PRACTICE PAPER – 7

Paper-I (Physics)

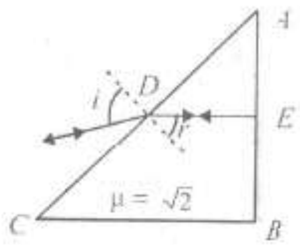
Section-1

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.

Q1

If one face of a prism of angle 30° and $\mu = \sqrt{2}$ is silvered and the incident ray retraces its initial path, what is the angle of incidence on the inclined surface ?



a. 90°

b. 180°

c. 45°

d. 65°

Q2

A proton is heading towards another proton at rest. Assume impact parameter to be zero, $i.e.$, head on collision. How close will the incident proton go to other proton ?

a. $\frac{e^3}{\pi^2 \varepsilon_0 m^2 v_0}$

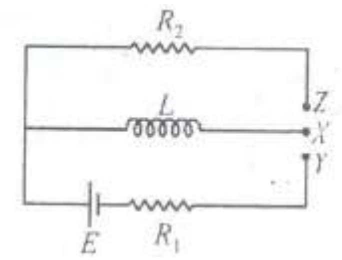
b. $\frac{e^3}{\pi \varepsilon_0^2 m v_0}$

c. $\frac{e^2}{\pi \varepsilon_0 m v_0^2}$

d. None of these

Q3

In the circuit shown, X is joined to Y for a long time and then X is joined to Z. The total heat produced in R_2 is



a. $\frac{LE^2}{2R_1^2}$

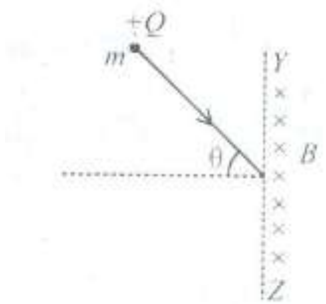
b. $\frac{LE^2}{2R_2^2}$

c. $\frac{LE^2R_2}{2R_1R_2}$

d. $\frac{LE^{2R^2}}{2R_1^3}$

Q4

A particle with charge + Q and mass m enters a perpendicular magnetic field of magnitude B, existing only to the right of boundary YZ. Let $T = 2\pi\left(\frac{m}{BQ}\right)$. The time spent by the particle in the field will be



a. $2T\ \theta$

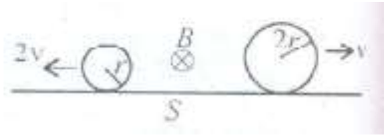
b. $4T\theta$

c. $T\left(\frac{\pi+2\theta}{2\pi}\right)$

d. $T\left(\frac{\pi-2\theta}{2\pi}\right)$

Q5

Two conducting rings of radii r and $2r$ move in opposite directions with velocities 2 v and v respectively on a conducting surface S. There is a uniform magnetic field of magnitude B perpendicular to the plane of rings. The potential difference between the highest points of the two rings is



a. Zero

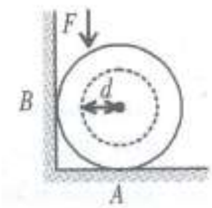
b. $2rv^2$ B

c. $8rv^2$ B

d. 8rv B

Q6

A cylinder having radius, $r = 0.1$ m and mass m = 2 kg is placed such that it is in contact with a vertical and horizontal surface as shown. The coefficient of static friction μ = 1/3 for both the surfaces. The distance d from the centre of the cylinder at which a force F = 40 N should be applied so that the cylinder just starts rotating in the anticlockwise direction is $(g = 10\ m/s^2)$



a. 0.04 m

b. 0.05 m

c. 0.06 m

d. 0.08 m

Q7

A cart loaded with sand having total mass m=1800 kg moves on a straight horizontal road starting from rest under the action of force of 120 N . The sand spills through a small hole in the bottom at a rate of K = 0.5 kg/sec. what will be the velocity of cart after 20 min ?

a. 220 m/s

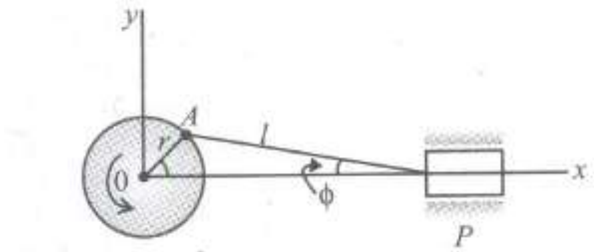
b. 160 m/s

c. 120m/s

d. 100m/s

Q8

The crank of a reciprocating mechanism of an engine rotates at an angular velocity of ω rad/sec, find the displacement time relation for the motion of piston *P* if the length of the connecting rod is l and the radius of the crank is r_1 assuming $l \gg r$



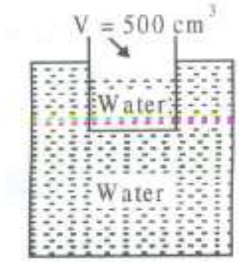
a. $r \sin \omega t + l^2$

b. $r \cos \omega t + l$

c. $r\ sin^2\ \omega t + l^2$

d. $r\ cos^2\ \omega t + l$

Q9



A glass beaker having mass 390 g and an interior volume of 500 cm^3 floats on water when it is less than half filled with water. What is the density of the material of the beaker ?

a. 2.79 g/cc

b. 0.37 g/cc

c. 13.5 g/cc

d. 0.35 g/cc

Section-II

Multiple Objective Type

Q10

A planet is observed by an astronomical refracting telescope having an object of focal length 16 m and an eye piece of focal length 2 cm. then

a. The distance between the objective and the eye piece is 16.02 m

b. The angular magnification of planet is -800.

c. The image of planet is inverted.

d. The objective is larger than the eye piece.

Q11

White light is used to illuminate the two slits in a Young's double slit experiment. The separation between the slits is b and the screen si at a distance $d(> b)$ from the slits. At a point on the screen directly in front of one of the slits, certain wavelengths are missing. Some of these missing wavelengths are

a. $\lambda = \frac{b^2}{d}$

b. $\lambda = \frac{2b^2}{d}$

c. $\lambda = \frac{b^2}{3d}$

d. $\lambda = \frac{2b^2}{3d}$

Q12

In Bohr's model of the hydrogen atom

a. The radius of the n^{th} orbit is proportional to n^2.

b. The total energy of the electron in n^{th} orbit is inversely proportional to n.

c. The angular momentum of the electron in an orbit is an integral multiple of $\frac{h}{2\pi}$

d. The magnitude of potential energy of the electron in any orbit is greater than its K.E.

Q13

Let m_p be the mass of a proton, m_n be the mass of a neutron, M_1 the mass of a ${}^{20}_{10}Ne$ nucleus and M_2 the mass of a ${}^{40}_{20}Ca$ nucleus. Then

a. $M_2 = 2M_1$

b. $M_2 > 2M_1$

c. $m_2 < 2M_1$

d. $M_1 < 10(m_n + m_p)$

Q14

A dielectric slab of thickness d is inserted in a parallel plate capacitor whose negative plate is at $x = 0$ and positive plate is at $x = 3d$. The slab is equidistant from the plates. The capacitor is given some charge. As x goes from 0 to 3d,

a. The magnitude of the electric field remains the same.

b. The direction of electric field remains the same.

c. The electric potential increases continuously.

d. The electric potential increases at first, then decreases and again increases.

Q15

A black body is at a temperature of 2880 K. the energy of radiation emitted by this object with wavelength between 499 nm and 500 nm is U_1, between 999 nm and 1000 nm is U_2 and between 1499 nm and 1500 nm is U_3. The wien constant $b = 2.88 \times 10^6$ nm K. then

a. $U_1 \neq U_2$

b. $U_3 = 0$

c. $U_1 > U_2$

d. $U_2 > U_1$

Q16

Two cylinders A and B are filled with pistons containing equal amounts of an ideal diatomic gas at 300 K. the piston of A is free to move, while that of B is held fixed. The same amount of heat is given to each gas in each cylinder. If the rise in temperature of the gas A is 30 K, Then

a. Rise in temperature of the B is 42° K.

b. Final temperature of the gas B will be 342° K.

c. Rise in temperature of gas B will be zero kelvin.

d. Not possible to calculate the rise in temperature of gas B with given data.

Q17

A particle is acted upon by a force of constant magnitude which is always perpendicular to the velocity of the particle. The motion of the particle takes place in a plane. It follows that

a. Its velocity is constant

b. Its acceleration is constant.

c. Its kinetic energy is constant.

d. It moves in a circular path.

Section-III

Assertion-Reason Type

Q18

Statement-1:

The temperature at which centigrade and Fahrenheit thermometers read the same is $-40°$.
because

Statement-2:

There is no relation between Fahrenheit and centigrade temperature.

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
Q19

Statement-1:

The ratio of specific heat of gas at constant pressure and specific heat at constant volume is more for helium gas than for hydrogen gas. Because

Statement-2:

Atomic mass of helium is more than that of hydrogen.

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

Q20

Statement-1:

Latent heat of fusion of ice is 336000 JKg^{-1}. because

Statement-2:

Latent heat refers to change of state without any change in temperature.

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

Q21

Statement-1:

The molecules at 0°C ice and 0°C water will have same potential energy. because

Statement-2:

Potential energy depends only on temperature of the system.

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

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

A liquid flowing from a vertical pipe has very definite shape as it flows from the pipe. To get the equation for this shape, assume that the liquid is in free fall once it leaves the pipe. Just as it leaves the pipe, the liquid has speed v_0 and the radius of stream of liquid is r_0.

Q22

A relation for the speed of liquid as a function of the distance y, it has fallen is

a. $v_2 = \sqrt{v_1^2 + 2a(y - y_0)}$

b. $v_1 = \sqrt{v_2^2 + 2a(y + y_0)}$

c. $v_2 = \sqrt{v_1^2 - 2a(y - y_0)}$

d. $v_1 = \sqrt{v_2^2 - 2a(y + y_0)}$

Q23

Combining the above result with the equation of continuity the expression for the radius of the stream as a function of y is

a. $r = \frac{r_0\sqrt{v_0}}{(v_0^2+2gy)^{1/2}}$

b. $r = \frac{r_0\sqrt{v_0}}{(v_0^2+2gy)^{1/4}}$

c. $r = (v_0^2 + 2gy)^{1/2}$

d. $r = (v_0^2 + 2gy)^{1/4}$

Q24

If water flows out of a vertical pipe at a speed of 1.2 m/s, how far below the outlet will the radius be half the original radius of stream ?

a. 410 m

b. 41 m

c. 1.1 m

d. 2 m.

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

To study the structure of lead nucleus, electrons are fired at a lead target. Some of the electrons actually enter the nuclei of the target, and the deflection of these electrons is measured. The deflection is caused by charge of nucleus, which is distributed almost uniformly over the spherical volume of the nucleus. A lead nucleus has a charge of + 82e and a radius of $R = 7.1 \times 10^{-15}\ m$.

Q25

Find the acceleration of an electron at a distance 2R from the centre of a calcium nucleus ?

a. $1 \times 10^{32} m/s^2$

b. $6 \times 10^{30} m/s^2$

c. $1 \times 10^{30} m/s^2$

d. $6 \times 10^{32} m/s^2$

Q26

Find the acceleration of an electron at a distance R from the centre of a calcium nucleus ?

a. $2 \times 10^{32} m/s^2$

b. $3 \times 10^{32} m/s^2$

c. $3.8 \times 10^{30} m/s^2$

d. $4.1 \times 10^{32} m/s^2$

Q27

Find the acceleration of an electron at a distance of R/2 from the centre of a calcium nucleus ?

a. $7 \times 10^{32} m/s^2$

b. $3 \times 10^{30} m/s^2$

c. $2.1 \times 10^{32} m/s^2$

d. $4.1 \times 10^{32} m/s^2$

Section-V

Subjective Type

0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

Q28

A well 20 m deep and 3 m in diameter contains water to a depth of 14 metre. How long will a 5 H.P. engine take to empty it ? Express answer in seconds.

Q29

Estimate the radius (in kilometer) of a rocky sphere with a density of 3 gm/cm^3 from the surface of which you could just barely throw a gold ball and have it never return. Assume your best throw is 40 m/s.

Q30

It is desired to construct a balloon which will lift a total weight including its own envelope of 150 kg. Calculate the volume of the envelope (in m^3). The balloon is filled with hydrogen of density 0.09 gm/litre. Density of air = 1.29 gm/litre and 1000 litre = 1 m^3.

Q31

A capacitor of capacitance C is fully charged by a 200 volt battery. It is then discharged through a small coil of resistance wire embedded in a thermally insulated block of specific heat 2.5×10^2 J kg^{-1} K^{-1} and of mass 0.1 kg. If the temperature of the block rises by 0.4 K, what is the value of capacitance (in microfarad) ?

Part-II (Chemistry)

Section-I

Straight Objective Type

Q32

4.0 g argon has pressure `P’ and temperature `T’ K in the vessel. On keeping the vessel at 50°C higher temperature, 0.8 g of argon was giv3en out to maintain the pressure P. the original temperature was

a. 273 K

b. 100 K

c. 200 K

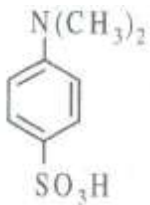
d. 205 K

Q33

Which of the following will not give red colour with $FeCl_3$ in Lassaigne's test ?

(a) $(NH_2)_2C = S$

(b) 

(c) 

(d) $(CH_3)_2 NH$

Q34

The enthalpy of neutralization of a strong acid by a strong base os −57.10 kJ mol^{-1}. The enthalpy of formation of H_2O is -286 kJ mol^{-1} . The enthalpy of formation of OH^- is [Take $\Delta H_f^o\ H^+ = 0$]

a. Zero

b. -228.9 kJ mol^{-1}

c. + 228.9 kJ mol^{-1}

d. - 228.9 J mol^{-1}

Q35

A polyhydroxy organic compound (A) has molecular weight 180 g mol^{-1} molecular weight of its acety1 derivative obtained after treating with excess of acetic an hydride is 390 g mol^{-1}. How many –OH groups are present in compound 'A'?

a. 4
b. 5
c. 6
d. 3

Q36

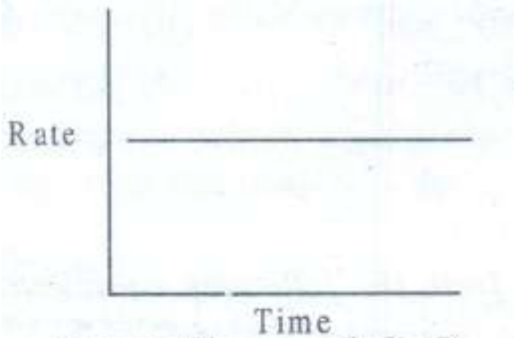
The ratio of ${}^{12}_{6}C$ and ${}^{14}_{6}C$ in a piece of wood is 16 parts that of atmosphere. Calculate the age of wood if $t_{1/2}$ of ${}^{14}_{6}C = 5577$ yrs.

a. 5000 yrs
b. 22318 yrs
c. 10000 yrs
d. 223 yrs

Q37

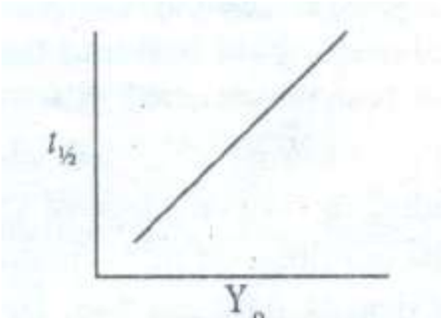
The rate law of a reaction of X and Y was found to be rate = k $[X]^a$ $[[Y]^b$

It was determined by plotting rate of disappearance of X vs time and $t_{1/2} vs$ (Y_0) the graphs were Graph (A)



Rate *vs* Time graph for X

Graph (B)



$t_{1/2}$ *vs* (Y_o) for Y

In the rate law `a' and `b' are

a. 0, 1

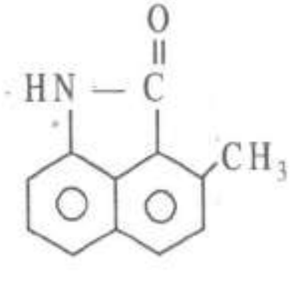
b. 1, 0

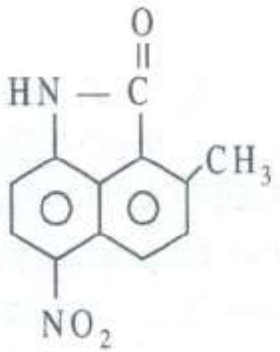
c. 0, 1

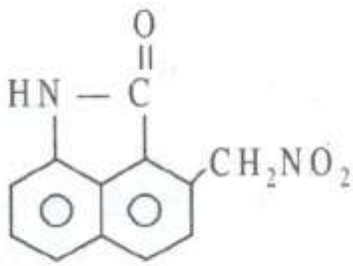
d. 1, 1

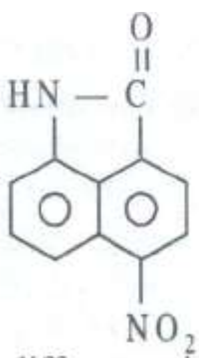
Q38

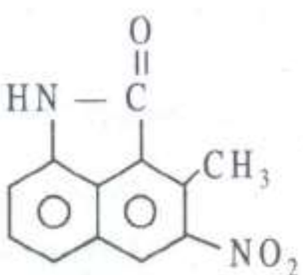
The major product obtained when HNO_3 and conc. H_2SO_4 is treated with



(a) 

(b) 

(c) 

(d) 

Q39

The difference in energy between e_g and t_{2g} orbitals will be high if

a. charge density of central atom is high

b. charge density of central atom is low

c. the ligand is a weak field ligand

d. the coordination number is low

Q40

The polarity is maximum in

a. N – F

b. C – F

c. O – F

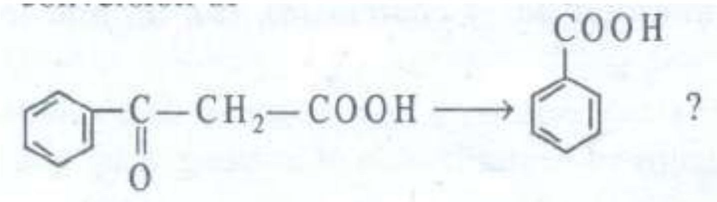
d. C1 – F

Section-II

Multiple Objective Type

Q41

Which of the following reagent can carry out the conversion of



a. KM_nO_4/KOH, heat

b. $K_2Cr_2O_7$/conc. H_2SO_4

c. (i) heat (ii) I_2/ NaOH, Δ(iii) HCI

d. (i) $NaBH_4$ (ii) AL_2O_3 , (iii) O_3 / H_2O_2 oxidative

Q42

For an isothermal irreversible expansion or compression of an ideal gas

a. $W = 0$

b. $\Delta U = 0$

c. $\Delta H = 0$

d. $\Delta S = 0$

a. Calamine and siderite are carbonate ores

b. Argentite and cuprite and cuprite are oxides

c. Zinc blende and iron pyrites are sulphide ores

d. Malachite and azurite are ores of copper

Q44

When liquid sodamide is dropped on red hot charcoal, the product(s) formed is/are

a. Sodium cyanide

b. Hydrogen

c. Sodium azide

d. Sodium nitrite

Q45

For ideal diatomic gases

a. $C_p = \frac{7}{2}R$

b. $C_p = \frac{3}{2}R$

c. $C_v = \frac{5}{2}R$

d. $C_v = \frac{3}{2}R$

Q46

100 ml of 1 M NaOH will neutralize

a. 50 ml of 1 M H_2SO_4

b. 100 ml of 1 N HCI

c. 100 ml of 1 M H_2SO_4

d. 100 ml of N H_2SO_4

Q47

A gas can be easily liquefied

a. When its inversion temperature equals the Boyle’s temperature

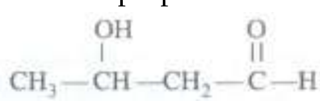
b. If it has higher value of `a’

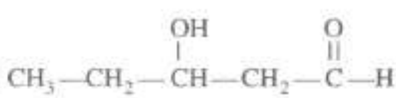
c. Under pressure when it is cooled to below the T_c (critical temperature)

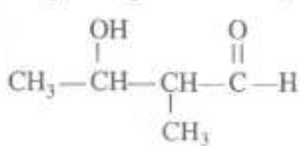
d. at low pressure and above T_c.

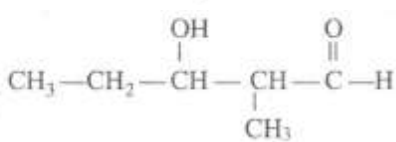
Q48

Ethanal and propanal react in presence of dilute NaOH to give

(a) 

(b) 

(c) 

(d) 

Section-III

Assertion-Reason Type

Q49

Statement-1:

Water can be made to boil without heating. because

Statement-2:

It can be done by reducing the pressure above water so that boiling point is lowered and becomes equal to room temperature.

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

Q50

Statement-1:

Dextron, poly(glycolic acid), poly(lactic acid) are biodegradable polymers. becouse

Statement-2

Dextron is used in post-operative stitches.

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

Q51

Statement-1:

Ally1 free radical is more stable than n-propyl free radical. because

Statement-2

The ally1 free radical is more stable due to presence of resonance.

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

Q52

Statement-1:

When all the four hydrogen of NH_4^+ are replaced by alky1 groups, quaternary ammonium salt is formed. because

Statement-2:

Quaternary ammonium salts are used as cationic detergents.

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

C_{53-55}: Paragraph for Question Nos. 53 to 55

$CoCI_2 + NH_4CNS \rightarrow Co(CNS)_2 + 2NH_4CI$

$Co(CNS)_2 + 2NH_4CNS \rightarrow (NH_4)_2[Co(CNS)_4]$ ….(i)

$ZnCI_2 + K_4[Fe(CN)_6] \rightarrow Zn_2[Fe(CN)_6] + 4KCI$ ….(ii)

Q53

The IUPAC of complex formed in (i) and (ii)

a. Ammounium tetrathiocyanatocobaltate (II), Zinc hexacyanoferrate (II)

b. Ammounium tetrathiocyanatocobaltate (III), Zinc hexacyanoferrate (III)

c. Ammounium tetrathiocyanatocobaltate (III), Zinc hexacyanoferrate (II)

d. Ammounium tetrathiocyanatocobaltate (II), Zinc hexacyanoferrate (III)

Q54

The magnetic behavior of (i) and (ii)

a. Paramagnetic, diamagnetic

b. Diamagnetic, diamagnetic

c. Paramagnetic, paramagnetic

d. Diamagnetic, paramagnetic

Q55

The hybridization of central atom in complex (i) and (ii) are

a. sp^3, sp^3d^3

b. dsp^2, d^2d^3

c. dsp^2, sp^3d^2

d. sp^3, d^2sp^3

C_{56-58}: Paragraph for Question Nos. 56 to 58

As a result of the researches of T. W Richard, walter Nernst, Max planck and others, another fundamental principle of thermodynamics which deals with entropy of pure crystalline substances at the absolute zero temperature has come into being. This principle called the third law of thermodynamics, states that the entropy of all pure crystalline solids may be taken as zero at the absolute zero temperature. The statement is confined to pure crystalline solids becomes theoretical arguments and experimental evidences have shown that the entropy of solutions and supercooled liquids is not zero at 0 K. for pure crystalline solids the law has been verified repeatedly. The variation of entropy with temperature at constant pressure is given as given below: as the third law states that for a crystalline substances. $S = 0 \ at \ T = 0 \ K$

In practice heat capacities are usually measured from approximately 20 K to temperature TK and then extrapolation are resorted.

Q56

If extrapolations are resorted by use of Debye third power law for heat capacity $C_p = aT^3$ then $S_t =$

a. $aT^2 dT$

b. $\frac{aT^2}{2}$

c. $\frac{aT^3}{3}$

d. aT^2

Q57

The entropy change accompanying chemical reactions C(s, graphite) + $2H_2$(g) $\rightarrow$ CH_3 OH (l)

Given that the standard molar entropy for various substances at 25°C is

C = 1.36 e VK^{-01}, H_2 = 31.21 eVK^{-1},

O_2 = 49.0 e VK^{-1}, CH_3OH = 30.3 eVK^{-1},

a. 100 eVK^{-1}

b. +58.0 eVK^{-1}

c. -100 eVK^{-1}

d. -58.0 eVK^{-1}

Q58

The reaction in the question (57) is carried at T K then the Δs at any temperature T is given as

a. $\Delta s = \int_{298K}^{TK} \frac{AC_p dT}{T}$

b. $\Delta s = \Delta s_{298K} + \int_{298K}^{TK} \frac{\Delta C_p dT}{T}$

c. $\int_{298K}^{TK} ds = \int_{298\,K}^{TK} \frac{dq}{T}$

d. $\int_{298\,K}^{TK} ds = \int_{298\,K}^{TK} \frac{dH}{T}$

Section-V

Subject Type

0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

Q59

When pent-1-yne (A) is treated with 4.0 N alcoholic KOH at 175°C it is converted at equilibrium into an equilibria mixture pent-1-yne (A) and pent-2-yne (B) 1.3% and 95.2% respectively along with 1, 2-pentadiene (c) 3.5%, what is the value of ΔG for the equilibria.

Q60

Calculate the decrease in oxidizing power of MnO_4^- / Mn^{2+} if $[H^+]$ is decreased from q M to 10^{-1} M at 25°C.

Q61

A gas expands from 3L to 5L at constant pressure of 3 atm. The work done during expansion was used too heat 10 mole of water at temperature 290 K. calculate the temperature to which the water is raised to [Specific heat of water – 4.184].

Q62

How much percentage of CO_2 in air be sufficient to prevent decomposition of Ag_2CO_3 on heating to 120°C. K_p= 0.0095 bar at 120°C.

Part-III (Mathematics)

Section-I

Straight Objective Type

Q63

If the point z in the complex plane describes a circle of radius 2 with centre at the origin, then the point $z = \frac{1}{z}$ describe

a. a circle

b. a parabola

c. an ellipse

d. a hyperbola

Q64

The equation $log_3 x - log_x 3 = 2$, has

a. no real solution

b. exactly one real solution

c. exactly two real solutions

d. infinite many real solutions

Q65

Suppose that three distinct real numbers a, b, c are in G. P. and $a + b + c = bx$, then

a. $-3 < x < 1$

b. $x > 1 \; or \; x < -3$

c. $x < -1 \; or \; x > 3$

d. $-3 < x < -1$

Q66

Consider a parallelogram $ABCD$ with E as the mid-point of its diagonal BD. The point E is connected to a point F on DA such that $DF = \frac{1}{3}DA$. Then, the ratio of the area of the triangle DEF to the area of the quadrilateral $ABEF$ is

a. 1 : 2

b. 1 : 3

c. 1 : 5

d. 1 : 4

Q67

Let $a_n = \frac{10^{n+1}+1}{10^n+1}$, for $n = 1, 2$ ..., then

a. for every $n, a_n \geq a_{n+1}$

b. for every $n, a_n \leq a_{n+1}$

c. there is an integer k such that $a_{n+k} = a_n$ for all n

d. None of the above

Q68

In a triangle ABC, for any $x > 0$ $\frac{a^x \cos A + b^x \cos B + c^x \cos C}{a^x + b^x + c^x}$ has the maximum value equal to

a. $\frac{1}{2}$

b. $\frac{1}{3}$

c. 1

d. 3

Q69

If $a > 0$, then root of the equation $log_{ax}a + log_x a^2 + log_x 2_x a^3 = 0$ is

a. $a^{-4/3}$

b. $a^{-3/4}$

c. $a^{1/2}$

d. a^{-1}

Q70

The number of positive integral solutions of the equation $\begin{vmatrix} x^3+1 & x^2y & x^2z \\ xy^2 & y^3+1 & y^2z \\ xz^2 & yz^2 & z^3+1 \end{vmatrix} = 30$ is

a. 0

b. 3

c. infinite

d. 4

Q71

Number of positive integers, which satisfying the inequality $\frac{(16)^{1/x}}{2^{x+3}} > 1$, is equal to

a. 0

b. 3

c. infinite

d. 4

Section-II

Multiple Objective Type

Q72

Two parabola $y^2 = 4a(x - \lambda_1) and\ x^2 = 4a(y - \lambda_2)$ always touch each other, $\lambda_1, \lambda_2$are parameters, then their point of contact lie on

a. hyperbola

b. circle

c. parabola

d. rectangular hyperobola

Q73

If $|z_1| + |z_2| + |z_3| = |z_1 + z_2 + z_3|$ then $z = \frac{z_1 z_2}{z_3^2} + \frac{z_2 z_3}{z_1^2} + \frac{z_1 z_3}{z_2^2}$ is

a. not real

b. purely imaginary number

c. real part (z)= imaginary (z)

d. None of above

Q74

The equation $(x - n)^m + (x - n^2)^m + (x - n^3)^n + \ldots + (x - n^m)^m = 0$, ($m$ is odd integer), has

a. all real roots

b. both real and imaginary roots

c. one real and $(m - 1)$ imaginary roots

Q75

P is any point inside the triangle ABC and PD, PE, PF are perpendicular on sides BC, AC and AB respectively on sides. Ratio $a : b : c$ is $2 : 3 : 4$, then $2PD + 3PE + 4\ PF$ is

a. an integral multiple of r

b. $9R$

c. $9\ r \cdot$

d. $24\ R$

Q76

For any real value of $\theta \neq \pi, let\ y = \frac{cos^2\theta - 1}{cos^2\theta + \cos 0}$, then

a. $y \leq 0$

b. $y > 2$

c. $-1 \leq y \leq 1$

d. $y \geq 1$

Q77

The value of $\int_{-1}^{1}[tan^{-1}\{\sin(cos^{-1}x)\} + cot^{-1}\{\cos(sin^{-1}x)\}]dx$ is

a. rational

b. irrational

c. π

d. 0

Q78

If $f(x+1) + f(x-1) = 2f(x)$, for all x and $f(0) = 0$, then if n is a natural number, then $f(n)$ is

a. $nf(1)$

b. $\{f(1)\}^n$

c. $0 \; \forall \; n$

d. an integer if $f(1)$ is an integer

Q79

The period of $\frac{|\sin x|+|\cos x|}{|\sin x-\cos x|+|sinx+\cos x|}$ is

a. π

b. π/2

c. 2π

d. 2π/3

Section-III

Assertion-Reason Type

Q80

Statement-1:

The inequality $\sin 2x < \sin x$ is not satisfied by any real number in $\left(\pi, \frac{3\pi}{2}\right)$. because

Statement-2:

$\sin x$ negative if $x \in \left(\pi, \frac{3\pi}{2}\right)$.

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

Q81

Statement-1:

$a_1, a_2, ... a_n; b_1, b_2, b_3 ... b_n$ are real numbers such that $a_1^2 + a_2^2 + \ldots + a_n^2 = b_1^2 + b_2^2 + \ldots + b_n^2 = 1$, then $-1 \leq a_1b_1 + a_2b_2 + \ldots + a_nb_n \leq 1$

because

Statement-2:

For two vectors $\vec{a}$ and $\vec{b}$ $\vec{a}.\vec{b} \geq |\vec{a}||\vec{b}|$

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

Q82

Statement-1:

If $S_n = \left(1 + \frac{1}{2} + \frac{1}{3} + \ldots + \frac{1}{n}\right)$, then $n\,S_n = n + \left(\frac{n-1}{1} + \frac{n-2}{2} + \ldots \frac{2}{n-2} + \frac{1}{n-1}\right)$

because

Statement-2:

$S_n = n - \left(\frac{1}{2} + \frac{2}{3} + \frac{3}{4} + \ldots \frac{n-1}{n}\right)$

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

Q83

Statement-1:

In any triangle ABC, $\sin\frac{A}{2} < \frac{a}{b+c}$

because

Statement-2:

In any triangle, $0 \leq \cos\frac{B-c}{2} \leq 1$

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

Section-IV

Linked Comprehension Type

$M_{84\text{-}86}$: Paragraph for Question Nos. 84 to 86

ABC is a triangle whre $\angle A = 60°$. The incircle of triangle ABC touch the opposite side at D such that $BD = l, DC = m$. If r be the inradius of the ΔABC and Δ be the area of the triangle ABC, then answer the following questions :

Q84

r must be equal to

a. $(S - a)\sqrt{3}$
b. $\frac{(S-a)}{\sqrt{3}}$

c. $2(S-a)$
d. None of these
Q85
Δ^2 must be equal to
a. $lm\ (S-a)\ S$
b. $(l+m)^2(S-a)^2$
c. $2\ lm\ (S-a)\ S$
d. None of these
Q86
Δ must be equal to
a. $(l+m)^2$
b. $\frac{lm}{\sqrt{3}}$
c. $lm\sqrt{3}$
d. None of these
M87-89: Paragraph for Question Nos. 87 to 89
Let a sequence of definite integrals $\{l_n\}$ be defined by $l_n = \int_0^a e^{-x}x^n dx$, where $a > 0$ be a real number and n be a positive integer. Answer the following question :
Q87
$l_n - nl_{n-1}$ must be
a. $e^{-a}a^n$
b. $-e^{-a}a^n$
c. $e^{-a}a^{n-1}$
d. None of these
Q88
$\left(1-\frac{l_n}{n!}\right)e^a$ must be equal to
a. $1+a+\frac{a^2}{2!}\ldots+\frac{a^n}{n!}$
b. $a+\frac{a^2}{2!}\ldots+\frac{a^n}{n!}$
c. a^n
d. None of these
Q89
If $a\to\infty, l_n\to$
a. $(n-1)!$
b. $n!$
c. $(n+1)!$
d. None of these

Section-V

Subjective Type

0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

Q90

The solution of the differential equation $(x-1)dy + ydx = x(x-1)y^{1/3}dx$ is given by $y^{2/3} = A(x-1)^{-2/3} + \frac{1}{4}(x-1)^2 + \frac{2}{\lambda}(x-1)$ then numerical quantity λ should be

Q91

If $y = e^{4x} + 2e^{-x}$ then $\frac{d^3\,y}{dx^3} - 13\frac{dy}{dx} - \lambda y = 0$, then numerical quantity λ should be

Q92

If $(4\,cos^2\,9° - 3)(4\,cos^2 27° - 3) = \tan\lambda°$, then λ must be

Q93

If a chord of the circle $x^2 + y^2 - 4x - 2y - K = 0$ is trisected at the point $\left(\frac{1}{3}, \frac{1}{3}\right)$ and $\left(\frac{8}{3}, \frac{8}{3}\right)$, then K must be

PAPER-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.

Q1

Dimensionally, wavelength is equivalent to

a. $\frac{E\sqrt{LC}}{B}$

b. $\frac{E^2}{B\sqrt{LC}}$

c. $\frac{B\sqrt{LC}}{E^2}$

d. $\frac{B^3}{E\sqrt{LC}}$

Q2

In an oscillating $L - C$ circuit the maximum charge on the capacitor is Q. the charge on the capacitor when the energy is stored equally between the electric and magnetic field is

a. $\sqrt{\frac{Q}{2}}$

b. $\frac{Q}{\sqrt{2}}$

c. $\frac{Q}{\sqrt{3}}$

d. $\frac{2Q}{3}$

Q3

A beaker is completely filled with water at 4°C. It will overflow if :

a. Heated above 4°C

b. Cooled below 4°C

c. Both heated and cooled above and below 4°C respectively.

d. None of the above

4. A photosensitive metallic surface has work function $h\nu_0$. If photons of energy $2h\nu_0$ falls on this surface, the electrons come out with a maximum velocity of 4×10^6 m/s. When the photon's energy is increased to 5 $h\nu_0$, the maximum velocity of photoelectrons will be

a. 22×10^6 m/s

b. 12×10^9 m/s

c. 8×10^9 m/s

d. 8×10^6 m/s

Q5

A ball falling freely from a height of 4.9 m hits a horizontal surface. If $e = \frac{3}{4}$, then the ball will hit the surface for the second time after

a. 0.5 sec

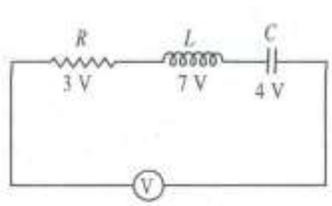
b. 1.5 sec

c. 3.5 sec

d. 1.0 sec

Q6

Current in resistance R is 1A then :



a. $V = 5$ volt

b. Impedance of the network is 5 Ω

c. Power factor of given circuit is 0.6 lagging.

d. All of the above

Q7

Let E be the energy required to raise a satellite to a height h above earth's surface and E' be the energy required to put the same satellite into orbit at that height. Then E/E' is equal to :\

a. $\frac{2h}{R+2h}$

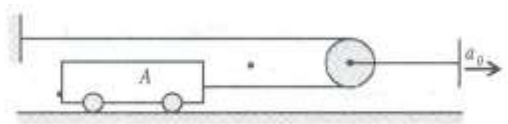
b. $\frac{2h}{2R+3h}$

c. $\frac{2R}{3R+h}$

d. $\frac{4R}{2h+R}$

Q8

The pulley is given an acceleration $a_0 = 2m/s^2$ starting from rest. A cable is connected to a block of A mass 50 kg as shown. Neglect the mass of the pulley. If $\mu = 0.3$ between the block and the floor, then the tension in the cable is :



a. 1200 N

b. 850 N

c. 600 N

d. 350 N

Q9

Four point charges $q, -q$, Q and 2Q are placed in order at the corner A, B, C and D of a square. If the field at the mid point CD of is zero then the value of q/Q is :

a. 10

b. $\frac{5}{\sqrt{2}}$

c. $\frac{2\sqrt{2}}{5}$

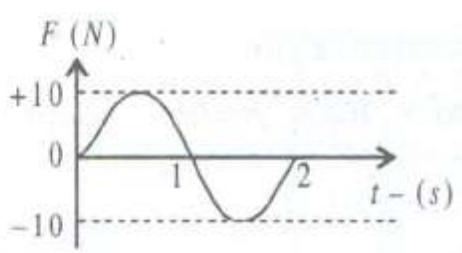
d. $\frac{5\sqrt{5}}{2}$

Section-II

Multiple Objective Type

Q10

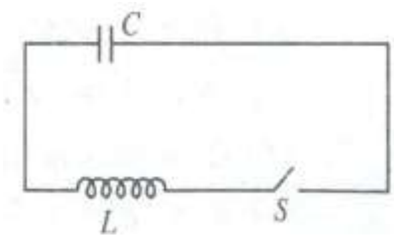
Force applied on a particle of 1 kg mass at rest in positive x-direction varies sinusoidally according to the equation $f_x = 10 \sin \pi t$. Which of following statements are true?



a. The velocity of particle is positive between 0 and 1 second and negative between 1 second and 2 second.
b. The velocity of particle increase between 0 and 1 sec and decreases between 1 second and 2 second.
c. The maximum velocity of the particle is $10/\pi \frac{m}{s}$ $at\ t = 1$second.
d. The maximum velocity of the particle is =10 m/s $at\ t = (1/2)$ second.

Q11

In the given circuit, initially the charge on capacitor is Q_0. At $t = 0$, the switch S is closed. Which of the following statement(s) is/are correct.



a. maximum current through inductor is $\frac{Q_0}{\sqrt{LC}}$
b. Charge on the capacitor is zero at $t = \frac{\pi}{2}\sqrt{LC}$
c. Current through inductor is zero at $t = \frac{\pi}{2}\sqrt{LC}$
d. Maximum magnetic energy can be stored in the inductor is $\frac{Q_0^2}{2C}$

Q12

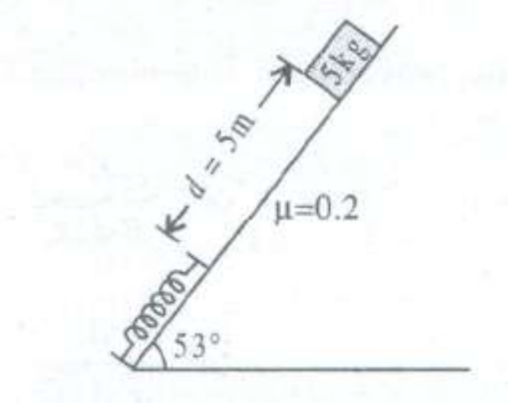
A flywheel (which has almost all its mass concentrated on its circumference) of mass 100 kg and diameter 2m is rotating at the rate of 300/π rev/min. Then
a. The kinetic energy of rotation of the flywheel is 5 kJ.
b. The angular momentum associated with the flywheel is 1000 kgm^2s^{-1}
c. The moment of inertia of flywheel is 100 kg-m^2
d. The fly wheel, will come to rest in 5 second if a continuous retarding torque of 200 N-m is acting on it.

Q13

The potential energy of a particle of mass 0.1 kg moving along the x-axis is given by $u = 5x(x-4)$J, where x is in metre. It can be concluded that
a. The particle is acted upon by a constant force.
b. The speed of particle is maximum at $x = 2m$.
c. the particle executes simple harmonic motion.
d. The period of oscillation of the particle is $\frac{\pi}{5}$ seconds.

Q14

A block of mass m is sliding on a rough inclined plane as shown in figure. The spring constant of spring is $K = 408\frac{N}{m}$, then $l(g = 10m/s^2)$



a. Maximum deformation of the spring will be 1 m.

b. Maximum velocity will be attained by block when compression will be 0.088 m.

c. Maximum spring force will be 408 N.

d. As the block just touches the spring, velocity of block will be maximum.

Q15

A stationary $\begin{matrix} 200 \\ 82 \end{matrix}$ Pb nucleus emits an ∝-particle with kinetic energy 6.00 MeV. Then :

a. The recoil speed of daughter nucleus is 3.44×10^5 m/s

b. The recoil speed of daughter nucleus is 6.92×10^4 m/s

c. The total energy liberated is 6.12 MeV

d. The total energy liberated is 300 MeV

Q16

During an experiment, an ideal gas is found to obey a condition $\frac{P^2}{\rho}$ constant [ρ = density of gas]. The gas is initially at temperature T, pressure P and density ρ. The gas expands such that density changes to ρ/2 :

a. The pressure of gas changes to $\sqrt{2}\,P$.

b. The temperature of gas changes to $\sqrt{2}\,T$.

c. The graph of above process on the $P - T$ diagram is parabola.

d. The graph of the above process on $P - T$ diagram is hyperbola.

Q17

The magnetic flux ϕ linked with a coil depends on time t as $\phi = at^n$ where a and n are positive constants. The emf induced in the coil is e :

a. If $0 < n < 1, e = 0$

b. If $0 < n < 1, e \neq 0$ and $|e|$ decrease with time.

c. If $n = 1, e$ is constant

d. If $n > 1, |e|$ increases with time.

Section-III

Assertion-Reason Type

Q18

Statement-1:

The resistance of a copper wire varies directly as the length and inversely as the diameter. because

Statement-2:

Because the resistance varies directly as the area of cross-section.

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

Q19

Statement-1:

Electrons move away from a region of higher potential to a region of lower potential. because

Statement-2:

Since an electron has negative charge.

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

Q20

Statement-1:

Material used in the construction of a standard resistance is constantan or manganin. because

Statement-2:

Its temperature coefficient of resistance is very small.

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

Q21

Statement-1:

The resistance of super conductor is zero. because

Statement-2:

The super-conductors are used for the transmission of electric power.

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

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

A gaseous mixture enclosed in a vessel of volume V consists of one mole of a gas A with $y = \frac{Cp}{C_v} = \frac{5}{3}$ and another gas B with $y = \frac{7}{5}$ at a certain temperature T. The relative molar masses of the gases A and B are 4 and 32, respectively. The gases A and B do not react with each other and are assumed to be ideal. The gaseous mixture follows the equation $PV^{19/13}$ = constant, in adiabatic processes.

Q22

The number of moles of the gas B in the gaseous mixture is :

a. 1 mol

b. 2 mol

c. 3 mol

d. 4 mol

Q23

The speed of sound in the gaseous mixture at 300 K is :

a. 400 ms^{-1}

b. 300 ms^{-1}

c. 250 ms^{-1}

d. 150 ms^{-1}

Q24

If T is raised by 1 K from 300 K, the percentage change in the speed of sound is

a. $\frac{1}{2}$

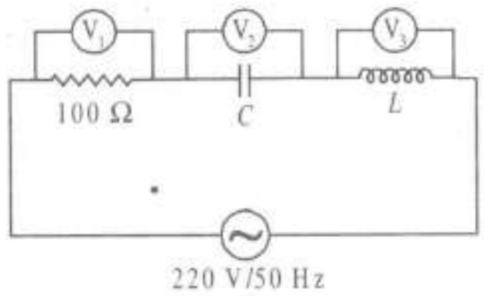
b. $\frac{4}{3}$

c. $\frac{7}{5}$

d. $\frac{1}{6}$

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

A series L-C circuit is connected to an AC source of 220 V and 50 Hz as shown in figure. If the readings of three voltmeters V_1, V_2 and V_3 are 65 V, 415 V and 204 V respectively.



Q25

The current in the circuit is :

a. 0.6 A

b. 0.65 A

c. 0.7 A

d. 0.75 A

Q26

The value of inductance *L* is approximately

a. 2.5 H

b. 1.0 H

c. 4.5 H

d. 3.0 H

Q27

The value of the capacitance C is :

a. 3 μF

b. 4 μF

c. 5 μF

d. 6 μF

Section-V

Subjective Type

0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

Q28

A 90 N rectangular solid block is kept on a 30° inclined plane. The plane is lubricated by a 3 mm thick film of oil of viscosity 8.0 poise. If contact area is 0.3 m^2, estimate the terminal velocity of the block in cm/sec.

Q29

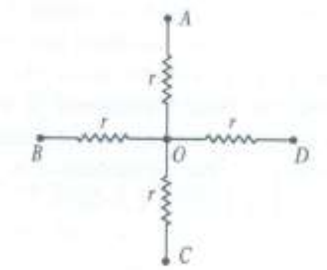
A source S having a detector D moving towards a wall with a certain velocity detects 9 beats/second. On doubling the velocity of te source, the detector D detect 20 beats/second. What is the original frequency of sound emitted by the source ? (Take speed of sound as 330 m/s)

Q30

A shell is fired from a point O at an angle of 60° with a speed of 40 m/s and it strikes a horizontal plane through O, at a point A. The gun is fired the second time with the same angle of elevation but a different speed u. If it hits the target which starts to rise vertically from A at the same instant as the shell is fired with constant speed $9\sqrt{3}$ m/s, find u.

Q31

The four terminal network shown in the figure, consists of four equal resistors and is a part of a larger circuit. The point, A, B and C are at same potential. The potential difference between A and D is 40 V. find potential difference between O and D.



Q32

A certain real gas is found to obey $PV^{3/2}$ = constant during an adiabatic process. When such a gas with volume V_1 and initial temperature T_1 is adiabatically compressed to half its initial volume its final temperature T_2 would be

a. 2.828 T_1

b. 1.414 T_1

c. -2 T_1

d. 1.732 T_1

Q33

A weak electrolyte AB has molal conductance at infinite dilution equal Λ_m^∞ to and molar conductance at any concentration equal to Λ_m. Hence, if C moles per litre of the electrolyte is taken in a one litre solution, then the Ostwald's equation for dissociation constant of the weak electrolyte is given by

a. $K = \frac{c}{\Lambda_m^{\infty}} \times \Lambda_m'$

b. $K = \frac{\Lambda_m'}{\Lambda_m^{\infty}}$

c. $K = \frac{c\left(\Lambda_m'\right)^2}{\Lambda_m^{\infty}\left(\Lambda_m^{\infty} - \Lambda_m'\right)}$

d. $K = \frac{\left(\Lambda_m^{\infty} - \Lambda_m'\right)}{c\,\Lambda_m^{\infty}}$

Q34

A mixture contains 28 g of N_2 and 20 g of H_2. If total pressure of mixture is 11 atm, the partial pressure of N_2 is

a. 1 atm

b. 2 atm

c. $\frac{20}{48} \times 11$

d. $\frac{28}{20} \times 11$

Q35

At 373 K, K_w of H_2O is 1×10^{-12}, the pH of water and its nature will be

a. pH = 6, Acidic

b. pH = 6, Neutral

c. pH = 12, Basic

d. pH = 7, Neutral

Q36

If pressure becomes four times, root mean square velocity will become

a. Four times

b. Two times

c. Remain same

d. One fourth

Q37

The Schrodinger wave equation for hydrogen atom is

$$\Psi_{2s} = \frac{1}{4\sqrt{2\pi}}\left(\frac{1}{a_0}\right)^{3/2}\left(2 - \frac{r}{a_0}\right)e^{-r/a_0}$$

Where a_0 is Bohr's radius. If the radial node in 2s be at r_0, then r_0 would be equal to

Q38

The solubility of CaF_2 in a buffer pH = 3.0. will be ………………… $K_{sp}\ of\ CaF_2 = 5 \times 10^{-9}, K_a\ of$ HF=6.7×10^{-4}

a. 1.43×10^{-3} M

b. 14.3×10^{-3} M

c. 0.143×10^{-3} M

d. 143×10^{-3} M

Q39

The states $+\frac{1}{2}$ or $-\frac{1}{2}$ for the electron spin represent

a. Rotation of the electron around nucleus in clockwise and anticlockwise direction respectively.

b. Rotation of the electron around nucleus in anticlockwise and clockwise direction respectively.

c. Magnetic moment of electron pointing up and down respectively.

d. To quantum mechani9cla spin states which haveno classical analogue.

Q40

$LiNO_3$, on heating gives

a. Li_2O

b. NO_2

c. O_2

d. all of these

Section-II

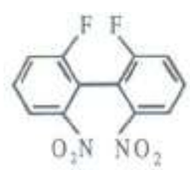
Multiple Objective Type

Q41

Which of the following are optically active ?

a. $CH_3CH=C=CHCH_3$

b. Meso tartaric acid

c. 

d. 

Q42

Which of the following statements are correct ?

a. ClO_2 is an angular molecule.

b. I_2O_5 is anhydride of HIO_3.

c. $HBrO_4$ is more acidic but less stable than HIO_4.

d. XeF_7- has sp^3d^3 hybridisation and pentagonal bipyramidal structure.

Q43

$pbO_2+2HNO_3 \rightarrow pb(NO_3)_2+H_2)+\frac{1}{2}O_2$ in the above reaction

a. pbO_2 is a reducing agent whereas HNO_3 is an oxidizing agent.

b. pbO_2 is an oxidizing agent

c. The oxidation state of oxygen changes from -2 to 0.

d. Oxidation state of pb changes from +2 to +4

Q44

For a reaction

$NO+Br_2 \xrightleftharpoons{K} NOBr_2$(fast)

$NOBr_2+NO \rightarrow 2NOBr$ (slow)

Which of the following are correct ?

a. rate = k$[NOBr_2]$ [NO]
b. rate = k[NO] $[Br_2]$
c. rate = k'$[NO]^2[Br_2]$
d. It is third order reaction.

Q45

Which of the following are used as fertilizer?
a. $CaCN_2$ + C
b. CAN
c. Nitrophos K
d. $Ca_3(PO_4)_2$

Q46

the complex ion which have no d-electrons
a. $[MnO_4]^-$
b. $[Cr_2O_7]^{2-}$
c. $[Fe(CN)_6]^{4-}$
d. $[Cr(NH_3)_6]^{3+}$

Q47

The phenomenon of mutarotation is shown by
a. Glucose
b. Fructose
c. Lactose
d. Maltose

Q48

Which of the following will show inert pair effect?
a. Te
b. Bi
c. pb
d. I

Section-III

Assertion-Reason Type

Q49

Statement-1:

Transition metals lose ns electrons first and then (n - 1)d electron. because

Statement-2:

The effective nuclear charge experienced by (n _ 1)d electrons is more than ns electrons.

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

Q50
Statement-1:
The position of electron can be determined with the help of electron microsope. because
Statement-2:
$\Delta x . \Delta p \geq \frac{\pi}{4\pi}$

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
Q51
Statement-1:
The pH of 10^{-8} M HCI is 6.95
because
Statement-2:
$[H^+] = 10^{-8} + 10^{-7}$ (from H_2O)

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
Q52
Statement-1:
The reactivity of alkali metals with air follows the order Cs>Rb>K>Na>Li
because
Statement-2:
The melting point order of alkali metals is Li>Na>K.Rb>Li
Because

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
$C_{53\text{-}55}$: Paragraph for Question Nos. 53 to 55
If two plates of the same metal are dipped separately into two dilute solutions of the same electrolyte and are connected by a salt bridge, the whole arrangement is found to act as a galvanic cell. Such cells are called concentration cells. Concentration cells are of two types :
(i) electrolyte concentration cell (ii) electrode concentration cell.

Q53

$Pt\ H_{2(P_1)}|H^+|H_{2(P_2)}Pt$

This is an example of

a. standard hydrogen electrode

b. electrolyte concentration cell

c. electrode concentration cell

d. such a cell cannot function

Q54

$M\left|M_{C_1}^{n+}\right|\left|N_{C_2}^{m+}\right|N \text{ is a}$

a. electrode concentration cell

b. electrolyte concentration cell

c. a simple cell

d. All of these

Q55

For the electrolyte concentration cell $M(s)\left|M_{C_1}^{n+}\right|\left|N_{C_2}^{n+}\right|M(s)$ the cell potential is given bu the expression

a. $E_{cell} = \frac{2.303RTlog\ K}{nF}$

b. $E_{cell} = E^{\circ}_{cell} - \frac{0.0591}{n}\log\frac{C_1}{C_2}$

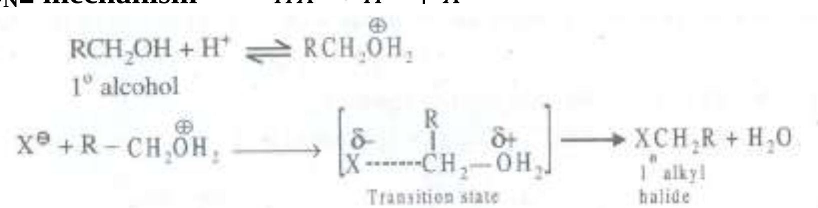
c. $E_{cell} = \frac{0.0591}{n}\log\frac{C_2}{C_1}$ at 25°C

d. $E_{cell} = E^{\circ}_{cell}$

$C_{56\text{-}58}$: Paragraph for Question Nos. 56 to 58

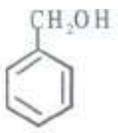
Primary alcohols undergo nucleophilic substitution reaction byS_N2 mechanism which involves intermediate transition state given below :

S_N2 mechanism $HX \rightarrow H^+ + X^-$



Q56

Which of these will undergo S_N1 mechanism?

a. 

b. CH_3CH_2OH

c. CH_3OH

d. $CH_3CH_2CH_2OH$

Q57

What will be product formed when 3-methylbutan-2-ol reacts with HCI?

a. $2 - Chloro - 3 - methylIbutane$

b. $2 - Chloro - 2 - methylIbutane$

c. $1 - chloro - 2 - methylIbutane$

d. $1 - Chloro - 3 - methylIbutane$

Q58

Ally1 alcohol will undergo which of the following mechanism on reaction with HCI ?

a. S_N1

b. S_N2

c. Both (a) and (b)

d. None of these

Section-V
Subjective Type

0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

Q59

the rate constant for the first order decomposition of a certain reaction is described by the equation :$\log k\ (s^{-1}) = 14.34 - \frac{1.25 \times 10^4 K}{T}$

What is energy of activation for this reaction?

Q60

`X' g of non-electrolytic compound (molar mass = 200) are dissolved in 1.0 L of 0.05 M NaCI aqueous solution. The osmotic pressure of this solution is found to be 4.92 atm at 27°c. Calculate the value of `X'. Assume complete dissociation of NaCI and ideal behavior of this solution. (R = 0.082 L atm mol^{-1} K^{-1})

Q61

A salt AB dissolves in water at 298 K according to the equation as follows :

AB $(s) \rightleftharpoons A^+(aq) + B^-(aq)$

$K_{sp} = 8 \times 10^{-14}\ M^2$

$\Delta S = 100\ J\ K^{-1}\ mol^{-1}$.

What is the value of $\Delta H_{solution}$?

Q62

A mixture of KI and HCI react with mercuric iodate $Hg_5(IO_6)^2$ according to the equation

$Hg_5(IO_6)_2$+ 34 KI + 24 HCI → $5K_2HgI_4$+$8I_2$ +24KCI + $12H_2O$

The iodine (I_2) which got liberated from this reaction was treated with $Na_2S_2O_3$ solution. 1 ml of this solution is equivalent to 0.05 g of $CuSO_4.5H_2O$. What is the volume in ml of $Na_2S_2O_3$ which will be required to react with iodine liberated from 0.7245 g of $[Hg_5(IO_6)_2]$?

Part-III (Mathematics)

Section-1

Straight Objective Type

Q63

How many pairs of positive integers (m, n) are there to satisfy $m^3 - n^3 = 21$?

a. exactly one

b. none

c. exactly three

d. infinitely many

Q64

The function $sin\,|x| + \cos(x-3) + |x^2 - 3x + 2|$ is differentiable in

a. (-∞, 1)

b. (-∞, 1) ∪ (2, 3)

c. (-∞, 0) ∪ (0, 1) ∪ (1, 2) ∪ (2, ∞)

d. (-∞, 3) ∪ (3, ∞)

Q65

The equations $x^3 + 2x^2 + 2x + 1 = 0$ and $x^{200} + x^{130} + 1 = 0$ have

a. exactly one common root

b. no common root

c. exactly three common roots

d. exactly two common roots

Q66

For each integer $i, 1 \leq i \leq 100, \in_i$ be either +1 or -1. Assume that $\in_1 = -1$. say that a sign change occurs at $i \geq 2$, if $\in_i, \in_{i-1}$ are of opposite sign. Then the total number of sign changes

a. is odd

b. is even

c. is at most 50

d. can have 49 distinct values

Q67

If $b_1, b_2, \ldots b_n$ are the nth roots of unity then ${}^nC_1 b_1 + {}^nC_2 b_2 + \ldots + {}^nC_n b_n$ is :

a. $\frac{b_1}{b_2}$

c. $\frac{b_1}{b_2}[(1 + b_2)^n - 1]$

d. None of these

Q68

Solution of equation$[\sin x] = [1 + \sin x] + [1 - \cos x], 0 \leq x \leq 2\pi$:

a. $x = \frac{3\pi}{2}$

b. $x = \frac{3\pi}{4}$

c. no real solution

d. None of these

Q69

If a, b, c sides of triangle such that $b^2 > 4ac$ then $a\ cos^2x + b\cos x + c = 0,$ has

a. always real roots $\forall\ x \in [0, 2\pi]$

b. non real roots $\forall\ x \in [0, 2\pi]$

c. real roots if $2a > b\ \forall\ x \in [0, 2\pi]$

d. None of these

Q70

If altitudes AD of ΔABC is produced to meet the circum circle at a point F, then $\cos \angle BFC$ equals :

a. $\frac{cos^2B+cos^2C+sin^2A}{\cos B \cos C}$

b. $\frac{sin^2A+sin^2B+cos^2C}{\cos B \cos C}$

c. $\frac{cos^2B+cos^2C-sin^2A}{Cos\ B \cos C}$

d. None of these

Q71

Let $f(x)$ be a function such that, $f(0) = f'(0) = 0, f''(x) = sec^4\ x - 4$, then the function is

a. $\ln(\sin x) + \frac{1}{2}\ tan^3x + x^2$

b. $\frac{2}{3}\ln(\sec x) + \frac{1}{6}tan^3x - 2x^2$

c. $\ln(\cos x) + \frac{1}{6}cos^2x + \frac{x^2}{5}$

d. None of these

Section-II

Multiple Objective Type

Q72

ABC is an equilateral triangle whose centroid is $G. GA = GB = GC = a.$ Let l be a line through $G. Let\ L, M, N$ be the feet of perpendicular on l from A, B, c respectively. Then $AL^2 + BM^2 + CN^2$ must be

a. less than $2a^2$

b. $\frac{3}{2}a^2$

c. more than $2a^2$

d. $\frac{3\sqrt{3}}{2^a}$

Q73

If in triangle ABC, median AD, altitude BE and bisector CF meet at a point then

a. $\frac{b^c}{a+b} = \frac{a^2c^2}{a-b}$

b. $\frac{b^2}{a+b} = \frac{a^2+c^2}{a-b}$

c. $\frac{b^2}{a-b} = \frac{a^2-c^2}{a+b}$

d. $a = b$ is not possible

Q74

In ΔABC, the altitude CD is given by $CD^2 = AD\ .DB$ then

a. $A + B = 90°$

b. $A + B = 120°$

c. $|A - B| = 90°$

d. $|A - B| = 60°$

Q75

If the median BD intersects the angle bisector CE at the point K, then

a. $CK = 2\,EK, if\ \angle A = \angle B$

b. $CK = 3\,EK, if\ \angle A = \angle B$

c. $\frac{CK}{EK} = \frac{\sin A+\sin B}{\sin A}$

d. $\frac{CK}{EK} = \frac{\sin A+\sin C}{\sin(A+B)}$

Q76

$(\sqrt[3]{2} - 1)^{1/3} = \sqrt[3]{\frac{1}{9}} - \sqrt[3]{\frac{A}{9}} + \sqrt[3]{\frac{B}{9}}$, where A and B are numerical quantities, then

a. $A = 2$

b. $A = 4$

c. $B = 4$

c. $B = 2$

Q77

Let $a_n = \left(1 + \frac{1}{\sqrt{2}}\right)^n + \left(1 - \frac{1}{\sqrt{2}}\right)^n$, $b_n = (1 + \frac{1}{\sqrt{2}})^n - \left(1 - \frac{1}{\sqrt{2}}\right)^n$, then

a. $a_{m+n=}a_m a_n - \frac{a_{m-n}}{2^n}$

b. $a_{m+n} = a_m a_n + \frac{a_{m-n}}{2^n}$

c. $b_{m+n} = a_m b_n + \frac{b_{m-n}}{2^n}$

d. $b_{m+n} = b_m b_n - \frac{b_{m-n}}{2^n}$

Q78

Let $l = \lim_{n-\infty} n^k x^n$ where K is a positive integer and $|x| < 1$, then

a. l does not depend upon K

b. l does not depend upon x

c. l depend upon K but does not depend upon x.

d. l depends upon x but does not depend upon K.

Q79

If $[x]$ denotes greatest integer $\leq x$ and $I = \int_0^{\pi/4} [3\, tan^2\, x] dx$, then

a. $I = [3 - \pi/4]$

b. $[I] = 2$

c. $\frac{\pi}{3} - tan^{-1}\sqrt{\frac{2}{3}}$

d. $[I] = 0$

Section-III

Assertion-Reason Type

Q80

Statement-1:

The circles $x^2 + y^2 + 2ax + c^2 = 0$ and $x^2 + y^2 + 2by + c^2 = 0$, will touch each other if $\frac{1}{a^2} + \frac{1}{b^2} + \frac{1}{c^2}$. because

Statement-2:

Two circles touches each other if distance between their centres is either equal to sum of radii or equals absolute differences of their radii.

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

Q81

Statement-1:

The function $f(x) = \int_0^{\pi/2} \frac{dt}{\sqrt{1-c\cos^2 t}}$ is decreasing in [0, 1].

Statement-2:

$\cos x$ is monotonically decreasing in (0, π/2).

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

Q82

Statement-1:

If $U_n = 1 + \frac{1}{2} + \frac{1}{3} + \ldots + \frac{1}{n} - \log n$, then $U_{n+1} < U_n$. because

Statement-2:

Both $S_n = 1 + \frac{1}{2} + \frac{1}{3} + \ldots + \frac{1}{n}$ and $t_n = \log n$ and are increasing.

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

Q83

Statement-1:

Let $p_n (n \geq 2)$ be the probability that n tosses of dice will give at least one 5 and one 6, then $p_n = 1 - \left(\frac{2}{3}\right)$ because

Statement-2:

$p_n \to 1$ as $n \to \infty$
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

$M_{84\text{-}86}$: Paragraph for question Nos. 84 to 86

A circle is circumscribed about a triangle ABC . A tangent to the circle at the point B intersects the line AC at D, where C lies between A and D. It is given that $\angle BCD = 29$ and distance of the circumcentre of triangle from side AC is 10. Answer the following question :

Q84

The altitude BN of the triangle ABC must be equal to
a. 10
b. 15
c. 20
d. None of these

Q85

The length of perpendicular from circumcentre O to the altitude BN must be
a. 10
b. 20
c. 5
d. None of these

Q86

The area of the triangle ABC must be
a. 180 sq. units
b. 210 sq. units
c. 216 sq. units
d. None of these

$M_{87\text{-}89}$: Paragraph for Question Nos. 87 to 89

If A, B, C, D are constant, define a function $f(n)$ of an integer n by $f(n) = A(n+3)^2 + B + C(-1)^n + D\, cos\frac{2n/\pi}{3}$ Answer the following questions :

Q87

The function $f(n)$
a. can never become a quadratic polynomial in n
b. can never become a constant
c. can be equal to 1 for some choice of $A, B, C, .D$ and n
d. None of these

Q88

$\cos\frac{2n\pi}{3} + \cos\frac{2(n-4)\pi}{3} + \cos\frac{2(n-5)\pi}{3}$, must be identically equal to

a. $\cos 2(n-1)\frac{\pi}{3} - \cos 2(n-2)\frac{\pi}{3} + \cos 2(n-6)\frac{\pi}{3}$

b. $\cos 2(n-1)\frac{\pi}{3} + \cos 2(n-2)\frac{\pi}{3} + \cos 2(n-6)\frac{\pi}{3}$

c. zero

d. None of these

Q89

n $f(n) + f(n-4) + f(n-5)$ must be equal to

a. $f(n-1) + f(n-2) + f(n-6)$

b. $f(n-1) + f(n-2) - f(n-6)$

c. $f(n-1) - f(n-2) + f(n-6)$

d. None of these

Section-V

Subjective Type

0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

Q90

The number of solutions of the equation $sin^{-1}x = 2tan^{-1}x$ is

Q91

In a triangle $tan\frac{A}{2} = \frac{5}{6}, tan\frac{B}{2} = \frac{20}{37}, tan\frac{C}{2} = \frac{2}{5}$, then $a + b - 2b$ must be equal to

Q92

Let P, Q, R be the three points (1, 4), (4, 2) and $(K, 2K-1)$ respectively, where K is a variable. If the value of K for which PR + RQ is minimum is $\frac{\lambda}{8}$, then the numerical quantity λ must be equal to

Q93

If the modulus of the complex number

$\left(\frac{2+i\sqrt{5}}{2-i\sqrt{5}}\right)^{10} + \left(\frac{2-i\sqrt{5}}{2+i\sqrt{5}}\right)^{10}$ $is\ 2\ cos\left(\lambda cos^{-1}\frac{2}{3}\right)$, then the numerical quantity λ should be equal to