PRACTICE PAPAR – 10

PAPER - I

PART – I (PHYSICS)

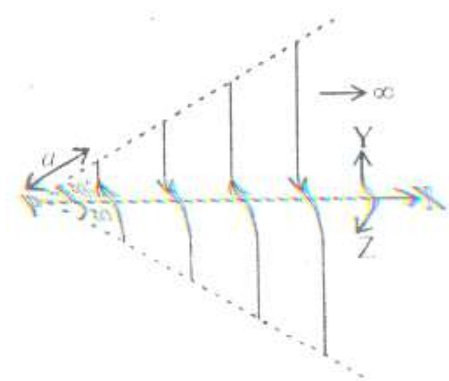
SECTION – I

Straight Objective Type

This section contains 9 multiple choice questions numbered 1 to 9. Each question has 4 choices (a), (b), (c) and (d), out of which ONLY ONE is correct.

Q 1.

An infinite number of straight wires each carrying current I are equally placed as shown in the figure. Adjacent wires have current in opposite direction. Net magnetic field at P is



(a) $\frac{\mu_0 i}{4\pi}\frac{ln2}{\sqrt{3}a}\hat{k}$

(b) $\frac{\mu_0 i}{4\pi}\frac{ln2}{\sqrt{3}a} - \hat{k}$

(c) $\frac{\mu_0 i}{4\pi}\frac{ln4}{\sqrt{3}a}\hat{k}$

(d) $\frac{\mu_0 i}{4\pi}\frac{2ln4}{\sqrt{3}a}\hat{k}$

Q 2.

A uniform rod of length l is placed with one and in contact with the horizontal. Table and is then inclined to angle α and angle α to the horizontal and allowed to fall. When it becomes horizontal, its angular velocity will be

(a) $\omega = \sqrt{\frac{3g\sin\alpha}{l}}$

(b) $\omega = \sqrt{\frac{2I}{3\,g\sin\alpha}}$

(c) $\omega = \sqrt{\frac{g \sin \alpha}{l}}$

(d) $\omega = \sqrt{\frac{l}{g \sin \alpha}}$

Q 3.

There are two radioactive nuclei X and Y. X is an α emitter and Y is an ß emitter. Their disintegration constants are in the ratio of 1 :2 . What should be the ratio of number of atoms of two at time t = 0 so that probabilities of getting α and ß particles are same at time t = 0 ?

(a) 2 : 1
(b) 1 : 2
(c) E
(d) $\frac{1}{e}$

Q 4.

A uniform rope of length I and mass m lies on a smooth horizontal table with its length perpendicular to the edge of the table and a small part of the rope hanging over the edge. The rope starts sliding from the root under the weight of the over-hanging end. The velocity of the rope when the length of the hanging part x is $\sqrt{\frac{gx^2}{l}}$ and its acceleration is $\frac{gx}{l}$ is

(a) $\sqrt{\frac{gx}{l}}$
(b) $\sqrt{\frac{gx^2}{l}}$
(c) $\frac{gx}{l}$
(d) $\frac{gx^2}{l}$

Q 5.

A body weighed with a spring balance in a train at rest shows a weight w_0, When the train begins to move with a velocity v around the equator from west to cast and if the angular velocity of earth is ω then the weight recorded by the spring balance is

(a) $w_0\left(1 + \frac{v^2}{R}\right)^2$
(b) $w_0\left(1 + \frac{v^2}{R}\right)^2$
(c) $w_0\left(1 - \frac{2v\omega}{g}\right)$
(d) $w_0\left(1 + \frac{2v\omega}{g}\right)$

Q 6.

A hemisphere of radius R and mass 4m is free to slide with its base on a smooth horizontal table. A particle of mass m is placed on the top of sphere. The angular velocity of particle relative to hemisphere at an angular displacement θ. when velocity of hemisphere has become v is

(a) $\frac{5v}{R\cos\theta}$
(b) $\frac{2v}{R\cos\theta}$
(c) $\frac{3v}{R\sin\theta}$
(d) $\frac{5v}{R\sin\theta}$

Q 7.

A free nucleus of mass 24 amu (initially at rest) emits a gamma photon. The energy of the photon is 7 MeV. The recoil energy of the nucleus in keV is (assuming 1 amu = 931 MeV = 1.66 x 10^{-27} kg)

(a) 22
(b) 4.2
(c) 3.6
(d) 1.1

Q 8.

In double slit experiment fringes are obtained using light of wavelength 4800 Å. One slit is covered with a thin glass film of refractive index 1.4 and another slit is covered by a film of same thickness but refractive index 1.7. By doing so that central fringe is shifted to fifth bright bright fringe in the original pattern. The thickness of glass film is

(a) 2 x 10^{-3} mm.
(b) 4 x 10^{-3} mm.
(c) 6 x 10^{-3} mm.
(d) 8 x 10^{-3} mm.

Q 9.

A boy of mass m stands at one at one end of a wooden plank of length L. and mass M. The plank is floating on water. If the boy walks from one end of the plank to the other end with a constant speed, the resulting displacement of the plank is given by

(a) $\frac{ML}{m}$
(b) $\frac{mL}{M}$
(c) $\frac{mL}{(M+m)}$
(d) $\left(\frac{ML}{M-n}\right)$

SECTION – II

Multiple Objective Type

This section contains 8 multiple choice questions numbered 10 to 17. Each question has 4 choices (a), (b), (c) and (d), out of which MORE THAN ONE may be correct.

Q 10.

A radioactive isotope X has a half life 3 seconds initially a given sample of this isotope contains 8000 atoms. Then:

(a) The time t_0 when 1000 atoms of isotope X remain in sample is 7.5 sec.
(b) The time t_0 when 1000 atoms of isotope X remain in sample is 9 sec.
(c) Activity of sample at $t = t_0$ is 231/sec.
(d) Activity of sample at $t = t_0$ is 461/sec.

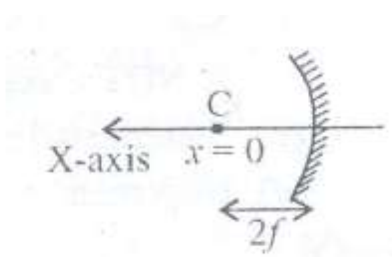
Q 11.

A bimetallic strip is formed out of two identical strips one of copper and other of brass. The linear expansion coefficients of metals are α_C and α_B. On heating, the temperature of strip goes up by ΔT and the strip bends to form an are of radius of curvature R. The R is

(a) Proportional to ΔT
(b) Inversely proportional to ΔT.
(c) Proportional to $(\alpha_B - \alpha_C)$.
(d) Inversely proportional to $(\alpha_B - \alpha_C)$.

Q 12.

A ball swings back and forth in front of a concave mirror. The motion of the ball is described approximately by equaltion $x = f\cos\omega t$ where f is the focal length of mirror and x is measured along the axis of mirro. Origin is taken at the centre of curvature of the mirror.



(a) At time t, distance of image from mirror is $\left(\frac{2+\cos\omega t}{1+\cos\omega t}\right)f$.
(b) At time t, distance of image from mirror is $\frac{2+f\cos\omega t}{1+f\cos\omega t}$
(c) At $t = \frac{T}{2}$, the image of ball is at focus.
(d) At $t = \frac{T}{2}$, the image of ball is at infinity.

Q 13.

A body of mass m kept on the floor of a lift moving downwards is pulled horizontally. If μ is coefficient of friction between the surface in contact, then

(a) Frictional resistance offered by the floor is μmg. when lift moves up with a uniform velocity of 5 m/s.
(b) Frictional resistance offered by the floor is μmg. when lift moves up with uniform velocity of 3 m/s.
(c) Frictional resistance offered by the floor is 5 μm, when lift accelerates down with an acceleration of 4.8 m/s^2.
(d) Frictional resistance (f) offered by the floor must lie in the range $0 \leq f < \infty$.

Q 14.

An interference is observed due to two coherent sources S_1 placed at origin and S_2 placed at (0, 3λ, 0). Here λ is wavelength of source. A detector D is moved along the positive X – axis. Then on the X – axis

(a) At x = ∞, zero-order maxima is obtained.
(b) At x = 4 λ, first – order maxima is obtained.
(c) At x = 1.25 λ, second – order maxima is obtained.
(d) Between x = 0 to x = ∞ only two maxima are observed.

Q 15.

Three simple harmonic motions in the same direction having the same amplitude a and same period are superimposed. If each differs in phase from the next by 45° then

(a) The resultant amplitude is $(1+\sqrt{2})$ a.
(b) The phase of the resultant motion relative to first is π/2.
(c) The energy associated with resulting motion is $(3+2\sqrt{2})$ times the energy associated with any single motion.
(d) The resulting motion is not simple harmonic.

Q 16.

A ring with a uniform charge Q and radius R, is placed in Y – Z plane with its centre at the origin. Then

(a) The electric field at the origin is zero.
(b) This potential at the origin is $\frac{1}{4\,\pi\, c_0}\frac{Q}{R}$
(c) The field at the point (x, 0, 0) is $\frac{1}{4\pi\,\epsilon_0}\frac{Q}{x^2}$
(d) The field at the point (x, 0, 0) is $\frac{1}{4\,\pi\,\epsilon_0}\frac{Q}{R^2+x^2}$

Q 17.

A uniform chain of length I. lies on a smooth horizontal tale with its length perpendicular to edge of the table and a small portion of chain is hanging over edge. The chain starts sliding due to weight of the hanging part. Then :

(a) The acceleration of the chain is $\frac{gx}{L}$ where x is length of hanging part of chain.
(b) The acceleration of the chain is $\frac{g}{L}$(L – x) where is the length of the hanging par of chain.
(c) The velocity of the chain is $x\sqrt{\frac{g}{L}}$ where x is the length of hanging part of chain.
(d) The velocity of the chain is (L – x) $\sqrt{\frac{g}{L}}$ where x is the length of hanging part of chain.

SECTION – III

Assertion – Reason Type

This section contains 4 question numbered 18 to 21. Each question contains STATEMENT – 1 (Assertion) and STATEMENT – 2 (Reason). Each question has 4 choices (a), (b), (c) and (d) out of which ONLY ONE is correct.

Q 18.

STATEMENT – 1

Lighter and heavier bodies moving with same momenta and experiencing same retarding force have equal stopping times.

Because

STATEMENT – 2

For a given force and momentum, stopping time is independent of mass.

(a) Statement – 1 is True, Statement – 2 is True; Statement – 2 is correct explanation for Statement – 1.
(b) Statement – 1 is True, Statement – 2 is True; Statement – 2 is NOT a correct explanation for Statement – 1.
(c) Statement – 1 is True, Statement – 2 is False.
(d) Statement – 1 is False, Statement – 2 is True.

Q 19.

STATEMENT – 1

The particle (P) of mass m_0 performs S.H.M if x $<<l$.

STATEMENT – 2

Because

Net gravitational force is directly proportional to x and oppositely directed.

(a) Statement – 1 is True, Statement – 2 is True; Statement – 2 is a correct explanation for Statement – 1.
(b) Statement – 1 is True, Statement – 2 is True; Statement – 2 is NOT a correct explanation for Statement – 1.
(c) Statement – 1 is True, Statement – 2 is False.
(d) Statement – 1 is False, Statement – 2 is True.

Q 20.

STATEMENT – 1

A charged particle moves perpendicular to magnetic field. Its kinetic energy remains constant, but momentum changes. Because

STATEMENT – 2

Force acts perpendicular to velocity of the particle.

(a) Statement – 1 is True, Statement – 2 is True; Statement – 2 is correct explanation for Statement – 1.
(b) Statement – 1 is True, Statement – 2 is True; Statement – 2 is True; Statement – 2 is NOT a correct explanation for Statement – 1.
(c) Statement – 1 is True, Statement – 2 is False.
(d) Statement – 1 is False, Statement – 2 is True.

Q 21.

STATEMENT – 1

The electron passing through crossed magnetic and electric field is always deflected from its path.

because

STATEMENT – 2

If velocity of electrons I equal to the ratio of electric and magnetic field applied then electron beam may remain undeflected.

(a) Statement – 1 is True, Statement – 2 is True; Statement – 2 is a correct explanation for Statement – 1.
(b) Statement – 1 is True, Statement – 2 is True; Statement – 2 is NOT a correct explanation for Statement – 1.
(c) Statement – 1 is True, Statement – 2 is False.
(d) Statement – 1 is False, Statement – 2 is True.

SECTION – IV

Linked Comprehension Type

This section contains 2 paragraph P_{22-24} and P_{25-27*} Based upon each paragraph, 3 multiple choice questions have to be answered. Each question has 4 choices (a), (b), (c) and (d) out of which ONLY ONE is correct.

P_{22-24} : Paragraph for Question Nos. 22 to 24

A charge q, mass m is allowed to enter a magnetic field $B\hat{k}$ will experience a force $\vec{F}$ = - q ($\vec{v}$x$\vec{B}$) if v $\neq$ 0. The path followed by them depends on the components of velocity. Using an Electric field it is possible to nullify the force due to magnetic field. Even though electric field E accelerates, the rate of work done by B is zero.

<u>Q 22</u>.

The rate of work done on the charge by the magnetic field is

(a) Zero
(b) qv^2 B
(c) qv^2 B sin θ
(d) qv^2 B cosθ

<u>Q 23</u>.

The charge will move undeflected if the velocity v of the charge is

(a) v = $\frac{E}{B}$ for any angle between v, E, B.
(b) v = $\frac{E}{B}$ only if v | E, E | B.
(c) K.E. given by B K. E given by E
(d) K. E. given B 2 x K.E. given by E

<u>Q 24</u>.

The path followed by the charge with v ||B $\neq$ 0 is

(a) Circular
(b) Parabolic
(c) Straight line
(d) Hclical

P_{25-27} : Paragraph for Question Nos. 25 to 27

A point moves in the plane x-y according to the law x = kt, y = kt(1 - αt) where k and α are positive constants and t is the time.

Q 25.

Equation of trajectory is :

(a) $y = x + \frac{\alpha}{k}$
(b) $y = \frac{\alpha x}{k}$
(c) $y = x - \frac{\alpha x^2}{k}$
(d) $y = \frac{\alpha}{kx}$

Q 26. The trajectory represents :

(a) Parabola
(b) Straight line passing through the origin
(c) Straight line not passing through the origin
(d) Rectangular hyperbola

Q 27.

The velocity of body at any instant of time $l$is :

(a) $k\sqrt{1 + (1 - \alpha t)^2}$
(b) $k\sqrt{1 + (1 - 2\alpha t)^2}$
(c) $k\,(1 + \alpha t)$
(d) $k\sqrt{(1 - 2\alpha t)^3}$

PART – II (CHEMISTRY)

Straight Objective Type

This section contains 9 multiple choice questions numbered 28 to 36. Each question has 4 choice (a), (b), (c) and (d), out of which ONLY ONE is correct.

Q 28.

The density of a certain mass of gas at 27°C and 1 atm pressure is 3.4 g L^{-1}. The density at 327°C and 0.5 atmpressure will be

(a) 13.6 g L^{-1}
(b) 0.85 g L^{-1}
(c) 3.4 g L^{-1}
(d) 1.7 g L^{-1}

Q 29.

The pH of a solution containing 0.1 M HCOOH and 0.050 M HCOONa ($K_a = 2.0 \times 10^{-4}$) is equal to

(a) 3.40
(b) 3.70
(c) 4.00
(d) 4.30

Q 30.

Which of the following represents correct order of reactivity towards nucleophilic substitution reaction?

(a) RCOCI > $(RCO)_2O$ > RCOOR' > $RCONH_2$
(b) RCOCI > RCOOR' > $(RCO)_2O$ > $RCONH_2$
(c) RCOCI > $(RCO)_2O$ > $RCONH_2$ RCOOR'
(d) RCOCI > RCOOR' > $RCONH_2$> $(RCO)_2O$

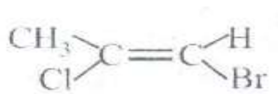
Q 31.

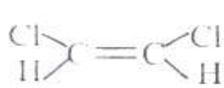
If the solubility of AgCl in H_2O, 0.1 M $CaCI_2$, 0.01 M K CI and 0.02 M $AgNO_3$ are S_1, S_2, S_3 and S_4 respectively, the correct order solubility are

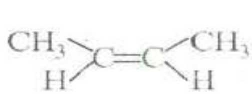
(a) $S_1 > S_2 > S_3 > S_4$
(b) $S_1 > S_3 > S_4 > S_2$
(c) $S_1 > S_2 > S_4 > S_3$
(d) $S_4 > S_2 > S_3 > S_1$

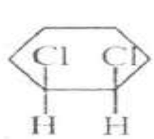
Q 32.

Which of the following will not have trans-isomer?

(a) 

(b) 

(c) 

(d) 

Q 33.

Which is the correct order of stability for the resonating structures given?

$$\underset{(X)}{CH_2-CH-CI} \qquad \underset{(Y)}{\overset{\ominus}{C}H_2-CH-\overset{\oplus}{C}I}$$

$$\underset{(Z)}{\overset{\oplus}{C}H_2-CH-\overset{\ominus}{C}I}$$

(a) Y > X > Z
(b) X > Y > Z
(c) Z > X > Y
(d) Z > Y > X

Q 34.

Magnesium reduced NO_3 according to the equation given below:

$$NO_3^- + Mg + 3H_2O \rightarrow Mg(OH)_2 + OH + NH_3$$

In basic medium, 25 ml sample of NO_2 was reacted with Mg. The ammonia gas evolved was passed through 50 ml of 1.15 N HCI. The excess HCI required 32.1 ml of 0.1 M NaOH for neutralization. The molarity of NO_3 in the original sample is

(a) 0.1 M
(b) 0.171 M
(c) 0.2 M
(d) 0.5 M

Q 35.

The molar conductance of $M^{n+} = \lambda_x^\infty$ at infinite dilution and the molar conductance at infinite dilution of $N^{m+} = \lambda_y^\infty$. The equivalent conductance of the salt M_mN_n at infinite dilution will be (neglecting conductance due to water)

(a) $\frac{\lambda_x^\infty}{n} + \frac{\lambda_y^\infty}{m}$
(b) $\frac{n\,\lambda_y^\infty}{m} + \frac{m\,\lambda_y^\infty}{n}$
(c) $\frac{\lambda_x^\infty}{m} + \frac{\lambda_y^\infty}{n}$
(d) $m\left(\frac{\lambda_x^\infty}{n}\right) + n\left(\frac{\lambda_x^\infty}{m}\right)$

Q 36.

A sample of U^{238} ($t_{1/2} = 4.5 \times 10^9$ yrs) is found to contains 23.8 g U^{238} and 20.6 g Pb^{206}, the age of ore is

(a) 10^{10} yrs
(b) 5 yrs
(c) 4.5×10^9 yrs
(d) 3.5×10^9 yrs

SECTION – II

Multiple Objective Type

This section contains 8 multiple choice questions numbered 37 to 44. Each question has 4 choices (a), (b), (c) and (d), out of which MORE THAN ONE may be correct.

Q 37.

Which of the following will give 1 – nitropropene as a product?

(a) Reaction of acctaldehyde with nitromethane
(b) Reaction of allyl chloride with nitromethane
(c) Reaction of $CH_3 - CH = CH - CI$ with $AgNO_2$ at high temperature.

Q 38.

Which of the following are inbox reactions?

(a) $NaIO_3 + 3\ NaHSO_3 \rightarrow 3\ NaHSO_4 + NaI$
(b) $U + CH_3 \rightarrow UF_6 + 3CIF$
(c) $AgCI + 2Na_2S_2O_3 \rightarrow Na_3\ [Ag(S_2O_3)_2] + NaCI$
(d) $Na_3\ BiO_3 + MnO_4 + 4\ HNO_3 \rightarrow MnO_4 + Bi(NO_3)_3$

$$+ NaNO_3 + Na_2\ SO_4\ 2\ H_2\ O$$

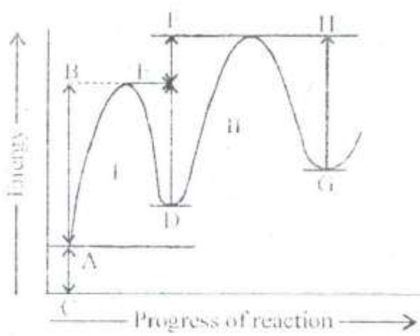
Q 39.

Pyridine is less basic than

(a) $(C_2\ H_5)_3\ N$
(b) $(C_2\ H_5)_2\ NH$
(c) $C_6\ H_5\ NH_2$
(d) $C_6H_5NHCH_3$

Q 40.

Observe the graph and identify, which of the following statement are correct?



(a) BC represents activation energy for forward reaction in step I
(b) AB represents $(E_a)_I$ whereas BC represents threshold energy for step I
(c) The graph is for endothermic process
(d) The second step is slow step.

Q 41.

A 2.844 g binary salt (X) of a univalent metal reacted completely with 0.642 g of sulphur in an evacuated sealed tube to give 3.486 g of a white crystalline solid (Y). (Y) forms a hydrated double salt (Z) with $Al_2(SO_4)_3$.

Therefore

(a) (X) is KO_2
(b) (Y) is $K_2SO_4 . Al_2(SO_4)_3. 24H_2O$
(c) (Z) is K_2SO_4
(d) (Y) is $K_2 SO_4$

Q 42.

The c.m.f. a cell is 0.265 V at 25°C and 0.2594 V at 35°C.

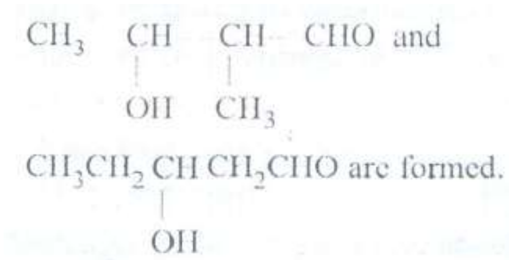
Hence

(a) The temperature coefficient is 5.5×10^{-4}
(b) The enthalpy change for the reaction is 82.8 kJ.
(c) The temperature coefficient for the cell is 5.5×10^{-4}.
(d) The ΔS for the reaction 2(96500) (5.5×10^{-4})

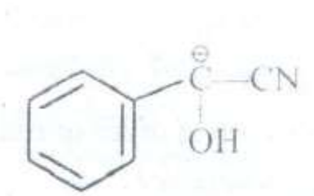
Q 43.

Which of the following statement are true?

(a) NCI_3 and PCI_3 both can be hydrolysed.
(b) NF_3 cannot be hydrolysed whereas PF_3 can be.
(c) When a mixture of CH_3 CHO and CH_3CH_2CHO are treated with NaOH, then



(d) During benzoin condensation, the carbanion formed is



Q 44.

For the reaction

$[Cu(L)_4]^2 + H_2\,O \rightleftharpoons [Cu(L)_3H_2O]^2 + I.$

The rate of the reaction is given s

Rate = 3×10^{-5} $\{[Cu(L)_4]^2\,]\}$ 3×10^5 $\{[Cu(L)_3H_2O]^2, [L]$

Hence

(a) The rate constant in the forward direction is $3 \times 10^{-5}\ s^{-1}$
(b) The rate constant in the backward reaction is $3 \times 10^{-5}\ mol^{-1}\ L\ s^{-1}$
(c) L is a stronger ligand than H_2O.
(d) From the above data nothing can be predicted.

SECTION – III

This section contains 4 question numbered 45 to 48. Each questions contains STATEMENT – 1 (Assertion) and STATEMENT – 2 (Reason). Each question has 4 choices (a), (b), (c) and (d) out of which ONLY ONE is correct.

Q 45.

STATEMENT – 1 :

N_2 is gas while P_4 is a solid

because

STATEMENT – 2 :

Nitrogen can form multiple bonds with itself while phosphorus cannot.

(a) Statement – 1 is True, Statement – 2 is True; Statement – 2 is correct explanation for Statement - 1,
(b) Statement – 1 is True, Statement – 2 is True; Statement – 2 is NOT a correct explanation for Statement – 1.
(c) Statement – 1 is True, Statement – 2 is False,
(d) Statement – 1 is False, Statement – 2 is True.

Q 46.

STATEMENT – 1:

NH_2 is stronger base than RO

because

STATEMENT – 2 :

The charge density on NH_2 is greater than that in RO

(a) Statement – 1 is True, Statement – 2 is True; Statement – 2 is NOT a correct explanation for Statement – 1.
(b) Statement – 1 is True, Statement – 2 is True; Statement – 2 is NOT a correct explanation for Statement – 1.
(c) Statement – 1 is True, Statement – 2 is False.
(d) Statement – 1 is False, Statement – 2 is True.

Q 47.

STATEMENT – 1 :

Nodal plane of p_x atomic orbital is along yz plane.

because

STATEMENT – 2 :

In p, orbitals, yz plane is the plane which passes through the nucleus.

(a) Statement – 1 is True, Statement – 2 is True, Statement – 2 is correct explanation for Statement - 1.
(b) Statement – 1 is True, Statement – 2 is True; Statement – 2 is NOT a correct explanation for Statement – 1.
(c) Statement – 1 is True, Statement – 2 is True.
(d) Statement – 1 is False, Statement – 2 is True.

Q 48.

STATEMENT – 1 :

The B.E. of N = N is very high but that of F – F is very low.

(a) Statement – 1 is True, Statement – 2 is True; Statement – 2 is correct explanation for Statement – 1
(b) Statement – 1 is True, Statement – 2 is True; Statement – 2 is NOT a correct explanation for Statement – 1.
(c) Statement – 1 is True, Statement – 2 is False.
(d) Statement – 1 is False, Statement – 2 is True.

SECTION – IV

Linked Comprehension Type

This section contains 2 paragraphs C_{49-51} and C_{52-54*} Based upon each paragraph, 3 multiple choice questions have to be answered. Each question has 4 choices (a), (b), (c) and (d) out of which ONLY ONE is correct.

C_{49-51} : Paragraph for Question Nos. 49 to 51

A colorless solid ‘X’ liberates a brown gas ‘Y’.

Compound ‘X’ on treatment with NaOH gave an alkaline gas ‘Z’ which gives brown ppt with Nessler’s reagent. Compound ‘X’ on heating gave a neutral gas ‘T’ which was colorless and non reactive.

Q 49.

The gas Z is

(a) NH_3
(b) $NH_2\ NH_2$
(c) $NH_2 - \underset{\underset{NH}{\|}}{C} - NH_2$
(d) N_2O

Q 50.

Compound 'Y' is

(a) NO
(b) N_2O
(c) NO_2
(d) N_2O_3

Q 51. Compound 'X' when heated decomposes to give $N_2 + H_2O$. So compound X is

(a) NH_4NO_3
(b) NH_4NO_2
(c) NH_4NO
(d) N_2

For a certain reaction $\log K\ (S^{-1}) = 14 - \frac{1.25\ x\ 10^4 K}{T}$ Hence it can be said that

Q 52. The pre-exponential factor is

(a) 14
(b) 10^{14}
(c) 1.25×10^4
(d) Log 1.25×10^4

Q 53.

The E_a for the reaction is

(a) 7000 kcal
(b) 6 kcal
(c) 57575 cal
(d) 57575 kcal

Q 54.

K will be equal to 10^{14} if

(a) $T = 0$
(b) $T = \infty$
(c) $T = 1000$ K
(d) $T = 10$ K

PART – III (MATHEMATICS)

SECTION – I

Straight Objective Type

This section contains 9 multiple choice questions numbered 55 to 63. Each question has 4 choices (a), (b), (c) and (d), out of which ONLY ONE is correct.

Q 55.

In a triangle ABC if A = (1, 2) and internal angle bisectors through B and C are y = x and y = - 2x. The inradius of the ΔABC must be

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

Q 56.

Number of different sections of 5 letter of 5 letters which can be from A, A, A, A; B, B, B, B; C, C, C; D, D; E is

(a) 70
(b) 71
(c) 72
(d) 73

Q 57.

If $a^2 + b^2 + c^2 = 1$ where a, b, c are real numbers then the maximum value of $(4a - 3b)^2 + (3c - 5a)^2$ is

(a) 25
(b) $50\sqrt{2}$
(c) 144
(d) 50

Q 58.

The solution of differential equation

(x cot y + In cos x) dy + (In sin y – y tan x) dx = 0

(a) $(\sin x)^y (\cos y)^x = c$
(b) $(\sin x)^x (\cos y)^y = c$

(c) $(\sin x)^y (\sin y)^x = c$
(d) $(\cot x)^y (\cot y)^x = c$

Q 59.

Let $x_1, x_2, \ldots\ldots\ldots x_{50}$ be fifty integers such that the sum of any six of them is 24. Then

(a) The smallest of x_i equals 3
(b) The largest of x_i equals 6
(c) $x_{16} = x_{34}$
(d) None of these

Q 60.

If $x > 1$ and $x + x^{-1} < \sqrt{5}$, then

(a) $2x < \sqrt{5} + 1, 2x^{-1} > \sqrt{5} - 1$
(b) $2x < \sqrt{5} + 1, 2x^{-1}, > \sqrt{5} - 1$
(c) $2x > \sqrt{5} + 1, 2x^{-1} < \sqrt{5} - 1$
(d) None of these

Q 61.

Let a and b any tow non-zero real numbers. Then the number of complex z satisfying the equation $|z|^2 + a|z| + b = 0$ is

(a) 0,2 or 4 and all these values are possible
(b) 0 or 2 and both these values are possible
(c) 0 or 4 and both these values are possible
(d) 0 or infinity many and both these values

Q 62.

In n stands for the number of negative roots and p for the number of positive roots of the equation $e^x = x$, then

(a) $n = 0, p = 1$
(b) $n = 0, p > 1$
(c) $n = 1, p = 0$
(d) $n = 0, p = 0$

Q 63.

Four statements are given below regarding elements and subsets of the set $\{1, 2, \{1, 2, 3\}\}$. Only one of them is correct. Which one is it ?

(a) $3 \in \{1, 2, \{1, 2, 3\}\}$
(b) $\{1, 2\} \subseteq \{1, 2, \{1, 2, 3\}\}$

(c) $\{1, 2\} \in \{1, 2, \{1, 2, 3\}\}$
(d) $\{1, 2, 3\} \subseteq \{1, 2, \{1, 2, 3\}\}$

SECTION – II

Multiple Objective Type

This section contains 8 multiple choice questions numbered 64 to 71. Each question has 4 choices (a), (b), (c) and (b), out of which MORE THAN ONE may be correct.

Q 64.

$abc \geq (a + b - c)(b + c - a)(c + a - b)$

(a) is true if $a, b, c > 0$, $a + b - c$, $b + c - a$, $c + a - b >$
(b) is true if $a, b, c < 0$
(c) it true if $a, b, c < 0$, $a + b - c$, $b + c - a$, $c + a - b < 0$
(d) is true if $a, b, c > 0$

Q 65.

If $f(a) = \int_0^\infty \frac{1-e^{-ax^2}}{xe^{x^2}}\,dx$ $(a > -1)$ then

(a) $f'(a) = 0$
(b) $f'(a) = \int_0^\infty xe^{-x^2(a+1)}dx$
(c) $f(a) = \log(1 + a)$
(d) $f(a) = \frac{1}{2}\log(1 + a)$

Q 66.

If the roots of (p, q, r are distinct) $x^3 + 3px^2 + 3qx + r = 0$ are in H.P. then

(a) $2q^3 = r(3pq - r)$
(b) p, q, r in A.P.
(c) P, q, r cannot be in A.P.
(d) p, q, r cannot be in G.P.

Q 67 Let $ß = \pi/7$, then

(a) $\cos ß$ is a root of $8x^3 + 4x^2 - 4x + 1 = 0$
(b) $\cos \pi/7$ is irrational
(c) $\operatorname{cosec} ß = \operatorname{cosec} 2ß + \operatorname{cosec} 4ß$
(d) $\cos ß - \cos 2ß + \cos 3ß = ½$

Q 68.

Let $\mu_n = (n!)^{-\frac{1}{n}}$then

(a) $u_n \leq \frac{1}{\sqrt{n}}$ for all n

(b) $\lim_{n\to\infty} u_n = 0$

(c) $\lim_{n\to\infty} u_n = 1$

(d) U_n is rational for sme n

Q 69.

Let $ß = \cos\frac{2\pi}{n} + i\sin\frac{2\pi}{n}$, where n is a positive integer and let $A_k = x_0 + x_1 ß^k + x_2 ß^{2k} + \ldots\ldots\ldots + x_{n-1} ß^{(n-1)k}$.

$k = 0, 1, 2 \ldots\ldots, n-1,$

where $x_0, x_1, x_2 \ldots\ldots x_{n-1}$ are n complex number then $\sum_{k=0}^{n-1} A_k^2$ must be equal to

(a) $N [\,|x_0|^2 + |x_1|^2 + \ldots\ldots + |x_{n-1}|^2]$

(b) $N\, |x_0\, x_1 \ldots\ldots|^{2/n}$

(c) Zero

(d) A non-negative real number

Q 70.

Let $a^2 + b^2 = 7ab$, a, b > 0, then

(a) $a + b = 3\sqrt{ab}$

(b) $\log\frac{a+b}{3} = \log a + \log b$

(c) $\log\frac{a+b}{3} = \frac{1}{2}(\log a + \log b)$

(d) $\log(a^2 + b^2) < 1$

Q 71.

Let $f(x) = \left(1 - \frac{\sqrt{21-4b-b^2}}{b+1}\right)x^3 + 5x + \sqrt{6},$

Where b is a real parameter then

(a) f (x) is increasing for all x if $b \in [2, 3]$

(b) f (x) is increasing for all x if $b \in [0, 3]$

(c) f (x) is increasing for all x if $b \in [-7, -1]$

(d) f (x) is increasing for no b

SECTION – III

Assertion – Reason Type

This section contains 4 question numbered 72 to 75. Each question contains Statement – 1 (Assertion) and Statement – 2 (Reason). Each question has 4 choices (a), (b), (c) and (d) out of which ONLY ONE is correct.

Q 72.

Statement – 1:

$$\int_0^{\frac{\pi}{2}} \frac{dx}{a^2\cos^2 x + b^2\sin^2 x} = \frac{\pi}{2ab}$$

because

Statement – 2:

$$\int_0^{\frac{\pi}{2}} \frac{dx}{a^2\cos^2 x + b^2\sin^2 x} = \int_0^{\frac{\pi}{2}} \frac{dx}{a^2\sin^2 x + b^2\cos^2 x}$$

(a) Statement – 1 is True, Statement – 2 is True; Statement – 2 is a correct explanation for Statement - 1,
(b) Statement – 1 is True, Statement – 2 is True, Statement – 2 is not a correct explanation for Statement – 1
(c) Statement – 1 is True, Statement – 2 is False
(d) Statement – 1 is False, Statement – 2 is True

Q 73.

Statement – 1:

If ω, ω^2 are non-real complex roots of unity then

$(a + \omega b + \omega^2 c)^3 + (a + \omega^2 b + \omega c)^3$

$= (2a - b - c)(2b - c - a)(2c - a - b)$ because

Statement – 2 :

$1 + \omega + \omega^2 = 0, \omega^{3n} = 1$

(a) Statement – 1 is True, Statement – 2 is True; Statement – 2 is a correct explanation for Statement – 1
(b) Statement – 1 is True, Statement – 2 is True; Statement – 2 is not a correct explanation for Statement – 1
(c) Statement – 1 is True, Statement – 2 is False
(d) Statement – 1 is False, Statement – 2 is True

Q 74.

Statement – 1:

If the three surfaces $y^2 + z^2 = ayz$, $x^2 = bzx$,

$x^2 + y^2$ cxy have a common point then

$a^2 + b^2 + c^2 - abc = 0$

because

Statement – 2:

The elimination of x, y, z from the three equations described in (A) is $a^2 + b^2 + c^2 - abc = 4$

(a) Statement – 1 is True, Statement – 2 is True; Statement – 2 is a correct explanation for Statement – 1
(b) Statement – 1 is True, Statement – 2 is True, Statement – 2 is True; Statement – 2 is not a correct explanation for statement – 1
(c) Statement – 1 is True, Statement – 2 is False
(d) Statement – 1 is False, Statement – 2 is True

Q 75.

Statement – 1 :

If the polynomial equation f(x) = 0 of degree n has distinct roots $x_1, x_2, \ldots\ldots., x_n$ then

$f'(x) = \frac{f(x)}{x-x_1} + \frac{f(x)}{x-x_2} + \ldots\ldots + \frac{f(x)}{x-x_n}$

because

Statement – 2:

$f(x) = k(x - x_1)(x - x_2) \ldots\ldots\ldots (x - x_n)$

(a) Statement – 1 is True, Statement – 2 is True; Statement – 2 is a correct explanation for Statement – 1
(b) Statement – 1 is True, Statement – 2 is True; Statement – 2 is not a correct explanation for Statement – 1
(c) Statement – 1 is True, Statement – 2 is False
(d) Statement – 1 is False, Statement – 2 is True

SECTION – IV

Linked Comprehension Type

This section contains 2 paragraph $M_{76\text{-}78}$ and $M_{79\text{-}81*}$ Based upon each paragraph, 3 multiple choice question have to be answered. Each question has 4 choice (a), (b), (c) and (d), out of which ONLY ONE is correct.

$M_{76\text{-}78}$: Paragraph for Question Nos. 76 to 78

A quadrilateral ABCD is inscribed in a circle whose diagonals are mutually perpendicular and intersect at a point E. A line perpendicular to AB is drawn through the point E meets CD at M It is given that AD = 8, AB = 4, ∠CDB = α.

Answer the following question:

<u>Q 76</u>.

The value of EM must be

(a) $2\sqrt{2\tan^2\alpha + 3}$
(b) $2\sqrt{4\tan^2\alpha + 3}$
(c) $2\sqrt{4\tan^2\alpha + 3}$
(d) None of these

<u>Q 77</u>.

DM must be equal to (?)

(a) $2\sqrt{4\tan^2\alpha + 3}$
(b) $4\sqrt{2\tan^2\alpha + 3}$
(c) $2\sqrt{2\tan^2\alpha + 3}$
(d) None of these

<u>Q 78</u>.

Area of the triangle AEB must be

(a) $4\sin 2\alpha$
(b) $4\cos 2\alpha$
(c) $8\cos 2\alpha$
(d) None of these

$M_{79\text{-}81}$: Paragraph for Question Nos. 79 to 81

For any $x > 0$, the inequality $\sin x < x$ is well known, Answer the following question:

Q 79.

$2 \sin \frac{x}{2}$ - sin x is certainly

(a) Greater than 0
(b) Less than 1
(c) Less than 1/8 x^3
(d) Less than equal to $\frac{x^3}{16}$

Q 80.

$2^n \sin \frac{1}{2^n}$ x – sin x is certainly

(a) Greater than 0
(b) Less than 1
(c) Less than x^3 / 6
(d) Less than x^3 / 36

Q 81.

The result in question 80 above implies if $n \to \infty$ then

(a) $x - \sin x > 1$
(b) $x - \sin x < \frac{1}{6} x^3$
(c) $x - x \sin x < x^3 / 8$
(d) None of these

PARPER – II

PART – I (PHYSICS)

SECTION – I

Straight Objective Type

This section contains 9 multiple choice questions numbered 1 to 9. Each question has 4 choices (a), (b), (c) and (d), out of which ONLY ONE is correct

Q 1.

A rod of length l made of isotropic material of Young's modulus Y, area of cross-section A is hung from the ceiling and heated uniformly. When the temperature is altered by 0 from 0°C, the tension will be

(a) AY α θ

(b) AY α 0 (1 + 2α θ)
(c) $\frac{AY\ \alpha\theta}{2}$ (2 + α θ)
(d) Y α (1 + 2αθ)

Q 2.

The ratio of de-Broglie wavelength of molecules of Hydrogen and Helium which are at 27°C and 127°C respectively is

(a) $\sqrt{\frac{5}{3}}$
(b) $\sqrt{\frac{8}{3}}$
(c) $\sqrt{\frac{3}{5}}$
(d) $\sqrt{\frac{3}{8}}$

Q 3.

The plane mirror is made of glass slab of refractive index μ = 1.5. thickness 2.5 cm and silvered on the back. A point object is placed 5 cm in front of the unsilvered face of the mirror. The position of final image is from front face.

(a) 12 cm.
(b) 14.6 cm.
(c) 5.67 cm.
(d) 8.33 cm.

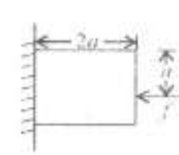
Q 4.

The dimension of of $\left(\frac{1}{2}\right)$ ϵ_0 E^2 (ϵ_0 : permittivity of free space, E : electric field) is

(a) MLT^{-1}
(b) $ML^2\ T^2$
(c) $ML^{-1}\ T^2$
(d) $ML^2\ T^{-1}$

Q 5.

A block of mass m is held stationary against a rough wall by applying a force F as shown in figure. Which one of the following statement is correct



(a) Frictional force f = mg.
(b) Normal reaction N = mg.
(c) F will not produce a torque.
(d) N will not produce any torque.

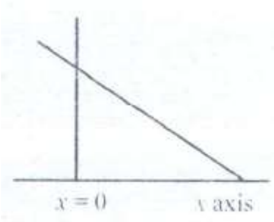
Q 6.

A plane is inclined at an angle 30° with horizontal. The component of vector A = - $10\hat{k}$ perpendicular to to this plane is (consider z – direction to be vertically upwards)

(a) $5\sqrt{2}$
(b) $5\sqrt{3}$
(c) 5
(d) 2.5

Q 7.

A uniform rod of length l is kept vertically on a rough horizontal source at x = 0. It is rotated slightly and relcased. When the road finally falls on the horizontal surface, the lower end will remain at



(a) $x = \frac{l}{2}$
(b) $x > \frac{1}{2}$
(c) $x < \frac{l}{2}$
(d) x = 0

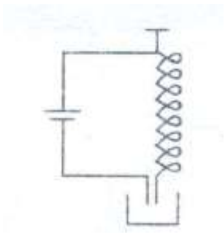
Q 8.

A uniform metallic ball is rotating with angular speed ω about its diameter. If coefficient of expansion of its metal is α and temperature is increased by T, then new angular speed is

(a) $\frac{\omega}{1+2\alpha\,\theta}$
(b) $\frac{\omega}{1+\alpha\,\theta}$
(c) $\frac{\omega}{2+3\,\alpha\,\theta}$
(d) $\frac{\omega}{1+\frac{2}{3}\alpha\,\theta}$

Q 9.

A soft spiral spring hangs freely. The lower end of the spring is immersed in a cup of mercury. The spring and the cup are connected to a d.c. source as shown. Then



(a) The spring will sink more into mercury.
(b) There will be no change in the length of spring.
(c) The spring will vibrate.
(d) The spring will become wider.

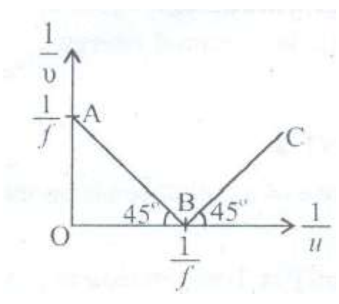
SECTION – II

Multiple Objective Type

This section contains 8 multiple choice questions numbered 10 to 17. Each question has 4 choices (a), (b), (c) and (d), out of which MORE THAN ONE may be correct.

Q 10.

The variation of $\frac{1}{v}$ versus $\frac{1}{u}$ for concave mirror has been drawn. From the graph one can conclude that



(a) Portion AB of graph corresponds to real image.
(b) Portion AB of graph corresponds to virtual image.
(c) Portion BC of graph corresponds to real image.
(d) Portion BC of graph corresponds to virtual image.

Q 11.

A sonometer wire of 110 cm has three segments vibrating with frequency ratio 1 : 2 : 3.

(a) The length of the middle segment is 27.27 cm.
(b) The ratio of the length of first and third segment is 3 : 1.
(c) The ratio of first to third is 2 : 3.
(d) The length of the middle segment is 10 cm.

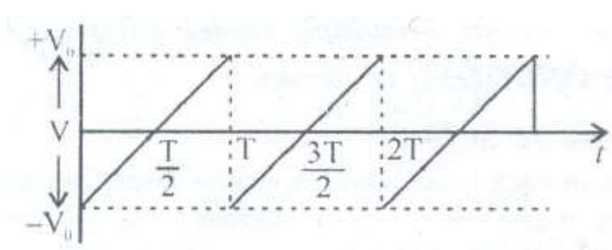
Q 12.

Two bulbs consume same power when operated a 200 V and 300 V respectively. When these bulbs are connected in series across a D.C source of 500 V, then

(a) Ratio of potential difference across them is 3/2.
(b) Ratio of potential difference across them is 4/9.
(c) Ratio of power consumed across them is 4/9.
(d) Ratio of power consumed across them is 2/3.

Q 13.

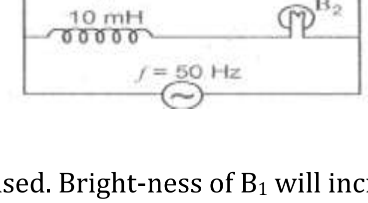
Saw-tooth voltage of peak value V_0 has been shown. For this type of wave



(a) Average value of voltage for time period $\frac{T}{2}$ $is \frac{V_0}{3}$.
(b) Average value of voltage for time period $\frac{T}{2}$ is $\frac{V_0}{2}$.
(c) Rms voltage for time period T is $\frac{V_0}{\sqrt{3}}$.
(d) Rms voltage for time period T is $\frac{V_0}{2}$.

Q 14.

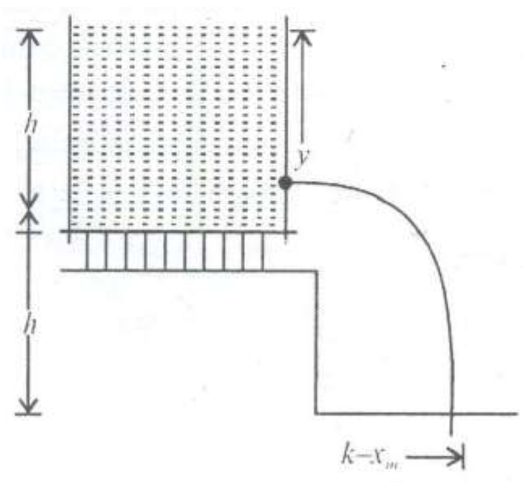
In circuit shown in the figure,



If both indentical then:

(a) Their brightness will be same.
(b) B_2 will be brighter than B_1.
(c) As frequency of supply voltage is increased. Bright-ness of B_1 will increase and that of B_2 will decrease.
(d) Only B_2 will glow because the capacitor has infinite impedence.

Q 15.



A tank is filled up to a height h with a liquid and is placed on a plateform of height h from the ground. To get maximum range x_m, a small hole is punched at a distance y from the free surface of the liquid. Then

(a) $x_m = 2h$
(b) $x_m = 1.5\ h$
(c) $y = h$
(d) $y = 0.75\ h$

Q 16.

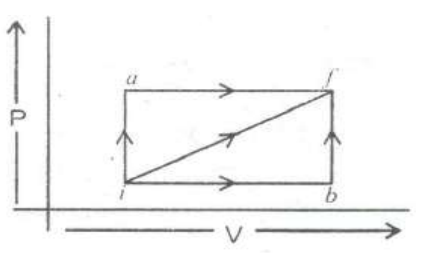
When an electron moving at a high speed strikes a metal surface then

(a) The entire energy of electron may be converted to X-ray photon.
(b) Any fraction of the energy of electron may be converted into X – ray photon.
(c) The entire energy of electron may get converted into heat.
(d) The electron may undergo elastic collision with the metal surface

Q 17.

When a system is taken from i of f along $i\ a\ f$, heat absorbed by the system is 50 calories and work done by the system is equal to 20 calorie. Along the path $i\ b\ f$, Q = 36 calorie. Then

(a) $W_{ibf} = 6$ cal
(b) Change in internal energy is different for different path
(c) Change in internal energy same for all path
(d) None of these.



SECTION – III

Assertion – Reason Type

This section contains 4 questions numbered 18 to 21. Each question contains STATEMENT – 1 (Assertion) and STATEMENT – 2 (Reason). Each question has 4 choices (a), (b), (c) and (d) out of which ONLY ONE is correct.

Q 18.

STATEMENT – 1

The force of friction in the case of a disc rolling without slipping down an inclined plane is zero.

Because

STATEMENT – 2

When the disc rolls without slipping, friction is required because for rolling condition velocity of point of contact is zero.

(a) Statement – 1 is True, Statement – 2 is True; Statement – 2 is a correct explanation for Statement – 1.
(b) Statement – 1 is True, Statement – 2 is True; Statement – 2 is NOT a correct explanation for Statement – 1.
(c) Statement – 1 is True, Statement – 2 is False.
(d) Statement – 1 is False, Statement – 2 is True.

Q 19.

No engine can cool a body, cooler than its surrounding.

because

STATEMENT – 2

External work done on the system, can make a body to lose more energy such that the temperature may fall lower than the surrounding.

(a) Statement – 1 is True, Statement – 2 is True; Statement – 2 is a correct for Statement – 1.
(b) Statement – 1 is True, Statement – 2 is True; Statement – 2 is NOT a correct explanation for Statement – 1.
(c) Statement – 1 is True, Statement – 2 is False.
(d) Statement – 1 is False, Statement – 2 is True.

Q 20.

STATEMENT – 1

Due to opposition offered by self-inductance, work is done by external agent in establishing current in circuit. This work done is stored as potential energy.

because

STATEMENT – 2

Self – inductance of a coil depends on the geometry of coils and medium.

(a) Statement – 1 is True, Statement – 2 is True; Statement – 2 is a correct explanation for Statement – 1.
(b) Statement – 1 is True, Statement – 2 is True; Statement – 2 is NOT a correct explanation for Statement – 1.
(c) Statement – 1 is True, Statement – 2 is False.
(d) Statement – 1 is False, Statement – 2 is True.

Q 21.

STATEMENT – 1

Direct vision spectroscope works on the principle of dispersion without deviation.

because

STATEMENT – 2

Crown and flint glass prisms are used to produce the effect of dispersion.

(a) Statement – 1 is True, Statement – 2 is True ; Statement – 2 is a correct explanation for Statement – 1.
(b) Statement – 1 is True, Statement – 2 is True; Statement – 2 is NOT a correct explanation for Statement – 1.
(c) Statement – 1 is True, Statement – 2 is False.
(d) Statement – 1 is False, Statement – 2 is True.

SECTION – IV

Linked Comprehension Type

This section contains 2 paragraph P_{22-24} and P_{25-27*} Based upon each paragraph, 3 multiple choice question have to be answered. Each question has 4 choices (a),(b), (c) and (d) out of which ONLY ONE is correct.

P22-24 : Paragraph for Question Nos. 22 to 24

When two bodies undergo collision, each one exert K on each other. The K's on each mass are in opposite direction. The collision may be perfectly elastic or inelastic depending on the conservation of momentum and energy. If an external force acts on the bodies during collision, the momentum conservation may not be applied for the direction of applied force. A quality called

$B = -\frac{Relative\ velocity\ after\ collision}{Relative\ velocity\ before\ collision}$ is define to find the nature of collision.

<u>Q 22</u>.

The factor K refers to

(a) Coefficient of restitution
(b) energy
(c) impulse
(d) momentum

<u>Q 23</u>.

The value of B can be

(a) > 0
(b) < 1
(c) $0 < B < 1$
(d) Always 1

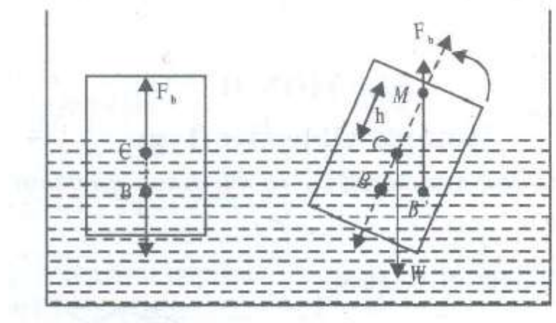
<u>Q 24</u>.

A particle of mass m moving with $u\hat{\imath} + \hat{\jmath}$ hits another particle 2m moving with $-2u\hat{\imath} + 2\hat{\jmath}$. If velocity of 2m is $\left(\frac{u}{2}\,\hat{\imath} + \hat{\jmath}\right)$ after collision, the velocity of m will be.

(a) $4u\hat{\imath} - 3\hat{\jmath}$
(b) $-4u\hat{\imath} - 3\hat{\jmath}$
(c) $+4u\hat{\imath} + 3\hat{\jmath}$
(d) $-4u\hat{\imath} + 3\hat{\jmath}$

P25-27 : Paragraph for Question Nos. 25 to 27

Figure 1 shows a body floating in equilibrium, with the centre of gravity and centre of buoyancy lying on the same normal. On tilting the body by an angle α, the centre of buoyancy shifts. The vertical line through the new centre of buoyancy meets the original line joining the centre of buoyancy meets and gravity at a point called Metacentre M. Distance between the centre of buoyancy B and metacetre M is given by the ratio between the moment of inertia about longitudinal axis and volume of water displaced. A cylinder has a diameter d, length l and specific gravity ρ. It displaces W weight per unit volume when immersed to a depth Y in water



Q 25.

From the bottom of the cylinder, the centre of buoyancy is at a distance,

(a) $\frac{\rho l}{2}$
(b) ρl
(c) $2\ \rho l$
(d) $\frac{2}{3}\rho l$

Q 26.

The metacentre is at a distance of (from the bottom surface)

(a) $\rho l + \frac{d^2}{pl}$
(b) $\frac{3d^2}{pl}$
(c) $2\rho l$
(d) $\frac{\rho l}{2} + \frac{d^2}{16\rho l}$

Q 27.

For any floating body to be in equilibrium Metacentre can / should be

(a) below centre of gravity
(b) above centre of gravity
(c) at the same level as centre of gravity
(d) any where

PART – II (CHEMISTRY)

SECTION – I

Straight Objective Type

This section contains 9 multiple choice questions numbered 28 to 36. Each question has 4 choices (a), (b), (c) and (d), out of which ONLY ONE is correct.

Q 28.

When neo-pentyl alcohol is reacted with conc. H_2SO_4, the major product formed is

(a) 2 – methyl-but – 2 enc
(b) 2 – methyl – but – 1 – enc
(c) 2,2 – dimethylpropene
(d) It cannot be dehydrated

Q 29.

Which of the following species is not linear?

(a) XeF_2
(b) I_3^-
(c) N_3^-
(d) OF_2

Q 30.

The standard reduction potential $E°_{Ag+/Ag} = 0.80$ V at 298K. If K_{sp} for AgCI, calculate the standard half cell reduction potential for the Ag/AgCI electrode.

(a) 0.50 V
(b) 0.22 V
(c) 0.2 V
(d) None of these

Q 31.

Which of the following liberate CI_2 when I_2 is added to

(a) $KCIO_3$
(b) KCI
(c) NaCI
(d) $CaCI_2$

Q 32.

A metal crystallizes into two cubic lattices i.e. FCC and BCC whose unit cell edge length are 3.5 Å and 3.0 Å respectively. The ratio of their densities of FCC to BCC are

(a) 2.259
(b) 1.259
(c) 3.259
(d) 4.259

Q 33.

There is a salt BA obtained from BOH, a weak base and HA, a weak acid, then degree of hydrolysis will be

(a) Directly proportional of $\sqrt{c}$ where c is the concentration in moles/litre of salt.
(b) Directly proportional to $\sqrt{k_h}$ where K_h is the hydrolysis constant.
(c) Directly proportional to $\sqrt{V}$ where V = volume of solution.
(d) Directly proportional to $\frac{1}{\sqrt{c}}$ where c concentration in moles / litre of salt

Q 34.

The temperature change occurring when one moles of a diatomic gas enclosed in a closed container fitted with a movable piston is heated by giving heat equal to 50 J and does not work 100 J is

(a) 2.14
(b) – 2.14
(c) – 1.24
(d) 1.24

Q 35.

A mixture of solid MSO_4 and solid NSO_4 is shacken up with until saturated solution i.e. equilibrium was established given that

K_{sp} $MSO_4 = 7.5 \text{ X } 10^{-7}$, K_{sp} $NSO_4 = 1.5 \text{ x } 10^{-9}$ I Ience. Solubility of M^{2+}. Is

(a) 1.73×10^{-6}
(b) 8.65×10^{-4}
(c) 8.65×10^{-4}
(d) 10.4×10^{-10}

Q 36.

The standard reduction potential for the reaction $2H_2O + 2e \rightarrow H_2$ OH is – 0.8277 V. The K for reaction $2\ H_2O \rightleftharpoons H_3O^+ + 2$ OH will be

(a) 10^{-14}
(b) 9.35×10^{-15}
(c) 10^{-13}
(d) 10^{-12}

SECTION – II

Multiple Objective Type

This section contains 8 multiple choice questions numbered 37 to 44. Each question has 4 choices (a), (b), (c) and (d), out of which MORE THAN ONE may be correct.

Q 37.

Which of the following contain and odd number of valence electrons and are paramagnetic ?

(a) NO
(b) NO_2
(c) CIO_2
(d) CO

Q 38.

$CH_3COOC_2H_2$ on reaction with sodium ethoxide gives a compound 'X' which on hydrolysis in presence of acid gives another compound 'Y' which on heating gives 'Z'. Which of the following are X, Y, and Z respectively?

(a) $CH_3COCH_2COOC_2H_5$
(b) CH_3COCH_2COOH
(c) CH_3COOCH_3
(d) $CH_3COCH_2CH_3$

Q 39.

In which of the following conditions, process will be spontancous?

(a) $\Delta H = -$ ve, $\Delta S = +$ ve
(b) $\Delta S_{Total} = +$ ve
(c) $K > 1$
(d) $E^\circ_{cell} = +$ ve

Q 40.

Which of the following statements related to equilibrium are spontancous?

(a) $\frac{dl \ln K_C}{dT} - \frac{\Delta U^\circ}{RT^2}$

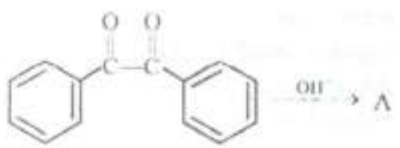
(b) $\left(\frac{\partial ln\, K_p}{\partial P}\right)_T \frac{\partial}{\partial P}\left(\frac{\Delta G^\circ}{RT}\right)_T = 0$

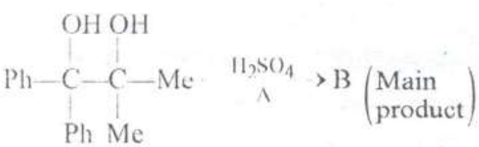
(c) $\left(\frac{\partial \ln K_C}{\partial P}\right)_T \left(\frac{\partial \ln K_p}{\partial P}\right)_T - \Delta n_g \left(\frac{\partial RT}{\partial P}\right)_T$

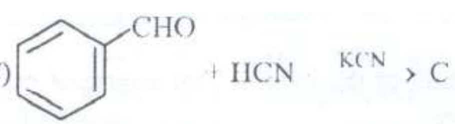
(d) $\left(\frac{\partial Q}{\partial T}\right)_P \left(\frac{\partial C}{\partial T}\right)_P$

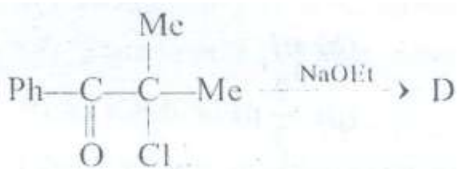
Q 41.

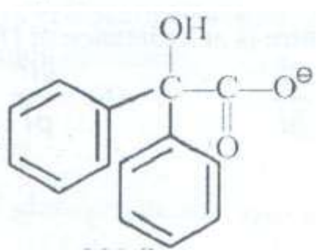
Which of the following statements are correct ?

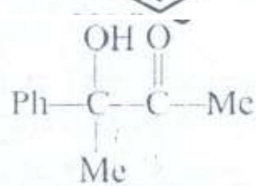
(i) 

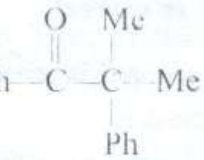
(ii) 

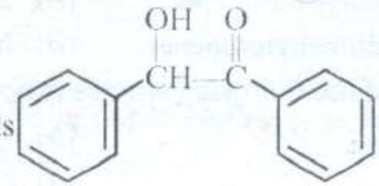
(iii) 

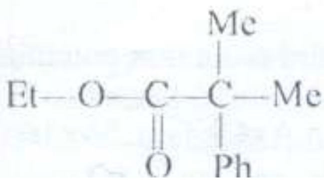
(iv) 

(a) Compound A is 

(b) Compound B is 

(c) Compound B is 

(d) Compound C is 

and compound D is 

Q 42.

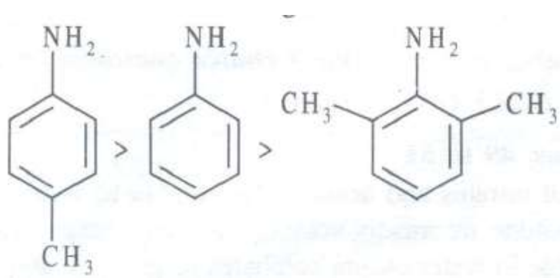
Which of the following statement are correct?

(a) The solubility of all salts of 2nd group decreases down the group.
(b) The solubility of chlorides of 1st group is CsCI > NaCI > KCI.
(c) The second group biearbonates are highly soluble.
(d) The acidic strength increases with increase in oxidation state of central atom.

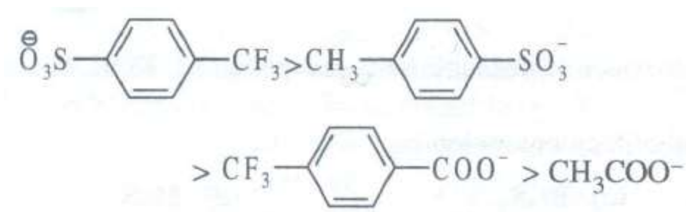
Q 43.

Which of the following statements are true ?

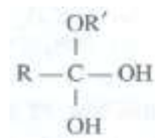
(a) The correct basic strength is



(b) The correct leavability order is

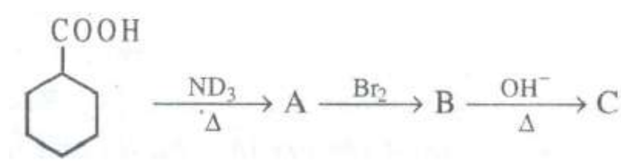


(c) The reactivity of carboxylic acids with alcohols depends

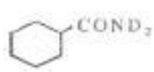
Upon the stability of the intermediate 

(d) During esterification reaction, the RCOOH behaves as a Lewis acid and not as a Bronsted Lowry acid

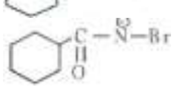
<u>Q 44</u>.

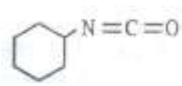


In the reaction sequence given above

(a) Compound A is 

(b) Compound B is 

(c) Compound C is 

(d) Compound C on rearrangement gives 

SECTION – III

Assertion – Reason Type

The section contains 4 questions numbered 45 to 48. Each question contains STATEMENT – 1 (Assertaion) and STATEMENT – 2 (Reason). Each question has 4 choice (a), (b), (c) and (d) out of which ONLY ONE is correct.

<u>Q 45</u>.

STATEMENT – 1 :

Rate of a zero order reaction increases with increase in concentration because

STATEMENT – 2:

Rate of zero order reaction = k (rate constant)

(a) Statement – 1 is True, Statement – 2 is True; Statement – 2 is a correct explanation for Statement – 1.
(b) Statement – 1 is True, Statement – 2 is True; Statement – 2 is NOT a correct explanation for Statement – 1.
(c) Statement – 1 is True, Statement – 2 is False.
(d) Statement – 1 is False, Statement – 2 is True.

Q 46.

STATEMENT – 1:

In nitrobenzene, addition reactions are possible.

because

STATEMENT – 2 :

Nitro group deactivated the benzene ring.

(a) Statement – 1 is True, Statement – 2 is True; Statement – 2 is correct explanation for statement – 1.
(b) Statement – 1 is True, Statement – 2 is True; Statement – 2 is NOT a correct explanation for Statement – 1.
(c) Statement – 1 is True, Statement – 2 is False.
(d) Statement – 1 is False, Statement – 2 is True,

Q 47.

STATEMENT – 1:

All proteins are enzymes while all enzymes are not proteins.

because

STATEMENT – 2:

Enzyme are biocatalysts.

(a) Statement – 1 is True, Statement - 2 is True; Statement – 2 is correct explanation for Statement – 1.
(b) Statement – 1 is True, Statement – 2 sit True, Statement – 2 is NOT a correct explanation for Statement – 1.
(c) Statement – 1 is true, Statement – 2 is False.
(d) Statement – 1 is False, Statement – 2 is True,

Q 48.

STATEMENT – 1 :

A reversible process involves the maximum work. because

STATEMENT – 2 :

In a reversible expansion, the system expands /contracts minimum number of times.

(a) Statement – 1 is True, Statement – 2 is True; Statement – 2 is a correct explanation for Statement – 1.
(b) Statement – 1 is True, Statement – 2 is True; Statement – 2 is NOT a correct explanation for Statement – 1.
(c) Statement – 1 is True, Statement – 2 is False.
(d) Statement – 1 if False, Statement – 2 is True.

SECTION – IV

Linked Comprehension Type

This section contains 2 paragraph C_{49-51} and C_{52-54*} Based upon each paragraph, 3 multiple choice question have to be answered. Each question has 4 choices (a), (b), (c) and (d) out of which ONLY ONE is correct.

C49-51 : Paragraph for Question Nos. 49 to 51

Solubility is defined as amount of solute dissolved per 100 g of solution. All nitrates and acetates are soluble in water because their hydration energy dominates over lattice energy. Chlorides, bromides, iodides are mostly soluble in water except of group 1 radicals $PbCI_2$. $PbBr_2$ are soluble in hot water. Most of the sulphates are soluble in water except sulphates of group V and $PbSO_4$, Ag_2SO_4 Hg_2SO_4 are sparingly soluble. All salts of alkali metals except lithium are soluble in water. All salts of ammonium are soluble in water.

All carbonates, phosphates are insoluble except Na^+, K^+, NH_4^+. Hydroxides of insoluble salts except NaOH, KOH, CsOH, RbOH, $Sr(OH)_2$, $Ba(OH)_2$, $Ca(OH)_2$ are slightly soluble.

Sulphides are insoluble except alkli metals, alkaline earth metals and of ammonium ion.

Q 49.

Which of the following are soluble in water?

(a) $MgSO_4$
(b) $BaSO_4$
(c) $PbSO_4$
(d) $SrSO_4$

Q 50.

Which of the following is soluble in water?

(a) BaS
(b) ZnS
(c) Bi_2S_3
(d) MnS.

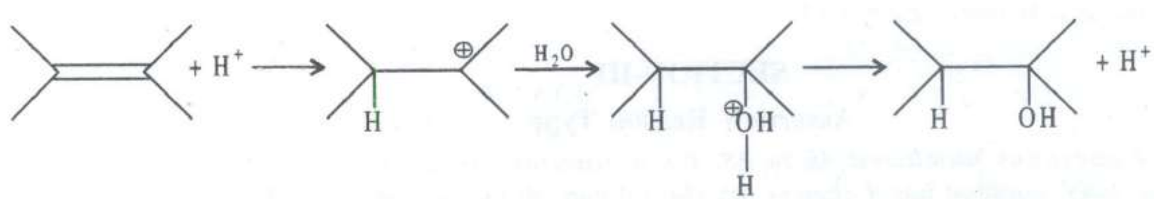
Q 51.

Which of the following are insoluble in water?

(a) CaC_2O_4
(b) $(NH_4)_2CO_3$
(c) $(NH_4)_3PO_4$
(d) $BaCI_2$

C52-54 : Paragraph for Question Nos. 52 to 54

The hydration of alkenes in the presence of acids proceed via carbocation mechanisms as given below:

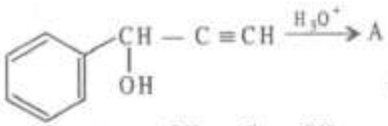


and that carbocation is formed which is most stable, It is observed that alkenes are more reactive than alkynes towards any electrophile.

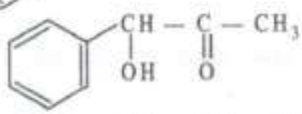
This reaction, i.e., the electrophilic addition reaction of alkenes and alkynes with symmetrical addendum

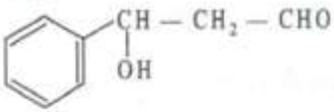
This shows that all reactions of alkenes and alkynes for electrophilic addition reactions may either take place via intermediates of transition state.

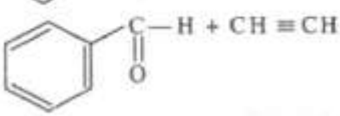
Q 52.

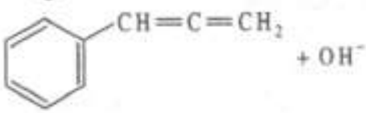


Hence here 'A' is

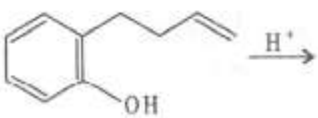
(a) 

(b) 

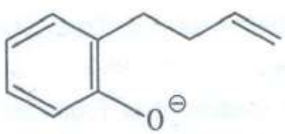
(c) 

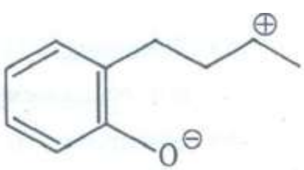
(d) 

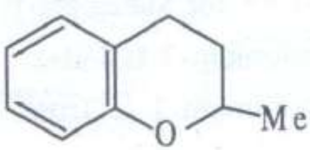
Q 53.

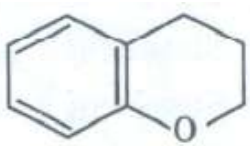


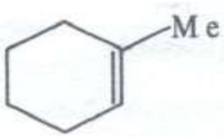
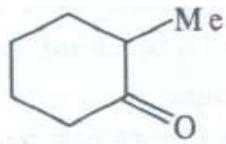
B, here B is

(a) 

(b) 

(c) 

(d) 

54.  can be converted to 

(a) (i) H^+/H_2O

(ii) PCC (pyridinium chlorochromate)

(b) (i) B_2H_6/ether (ii) H_2O_2 / OH^- (iii) PCC
(c) (i) Hg $(OAc)_2$ /AcOH (ii) PCC
(d) (i) $H^+/H_2O/H_2O_2$ (ii) PCC

PART – III (MATHEMATICS)

SECTION – I

Straight Objective Type

This section contains 9 multiple choice questions numbered 55 to 63. Each question has 4 (a), (b), (c) and (d), out of which ONLY ONE is correct.

Q 55.

Evergy integer of the form $(n^3 - n)(n - 2)$, (for n = 3, 4. ....) is

(a) divisible by 9
(b) divisible by 12 but not always divisible by 24
(c) divisible by 24 but not always divisible by 48
(d) divisible by 6 but not always divisible such that

Q 56.

Let $x_1, x_2, \ldots\ldots, x_{50}$ fifty non-zero numbers such that $x_i + x_{i+1} = k$ for all I, $1 \leq i \leq 49$.

If $x_{14} = a$, $x_{27} = b$, then $x_{20} + x_{37}$ equals to

(a) 2 (a +b) – k
(b) k + b
(c) k + a
(d) None of these

Q 57.

The number of ordered pairs (x, y) of positive integers such that $x + y = 90$ and their greatest common divisor is 6 q in terms of a and b is 6 equals

(a) 8
(b) 14
(c) 15
(d) 10

Q 58.

$a \pm bi$ $(b \neq 0, i = \sqrt{-1})$ are complex roots of the equation $x^3 + qx\ r = 0$, where a, b, q and r real numbers. Then q in terms of a and b is

(a) $a^2 + b^2$
(b) $b^2 - 3a^2$
(c) $b^2 - 2a^2$
(d) $a^2 - b^2$

Q 59.

ABC is a right-angled triangle with right angle at B, D is a point on AC such that $\angle ABD = 45°$. If $AC = 6$ cm and $AD = 2$ cm, then AB is

(a) $\frac{6}{\sqrt{5}}$ cm
(b) $\frac{125}{\sqrt{5}}\ cm$
(c) $2\ cm$
(d) $3\sqrt{2}$ cm

Q 60.

If $f(x) = \frac{x^n(1-x)^n}{n!}$, then for any integer $k \geq 0$, the k-th derivatives $f^{(k)}(0)$ and $f^{(k)}(1)$

(a) are both rational numbers but not necessarily integers
(b) are both 0
(c) are both integers
(d) None of these

Q 61.

If $(3 + x^{2008} + x^{2009})^{2006} = \alpha_0 + \alpha_1 x + \alpha_2 x^2 + \ldots\ldots \alpha_m x^m$, then the value of

$$\alpha_0 - \frac{1}{2}\alpha_1 - \frac{1}{2}\alpha_2 + \alpha_3 - \frac{1}{2}\alpha_4 - \frac{1}{2}\alpha_5 + \alpha_6 \ldots\ldots\ldots is$$

(a) 3^{2006}
(b) 1
(c) 2^{2006}
(d) None of these

Q 62.

$\lim_{x \to 0} \frac{\tan(\pi \sec^2 x)}{x \sin^{-1} x}$ is equal to

(a) $-\pi$
(b) 2π
(c) 0
(d) Π

Q 63.

The number of integers $n > 1$, such that n, $n + 2$, $n + 4$ are all prime numbers, is

(a) Infinite
(b) One
(c) Zero
(d) More than one, but finite

SECTION – II

Multiple Objective Type

This section contains 8 multiple choice questions numbered 64 to 71. Each question has 4 choices (a), (b), (c) and (d), out of which MORE THAN ONE may be correct.

Q 64.

If $\alpha \geq b > 0$ and $M = \frac{a+b}{2} - \sqrt{ab}$ then

(a) $M \geq \frac{(a-b)^2}{8a}$
(b) $M \geq \frac{(a-b)^2}{4a}$
(c) $M \geq \frac{1}{2}\frac{(a-b)^2}{b}$
(d) $M \geq \frac{(a-b)^2}{4b}$

Q 65.

If f (a, b)= $\int_0^{\pi/2} \log(a^2 \cos^2 x + b^2 \sin^2 x)dx$, then

(a) f (a, v) > 0 for all a, b
(b) f (a, b) = 0 if a = b
(c) f (a, b) = π log $\frac{a+b}{2}$
(d) f (a, b) = $\frac{\pi}{2}$ log (a + b)

Q 66.

The system of equations ax + by = 1, $cx^2 + dy^2 = 1$

(a) Has only one solution if $\frac{a^2}{c} + \frac{b^2}{d} = 1$
(b) Has only one solution if $a^2 + b^2 = c^{2+d}2$
(c) may be satisfied by x = a/c
(d) may be satisfied by y = b/d

Q 67.

Let I = $\int_0^z \frac{dx}{1+x^4}$, J $\int_0^\infty \frac{x^2\,dx}{1+x^4}$, then

(a) I = $\frac{\pi}{2\sqrt{2}}$
(b) J = $\frac{\pi}{\sqrt{2}}$
(c) I = $\frac{\pi}{\sqrt{2}}$
(d) J = $\frac{\pi}{2\sqrt{2}}$

Q 68.

If a > 0 we define $x_0 = \sqrt{a}$, $x_1 = \sqrt{a+\sqrt{a}}$, $x_2 = \sqrt{a+\sqrt{a+\sqrt{a}}}$ and so on then

(a) $x_n^2 = a + x_{n-1}$
(b) $x_n^2 = a - x_{n-1}$
(c) $x_{n-1}^2 - x_{n-1} - a < 0$
(d) $\lim\limits_{n\to\infty} x_n = \frac{\sqrt{4a+1}+1}{2}$

Q 69.

If $^nC_3 + {}^nC_7 + {}^nC_{15} + \ldots\ldots\ldots$ upto meaning full terms = $2^\lambda - 2^\mu \sin\frac{n\pi}{4}$, where λ, μ are constants which depend upon n then

(a) λ = n

(b) λ – n – 2
(c) $\mu = \frac{n-1}{2}$
(d) $\mu = \frac{n-2}{2}$

Q 70.

If $\frac{x\,(y+z-x)}{\log x} = \frac{y\,(z+x-y)}{\log y} = \frac{z\,(x+y-z)}{\log z}$

(a) x = y = z essentially
(b) $y^y . y^x = y^z . z^y = x^z . z^x$
(c) $x^y = y^z = z^x$
(d) xyz = 1

Q 71.

Let f (x) = cos x + $\frac{1}{2}$ cos 2x – $\frac{1}{3}$ cos 3x then

(a) difference of max. f (x) and min. f (x) is 1/2.
(b) difference of max. f (x) and min. f (x) is 9/2.
(c) difference of max. f (x) and min. f (x) is greater then 1
(d) difference of max. f (x) and min. f (x) is smaller than 1

SECTION – III

Assertion – Reason Type

This section contains 4 question numbered 72 to 75. Each question contains Statement – 1 (Assertion) and Statement – 2 (Reason). Each question has 4 (a), (b), (c) and (d) out of which ONLY ONE is correct.

Q 72.

Statement – 1:

If a > - 1 then f (a) $\int_0^x \frac{1-e^{-ax}}{xe^x}$ dx = log (1 + a)

because

Statement – 2:

f' (a) $\int_0^x e^{-x(a+1)}$dx

(a) Statement – 1 is True, Statement – 2 is True; Statement – 2 is a correct explanation for Statement – 1
(b) Statement – 1 is True, Statement – 2 is True; Statement – 2 is not a correct explanation for Statement – 1

(c) Statement – 1 is True, Statement – 2 is False
(d) Statement – 1 is False, Statement – 2 is True

Q 73.

Statement – 1:

If the points of intersection of line $x + y = a$ with the circle $x^2 + y^2 = b^2$ lie on $x^4 + y^4 = c^4$ then

$a^4 - 2a^2b^2 - b^4 = 0$.

because

Statement – 2:

No point on the curve $x^4 + y^4 = c^4$ can have x-coordinate more than c.

(a) Statement – 1 is True, Statement – 2 is True; Statement – 2 is a correct explanation for statement – 1
(b) Statement – 1 is true, Statement – 2 is True; Statement – 2 is not a correct explanation for Statement – 1
(c) Statement – 1 is True, Statement – 2 is False
(d) Statement – 1 is False, Statement – 2 is True

Q 74.

Statement – 1:

If the equation $x^5 - 10a^3 x^2 + b+4^x + c^5 = 0$ has three equal roots the $ab^4 - 9a^5 + c^5 = 0$.

because

Statement – 2:

If ß is a root of multiplicity 3 of the question $f(x) = 0$ then $f(ß) = f'(ß) = f''(ß) = 0$.

(a) Statement – 1 is True, Statement – 2 is True; Statement – 2 is a correct explanation for Statement – 1
(b) Statement – 1 is True, Statement – 2 is True; Statement – 2 is not a correct explanation for Statement 1
(c) Statement – 1 is True, Statement – 2 is False
(d) Statement – 1 is False, Statement – 2 is True

Q 75.

Statement – 1:

The roots of the equation

$x^3 + 12x - 12 = 0$ is $2 . 2^{1/3} - 4^{1/3}$.

because

Statement – 2 :

One of the roots of a cubic equation is always of the form $a^{1/3}$ where a is not a perfect cube.

(a) Statement – 1 is True, Statement – 2 is True; Statement – 2 is a correct explanation for Statement – 1
(b) Statement – 1 is True, Statement – 2 is True; Statement – 2 is not a correct explanation for Statement 1
(c) Statement – 1 is True, Statement – 2 is False
(d) Statement – 1 is False, Statement – 2 is True

SECTION – IV

Linked Comprehension Type

This section contains 2 paragraph $M_{76\text{-}78}$ and $M_{79\text{-}81*}$ Based upon each paragraph. 3 multiple choice question have to be answered. Each question has 4 choices (a), (b), (c) and (d), out of which ONLY ONE is correct.

M76-79 : Paragraph for Question Nos. 76 to 78

AOB is a triangle with $\angle AOB = \alpha$, A circle touches the side AO at a point C and interseets the side OB at points D and E. Let OC – a, OD = b, OD = b(b > a) $\angle OCE$ = ß. Answer the following questions:

Q 76.

The length DE must equal to

(a) $\frac{b^2 - a^2}{a}$
(b) $\frac{b^2 - a^2}{b}$
(c) $\sqrt{ab}$
(d) None of these

Q 77.

tan ß must be equal to

(a) $\frac{a \sin \alpha}{b - a \cos \alpha}$
(b) $\frac{a \cos \alpha}{b - a \cos \alpha}$
(c) $\frac{a \cos \alpha}{b - a \sin \alpha}$
(d) None of these

Q 78.

The radius of the circle must be equal to

(a) $\frac{a^2 + b^2 - 2ab \cos \alpha}{2b \sin \alpha}$
(b) $\frac{a^2 + b^2 - 2ab \cos \alpha}{2b \cos \alpha}$
(c) $\frac{a^2 + b^2 - 2ab \sin \alpha}{2b \sin \alpha}$
(d) None of these

M79-81 : Paragraph for Question Nos. 79 to 81

Consider the equation $x^2 + \frac{a^2 x^2}{(a+x)^2} = m^2$, where a and m are positive reals. Answer following questions :

Q 79.

By the transformation $y = \frac{x^2}{a+x}$, the equation is equivalent to

(a) $y^2 - 2ay + m^2 = 0$
(b) $y^2 - 2ay - m^2 = 0$
(c) $y^2 + 2ay - m^2 = 0$
(d) None of these

Q 80

All the four roots of the given equation will be real if

(a) $m^2 \geq 8a^2$
(b) $m^2 < 8a^2$
(c) $m^2 \geq 16a^2$
(d) None of these

Q 81.

If all four roots are real then

(a) The given equation has one negative and three positive roots
(b) The given equation has one negative and two positive roots
(c) The given equation has one negative and three negative roots
(d) None of these