23 32g of hydrated magnesium sulphate

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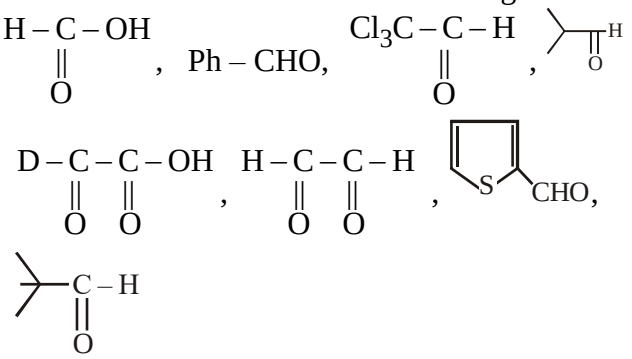
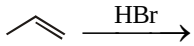
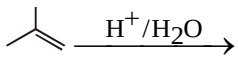
$MgSO_4.x\ H_2O$, when dissolved in 84 g of water, the solution freezes at –4.836°C.
If K_f = 1.86 K kg mol^{-1} and $MgSO_4$ is a strong electrolyte, what is the value of x.

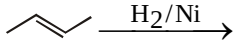
Q.24 How many of the following which can give Cannizaro reaction out of the following.

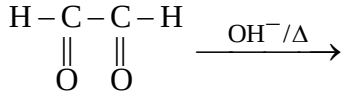


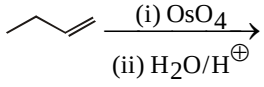
Q.25 Give total number of reactions in which atleast 1 carbon oxidise during reaction.

(i) 

(ii) 

(iii) 

(iv) 

(v) 

(vi) $H_3C-Br \xrightarrow{\overset{\Theta}{OH}}$

(vii) $H_3C-CH_2-OH \xrightarrow{SOCl_2}$

Q.26 20% surface sites have adsorbed N_2. On heating N_2 gas evolved from sites and were collected at 0.001 atm and 298K in a container of volume is 2.46 cm^3. Density of surface sites is $6.023 \times 10^{14}/cm^2$ and surface area is 1000 cm^2, find out the no. of surface sites occupied per molecule of N_2.

Q.27 The maximum number of electrons that can have principal quantum number, n = 3, and spin quantum number, m_s = –1/2, is

Q.28 My weight is 80 kg. I want to fly in the sky with the aid of balloons each containing 50 moles of H_2 gas at 0.05 atm pressure and 27ºC temperature. If the density of air at the given condition is 1.25 gm/lit, how many such type of balloons do I need to attach with myself to fly in the sky.

Q.29 The oxidation number of Mn in the product of alkaline oxidative fusion of MnO_2 is –

Q.30 Number of crystal water in Gypsum, Plaster of Paris and Epsom salt respectively are X, Y, Z. Find the value of (X + 2Y + Z).

PART B – PHYSICS

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

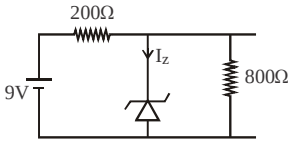
Each question has FOUR options (1), (2), (3) and (4). ONLY ONE of these four options is correct.

Q.31 Assume that the earth moves around the sun in a circular orbit of radius R and there exists a planet which also moves around the sun in circular orbit with an angular speed twice as large as that of the earth. The radius of the orbit of the planet is

(1) $2^{-2/3}$ R (2) $2^{2/3}$R

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

Q.32 The reverse breakdown voltage of a Zener diode is 5.6 V in the given circuit. The current I_Z through the Zener is :



(1) 7 mA (2) 17 mA

(3) 10 mA (4) 15 mA

Q.33 In the figure area of each plate is A and the distance between consecutive plates is as shown in the figure. What is the effective capacitance between points A & B.

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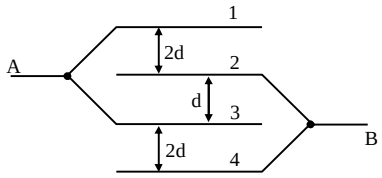


(1) $\frac{\varepsilon_0 A}{d}$ (2) $\frac{3\varepsilon_0 A}{d}$

(3) $\frac{2\varepsilon_0 A}{d}$ (4) $\frac{4\varepsilon_0 A}{d}$

Q.34 The wavelength of the first line of Lyman series is λ. Wavelength of the first line in Paschen series is –

(1) (108/7) λ (2) (27/5) λ

(3) (7/108) λ (4) (5/27) λ

Q.35 A convex lens of focal length 20 cm produces images of the same magnification 2 when an object is kept at two distances x_1 and x_2 ($x_1 > x_2$) from the lens. The ratio of x_1 and x_2 is

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

(3) 4 : 3 (4) 3 : 1

Q.36 A thin ring of 10 cm radius carries a uniformly distributed charge. The ring rotates at a constant angular speed of 40 π rad s^{-1} about its axis, perpendicular to its plane. If the magnetic field at its centre is 3.8×10^{-9} T, then the charge carried by the ring is close to ($\mu_0 = 4\pi \times 10^{-7}$ N/A^2) :

(1) 2×10^{-6} C (2) 3×10^{-5} C

(3) 4×10^{-5} C (4) 7×10^{-6} C

Q.37 In Young's experiment for the interference of light, the separation between the silts is d and the distance of the screen from the slits is D. If D is increased by 0.5% and d is decreased by 0.3%, then for the light of a given wavelength, which one of the following is true? "The fringe width....."

(1) increases by 0.8% (2) decreases by 0.8%

(3) increases by 0.2% (4) decreases by 0.2%

Q.38 The physical sizes of the transmitter and receiver antenna in a communication system are :

(1) proportional to carrier frequency.

(2)inversely proportional to modulation frequency

(3) inversely proportional to carrier frequency.

(4) independent of both carrier and modulation frequency.

Q.39 The elastic limit of brass is 379 MPa. What should be the minimum diameter of a brass rod if it is to support a 400 N load without exceeding its elastic limit ?

(1) 1.16 mm (2) 0.90 mm

(3) 1.36 mm (4) 1.00 mm

Q.40 A thin disc of mass M and radius R has mass per unit area $\sigma(r) = kr^2$ where r is the distance from its centre. Its moment of inertia about an axis going through its centre of mass and perpendicular to its plane is :

(1) $MR^2 / 6$ (2) $MR^2 / 3$

(3) $2MR^2 / 3$ (4) $MR^2 / 2$

Q.41 An insulating thin rod of length ℓ has a x linear charge density $\rho(x) = \rho_0 (x/\ell)$ on it. The rod is rotated about an axis passing through the origin (x = 0) and perpendicular to the rod. If the rod makes n rotations per second, then the time averaged magnetic moment of the rod is :

(1) $(\pi/4)\, n\rho_0 \ell^3$ (2) $n\rho_0 \ell^3$

(3) $\pi n\rho_0 \ell^3$ (4) $(\pi/3)\, n\rho_0 \ell^3$

Q.42 A particle is moving with constant speed $\sqrt{2}$ m / s on a circular path of radius 10 cm. Find the magnitude of average velocity when it has covered $(3/4)^{th}$ circular path.

(1) (π/3) m / s (2) (3/2π) m / s

(3) (3/π) m / s (4) (4/3π) m / s

Q.43 Two sources of sound S_1 and S_2 produce sound waves of same frequency 660 Hz. A listener is moving from source S_1 towards S_2 with a constant speed u m/s and he hears 10 beats/s. The velocity of sound is 330 m/s. Then, u equals:

(1) 2.5 m/s (2) 15.0 m/s

(3) 5.5 m/s (4) 10.0 m/s

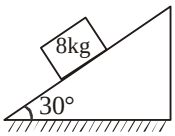
SPACE FOR ROUGH WORK

Q.44 Two particles move at right angle to each other. Their de-Broglie wavelengths are λ_1 and λ_2 respectively. The particles suffer perfectly inelastic collision. The de-Broglie wavelength λ, of the final particle, is given by :

(1) $\lambda = \frac{\lambda_1 + \lambda_2}{2}$ (2) $\frac{2}{\lambda} = \frac{1}{\lambda_1} + \frac{1}{\lambda_2}$

(3) $\lambda = \sqrt{\lambda_1 \lambda_2}$ (4) $\frac{1}{\lambda^2} = \frac{1}{\lambda_1^2} + \frac{1}{\lambda_2^2}$

Q.45 A block of mass 8 kg is at rest on a rough inclined plane as shown in the figure below. The magnitude of net force exerted by the surface on the block will be ($g = 10\ m/s^2$)



(1) 40 N (2) $40\sqrt{3}$ N

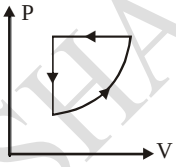
(3) 60 N (4) 80 N

Q.46 A sample of radioactive element has a mass of 10g at an instant t = 0. The approximate mass of this element in the sample after two mean lives is :

(1) 2.50 g (2) 3.70 g

(3) 6.30 g (4) 1.35 g

Q.47 For one complete cycle of a thermodynamic processes on a gas as shown in P-V diagram. Which is true :



(1) $\Delta U = 0; Q < 0$ (2) $\Delta U > 0; Q < 0$

(3) $\Delta U = 0; Q > 0$ (4) $\Delta U < 0; Q > 0$

Q.48 A man of mass M stands at one end of a plank of length ℓ, which lies at rest on a frictionless surface. The man walks to the other end of plank, if mass of plank is 3M, the distance moved by the man relative to the ground is-

(1) $\ell / 4$ (2) $3\ell / 4$

(3) $2\ell / 3$ (4) $\ell / 3$

Q.49 In a vernier callipers, 10 divisions of vernier scale coincides with 9 divisions of main scale, the least count of which is 0.1 cm. If in the measurement of inner diameter of cylinder zero of vernier scale lies between 1.3 cm and 1.4 cm of main scale and 2nd division of vernier scale coincides with main scale division then diameter will be :

(1) 1.30 cm (2) 1.34 cm

(3) 1.32 cm (4) 1.36 cm

Q.50 A wire is stretched between two rigid supports vibrates in its fundamental mode with a frequency of 50 Hz. The mass of the wire is 30 g and its linear density is 4×10^{-2} kg/m. The speed of the transverse wave at the string is :

(1) 25 m s^{-1} (2) 50 m s^{-1}

(3) 75 m s^{-1} (4) 100 m s^{-1}

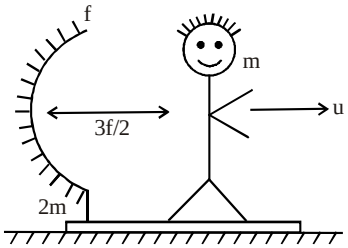
SECTION - 2 (Q.51 - Q.60)

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 work of 147 kilojoule is performed in order to compress one kilomole of a gas adiabatically and in this process the temperature of the gas increases by 7ºC. If R = 8.4 J/mole-k. Then find the degree of freedom of gas.

Q.52 A man of mass m starts moving w.r.t. a platform of mass 2m with a velocity u = 9/13 m/s as shown in the figure. The platform is fitted with a concave mirror of focal length f. The velocity of image (in m/s) at the initial moment is :

SPACE FOR ROUGH WORK

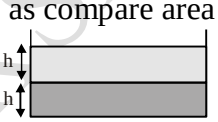


Q.53 Consider a huge charge reservoir at potential V = 200volts. A spherical capacitor C_1 = 40nF is brought in contact with the charge reservoir and then removed. Next another spherical capacitor C_2 = 30nF is brought in contact with C_1 and removed. We repeat this process a large number of times. Assume that potential of reservoir does not change during this exercise. Then the charge (in μC) on C_2 after a very long time is?

Q.54 A man throws a packet from a tower directly aiming at his friend who is standing at a certain distance from the base which is same as a height of the tower. If packet is thrown with a speed of 4m/s and it hits the ground midway between the tower base & his friend. If height of the tower is (4x/5) m then x is ($g = 10m/s^2$)

Q.55 Equal volumes of two immiscible liquids of densities ρ and 3ρ are filled in a vessel. Two small holes are made at depth h/3 and 4h/3 from upper surface of lighter liquid. If v_1 and v_2 are velocities of efflux at these two holes respectively at given time, then

v_1/v_2 is $\frac{X}{4\sqrt{2}}$ then X is : (Assume area of hole is negligible as compare area of container)



Q.56 Two particles of mass 5 kg and 10 kg respectively are attached to the two ends of a rigid rod of length 1 m with negligible mass. The centre of mass of the system from the 5 kg particle is nearly at a distance of (in cm):

Q.57 A bird flies for 4 s with a velocity of | t – 2 | m/s in a straight line, where t = time in seconds. It covers a distance (in m)of

Q.58 Two identical sounds A and B reach a point in the same phase. The resultant sound is C. The loudness of C is n dB higher than the loudness of A. The value of n is

Q.59 A body weighs 200 N on the surface of the earth. How much will it weigh(in N) half way down to the centre of the earth ?

Q.60 A block of mass 10 kg is in contact against the inner wall of a hollow cylindrical drum of radius 1m. The coefficient of friction between the block and the inner wall of the cylinder is 0.1. The minimum angular velocity (in rad/s) needed for the cylinder to keep the block stationary when the cylinder is vertical and rotating about its axis, will be : ($g = 10\ m/s^2$)

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 equation of the plane, which bisects the line joining the points (1, 2, 3) and (3, 4, 5) at right angles is –

(1) x + y + z = 0 (2) x + y – z = 9

(3) x + y + z = 9 (4) x + y – z + 9 = 0

Q.62 If $A = \begin{pmatrix} 5 & 5x & x \\ 0 & x & 5x \\ 0 & 0 & 5 \end{pmatrix}$ and $|A^2| = 25$, then |x| is equal to –

(1) 1/5 (2) 5

(3) 5^2 (4) 1

Q.63 A value of α such that

$$\int_{\alpha}^{\alpha+1} \frac{dx}{(x+\alpha)(x+\alpha+1)} = \log_e\left(\frac{9}{8}\right) \text{ is}$$

(1) 1/2 (2) 2

(3) –1/2 (4) – 2

SPACE FOR ROUGH WORK

Q.64 Let $f(x) = 15 - |x - 10|$; $x \in R$. Then the set of all values of x, at which the function, $g(x) = f(f(x))$ is not differentiable, is :
(1) {5, 10, 15, 20} (2) {10, 15}
(3) {5, 10, 15} (4) {10}

Q.65 Straight lines $x - y = 7$ and $x + 4y = 2$ intersect at B. Points A and C are so chosen on these two lines such that AB = AC. The equation of line AC passing through (2, –7) is
(1) $x - y - 9 = 0$ (2) $23x + 7y + 3 = 0$
(3) $2x - y - 11 = 0$ (4) $7x - 6y - 56 = 0$

Q.66 $\lim\limits_{x\to 0} \dfrac{\sin^2 x}{\sqrt{2} - \sqrt{1+\cos x}}$ equals :
(1) $2\sqrt{2}$ (2) $4\sqrt{2}$
(3) $\sqrt{2}$ (4) 4

Q.67 Which one of the following Boolean expressions is a tautology ?
(1) $(p \vee q) \wedge (\sim p \vee \sim q)$ (2) $(p \wedge q) \vee (p \wedge \sim q)$
(3) $(p \vee q) \wedge (p \vee \sim q)$ (4) $(p \vee q) \vee (p \vee \sim q)$

Q.68 The mean and the median of the following ten numbers in increasing order 10, 22, 26, 29, 34, x 42, 67, 70, y are 42 and 35 respectively, then y/x is equal to :
(1) 7/3 (2) 9/4
(3) 7/2 (4) 8/3

Q.69 A value of $\theta \in (0, \pi/3)$, for which
$$\begin{vmatrix} 1+\cos^2\theta & \sin^2\theta & 4\cos 6\theta \\ \cos^2\theta & 1+\sin^2\theta & 4\cos 6\theta \\ \cos^2\theta & \sin^2\theta & 1+4\cos 6\theta \end{vmatrix} = 0, \text{ is}$$
(1) $7\pi/24$ (2) $\pi/18$
(3) $\pi/9$ (4) $7\pi/36$

Q.70 Let P(4, 3) be a point on the hyperbola $\dfrac{x^2}{a^2} - \dfrac{y^2}{b^2} = 1$. If the normal at P intersects the X-axis at (16, 0), then the eccentricity of the hyperbola is
(1) $\sqrt{5}/2$ (2) 2
(3) $\sqrt{2}$ (4) $\sqrt{3}$

Q.71 The tangent to the parabola $y^2 = 4x$ at the point where it intersects the circle $x^2 + y^2 = 5$ in the first quadrant, passes through the point :
(1) (–1/3, 4/3) (2) (–1/4, 1/2)
(3) (3/4, 7/4) (4) (1/4, 3/4)

Q.72 If the fourth term in the binomial expansion of $\left(\dfrac{2}{x} + x^{\log_8 x}\right)^6$ $(x > 0)$ is 20×8^7, then value of x is :
(1) 8 (2) 8^2
(3) 8^{-2} (4) 8^3

Q.73 A problem in mathematics is given to 4 students whose chances of solving individually are $\dfrac{1}{2}, \dfrac{1}{3}, \dfrac{1}{4}$ and $\dfrac{1}{5}$. Then probability that the problem will be solved at least by one student is
(1) 2/3 (2) 3/5
(3) 4/5 (4) 3/4

Q.74 A candidate is required to answer 6 out of 12 questions which are divided into two parts A and B each containing 6 questions and he/she is not permitted to attempt more than 4 questions from any part. In how many different ways can he/she make up his/her choice of 6 questions?
(1) 850 (2) 800 (3) 750 (4) 700

Q.75 The sum of all natural numbers 'n' such that $100 < n < 200$ and H.C.F. (91, n) > 1 is :
(1) 3221 (2) 3121
(3) 3203 (4) 3303

Q.76 $y = \int \cos\left\{2\tan^{-1}\sqrt{\dfrac{1-x}{1+x}}\right\} dx$ is an equation of a family of
(1) straight lines (2) circles
(3) ellipses (4) parabolas

Q.77 If the lengths of the sides of a triangle are in A.P. and the greatest angle is double the smallest, then a ratio of lengths of the sides of this triangle is :
(1) 5 : 9 : 13 (2) 5 : 6 : 7
(3) 4 : 5 : 6 (4) 3 : 4 : 5

SPACE FOR ROUGH WORK

Q.78 If S_1 and S_2 are respectively the sets of local minimum and local maximum points of the function, $f(x) = 9x^4 + 12x^3 - 36x^2 + 25$, $x \in R$,

(1) $S_1 = \{-2, 1\}$; $S_2 = \{0\}$

(2) $S_1 = \{-2, 0\}$; $S_2 = \{1\}$

(3) $S_1 = \{-2\}$; $S_2 = \{0, 1\}$

(4) $S_1 = \{-1\}$; $S_2 = \{0, 2\}$

Q.79 If is a vector in the direction of (2, –2, 1) of magnitude 6 and is a vector in the direction of (1, 1, –1) of magnitude $\sqrt{3}$, then $|\vec{x} + 2\vec{y}| =$

(1) 40 (2) $\sqrt{35}$ (3) $\sqrt{17}$ (4) $2\sqrt{10}$

Q.80 Given the relation $R = \{(1, 2), (2, 3)\}$ on the set $A = \{1, 2, 3\}$, the minimum number of ordered pairs which when added to R make it an equivalence relation is-

(1) 5 (2) 6

(3) 7 (4) 8

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 Pair of tangents are drawn from every point on the line $3x + 4y = 12$ on the circle $x^2 + y^2 = 4$. Their variable chord of contact always passes through a fixed point whose co-ordinates are (1, A/3). Find the value of A.

Q.82 In a class of 140 students numbered 1 to 140, all even numbered students opted mathematics course, those whose number is divisible by 3 opted Physics course and those whose number is divisible by 5 opted Chemistry course. Then the number of students who did not opt for any of the three courses is (30 + X). Find the value of X.

Q.83 Consider the quadratic equation $(c - 5)x^2 - 2cx + (c - 4) = 0$, $c \neq 5$.

Let S be the set of all integral values of c for which one root of the equation lies in the interval (0,2) and its other root lies in the interval (2,3). Then the number of elements in S is (12 – A). Find the value of A.

Q.84 The value of $\cot\left(\sum_{n=1}^{19} \cot^{-1}\left(1 + \sum_{p=1}^{n} 2p\right)\right) = \frac{7 \times X}{19}$. Find the value of X.

Q.85 If y (x) is the solution of the differential equation $\frac{dy}{dx} + \left(\frac{2x+1}{x}\right) y = e^{-2x}$, $x > 0$,

where $y(1) = \frac{1}{2}e^{-2}$, then y (x) is decreasing in (1/A, 1). Find the value of A.

Q.86 If $\vec{a}$ & $\vec{b}$ are vectors in space given by $\vec{a} = \frac{\hat{i} - 2\hat{j}}{\sqrt{5}}$ and $\vec{b} = \frac{2\hat{i} + \hat{j} + 3\hat{k}}{\sqrt{14}}$, then the value of $(2\vec{a} + \vec{b}).[(\vec{a} \times \vec{b}) \times (\vec{a} - 2\vec{b})]$ is

Q.87 Let $0 \le a \le 4$. If the maximum area bounded by the curves $y = 1 - |x - 1|$ and $y = |2x - a|$ is A then A = 1/P. Find the value of P.

Q.88 Let F (x) be a cubic polynomial defined by $F(x) = \frac{x^3}{3} + (a-3)x^2 + x - 13$. Find the sum of all possible integral value(s) of 'a' for which F (x) has negative point of local minimum in the interval [1, 100].

Q.89 If the system of the equations :

$x + y + 2z = 6$ ..... (1), $x + 3y + 3z = 10$..... (2)

$x + 2y + \lambda z = \mu$ ..... (3)

has infinite number of solutions, then find the value of $4(\lambda + \mu)$.

Q.90 An equilateral triangle ABC is inscribed in the parabola $y = x^2$ and one of the side of the equilateral triangle has the gradient 2. If the sum of x-coordinates of the vertices of the triangle is a rational in the form p/q where p and q are coprime, then find the value of (p+q).

SPACE FOR ROUGH WORK

SPACE FOR ROUGH WORK