PRACTICE PAPER 9

Paper-I (Physics)

Section-I

Straight Objective Type

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

Q 1.

If and X-ray tube operates at a voltage of 10 kV, find the ratio of the de-Beroglie wavelength of the incident electrons to the shortest wavelength of X-rays produced. The specific charge of electron id $1.8 \times 10^{11} CKg^{-1}$.

a. 4.9

b. 0.1

c. 1.85

d. 4.2

Q 2.

The potential difference across the Coolidge tube is 20 kV and 10 mA current flows through the voltage supply. Only 0.5% of the energy carried by the electron striking the target is converted into X-rays. The power carried by X-rays beam is P.

a. $P = 0.1$ W

b. $P = 1$ W

c. $P = 2$ W

d. $P = 10$ W

Q 3.

An astronomical telescope has an objective at 50 cm focal length. The eyepiece has a focal length at 3.5 cm. how far must these lenses be separated while viewing an object 200 cm away from the objective ?

a. 65 cm

b. 70.2 cm

c. 66.7 cm

d. 3.5 cm.

Q 4

If in a region, a uniform magnetic field and a uniform electric field, both exist, a charged particle moving in a region.

a. Cannot trace a circular path.

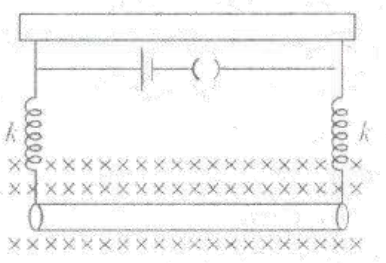
b. May trace a circular path.

c. May trace a straight line path.

d. Cannot move in a region with constant velocity.

Q 5.

A metal rod of mass 10 gm and length 25 cm is suspended using two springs as shown in figure. The springs are extended by 4 cm. When a 20 ampere current passes through the rod it rises by 1 cm. Determine the magnetic field. Assuming acceleration due to gravity to be $10\ m/s^2$.



a. $1.5 \times 10^{-2}T$

b. $0.15 \times 10^{-2}T$

c. $45 \times 10^{-2}T$

d. $1534 \times 10^{-2}T$.

Q 6.

An electron having kinetic energy `$T'$ is moving in a circular orbit of radius `R' perpendicular to a uniform magnetic field of induction $\vec{B}$. If kinetic energy is doubled and magnetic field induction is tripled, the radius will become?

a. $R\sqrt{9/4}$

b. $R\sqrt{3/2}$

c. $R\sqrt{2/9}$

d. $R\sqrt{4/3}$

Q 7

An electric hoist makes 10 double journeys per hour. In each journey a load of 6 tonnes is raised to a height of 60 meters in 90 second and the hoist return empty in 75 seconds. The hoist cage weighs 500 kg and has a balance weight of 3 tonnes. The efficiency of the hoist is 80% and of driving motor 90 %. Calculate the electrical energy expended per double journey :

a. 49.05 KWh

b. 13.8235 KWh

c. 13625 KWh

d. 1.3625KWh.

Q 8.

In Milikan's oil drop experiment, an oil drop carrying a charge Q is held stationary by a potential difference of 2400 volt between the plates. To keep a drop half the radius of stationary drop, the potential difference to be applied is 600 volt. What is charge on the second drop ?

a. Q/4

b. Q/2

c. Q

d. 3Q/2.

Q 9.

Hollow spherical conductor with a charge of 500 μC is acted upon by a force 562.5 N. what is electric intensity at it's surface?

a. Zero

b. 1.125×10^6 N/C

c. 2.25×10^6 N/C

d. 4.5×10^6 N/C.

Section-II

Multiple Objective Type

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

Q 10.

When an electron jumps from $n = 6\ to\ n = 2$ in hydrogen like atom :

a. Ten emission lines will be obtained

b. Angular momentum will increase by three times

c. Kinetic energy will increase to nine times

d. Potential energy will increase to three times.

Q 11.

Maximum kinetic energy of a particle of mass 1 kg in simple harmonic motion is 8 J. time period os SHM is 4s. Maximum potential energy during the motion is 10 J. Then :

a. Amplitude of oscillations is approximately 2.53 m.

b. Minimum potential energy of particle is 2 J.

c. Maximum acceleration of the particle is approximately 6.3 m/s^2.

d. Maximum K.E of the particle is 2 J.

Q 12.

Two unit vectors when added gives a unit vector. Then choose the correct statement :

a. Magnitude of their difference is $\sqrt{3}$.

b. Magnitude of their difference is 1.

c. Angle between the vectors is 90°

d. Angle between the sum and the difference of the two vectors is 90°.

Q 13

A particular hydrogen like atom has its ground state energy of -54.4 eV. Then :

a. Its atomic number is 2.

b. It can absorb a photon of 54 e V

c. In its ground state it's potential energy is -108.8 eV and kinetic energy is + 54.4 e V.

d. For Its ground state its potential energy is -108.8 eV and kinetic energy is + 54.4 eV.

Q 14.

In a potentiometer arrangement, E_1 is the cell establishing current in primary circuit, E_2 is the cell to be measured. $AB$is the potentiometer wire and G is a galvanometer. Which of the following are the essential conditions for balance to be obtained:

a. The emf of E_1 must be greater than the emf of E_2.

b. Either the +ve terminals of both E_1 and E_2 must be joined to one end at potentiometer wire.

c. The emf E_2 must be greater than E_1.

d. Terminals can be joined in any manner.

Q 15.

Two spheres of masses m and 2 m are separated by a distance d. A particle of mass $m/5$ is projected straight from 2 m towards m with a velocity V_0. Which of the following statement is correct ?

a. Velocity of the particle decreases constantly.

b. Velocity of the particle increases constantly.

c. Acceleration of the particle may become momentarily zero.

d. The particle may retrace it's path depending on value of V_0.

Q 16

Consider three solid spheres $A(m, r), B(3m,\ r)$ and $C(m, 3r)$ with mass m and radius r. All can be placed at the same point on the same inclined plane where they will roll without slipping to the bottom. If allowed to roll down the incline, then at the bottom of the incline :

a. Sphere A will have the largest speed

b. Sphere B will have the largest speed

c. Sphere B will have largest kinetic energy

d. All the sphere will have equal speed.

Q 17.

Which of the following statement is/are true-correct :

a. A capacitor acts as an infinite resistance for a.c as well d.c current

b. An electric transformer can step-up or down the a.c as well as d.c current

c. A hot wire ammeter and voltmeter can measure current and voltage respectively for an a.c and d.c voltage both.

d. We use a choke coild in series with a tube light to reduce voltage across tube light, without long electrical energy in the form of heat, as an ideal inductor does' nt consume power in a circuit.

Section-III

Linked Comprehension Type

This section contains 2 paragraphs $P_{18\text{-}20}$ Based upon each paragraph, 3 multiple choice questions have to be answered. Each questions has 4 choices (a), (b), (c) out of which ONLY ONE is correct.

$P_{18\text{-}20}$: Paragraph for Question Nos. 18 to 20

When a toy car is rapidy scooted across the floor the floor it stores energy in a flywheel. The car has made 0.180 Kg., and its flywheel has a moment of inertia of 4.00×10^{-5} Kg m^2. The car is 15.0 cm long. An advertisement claims that the car can travel at a scare speed of upto 700 Km/hr. The scale speed is the speed of the toy car multiplied by the ratio of the length of an actual car to the length of the toy. Assume a length of 3.0 m for a real car.

Q 18.

For a scale speed of 700 Km/h, what is the actual translational speed of the car ?

a. 97 m/s

b. 9.72 m/s

c. 19 m/s

d. 20 m/s

Q 19.

If all the kinetic energy that is initially in the flywheel is converted into translational kinetic energy of the toy, how much energy is originally stored in the flywheel ?

a. 10 J

b. 20 J

c. 8.5 J

d. 5.5 J.

Q 20.

What initial angular velocity of the flywheel is needed to store the amount of energy, as calculated in the above question.

a. 52 rad/sec

b. 65 rad/sec

c. 652 rad/sec

d. 6520 rad/sec

$P_{21\text{-}23}$: Paragraph for Question Nos. 21 to 23

Light from a discharge tube containing hydrogen atoms falls on the surface of a place of sodium. The kinetic energy of the fastest photoelectrons emitted from sodium is 0.73 cV. The work function for sodium is 1.82 eV.

Q 21

The energy of the photons causing the photoelectric emission

a. 2.55 eV

b. 0.73 eV

c. 1.82 eV

d. Information insufficient

Q 22.

The quantum numbers of two levels involved in the emission of these photons

a. $4 \rightarrow 2$

b. $3 \rightarrow 1$

c. $3 \rightarrow 2$

d. $4 \rightarrow 3$

Q 23.

The change in the angular momentum of the electron in the hydrogen atom in above transition.

a. $\frac{2h}{\pi}$

b. $\frac{h}{2\pi}$

c. $\frac{h}{\pi}$

d. $\frac{h}{4\pi}$

Section-IV

Subjective Type

This section contains 4 questions, write the answer of the question (24 – 27) from the following combinations:

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
☐	☐	☐	☐

Q 24.

With a certain resistance in the left gap of a meter bridge, the balancing point is obtained, when a resistance of 10 Ω is taken out from the resistance box. On increasing the resistance form the resistance box by 12.5 Ω, the balancing point shifts by 20 cm. find the value of unknown resistance.

Q 25.

A thin fixed ring of radius 1 m has a positive charge of 10^{-5} C uniformly distributed over it. A particle of mass 0.9 gram and having a negative charge at 10^{-6} C is placed on the axis at a distance of 1 cm from the centre of the ring. Show that motion of the negatively charged particle is approximately simple harmonic and calculate the time period of oscillation.

Q 26.

A simple pendulum of length 1 m has a wooden bob at mass 1 kg. it is struck by a bullet of mass 10^{-2} kg. Moving with a speed of 2×10^{2} ms^{-1}. The bullet gets embedded into the bob. Obtain the height to which the bob rises before swinging back.

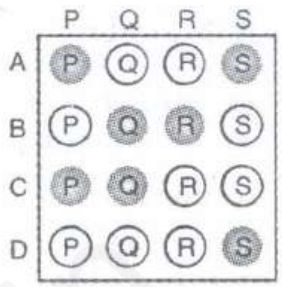
Q 27

A cylinder of fixed capacity 44.8 litres contains helium gas at standard temperature and pressure. What is the amount of heat needed to raise the temperature of the gas int the cylinder by 15°C ? (given $R = 8.31\ J\ mole^{-1}K^{-1}$)

Section-V

Matrix-Match Type Questions

This section contains 3 questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in Column I have to be matched with statement (P, O, R, S) in Column II. The answers to these questions have to be appropriately bubbled as illustrated in the following example.



Q 28.

Relative to a satellite with total energy E in an orbit.

Column I	Column II
a. $E = 0$	p. Circular or elliptical
b. $E < 0$	q. Escape away from the obrit and its path becomes parabolic
c. E is constant	r. Orbit of variable radius
d. E varies	s. Obrit will be stable

Q 29.

Column I	Column II
a. Specific heat capacity S	p. $l_1 - l_2$ constant for $l_1 \propto_1 = l_2 \propto_2$
b. Two metals $(l_1, \propto_1)$ and are heated uniformly	q. Y is same
c. Thermal stress	r. S = ∞ for $\Delta T = 0$
d. Four wires of same material	s. directly proportional to change in temperature

Q 30.

A current (i) carrying loop of area A is placed in magnetic field Bthen:

Column I	Column II
a. Dipole moment	p. Angle between dipole moment and magnetic field is zero
b. Torque acting will be maximum	q. Angle between dipole moment and magnetic field is 90°
c. Work done in rotating the dipole from orientation 0° to 180°	r. iA
d. Potential energy is minimum	s. 2 MB

Part-II (Chemistry)

Section-I

Straight Objective Type

This section contains 9 multiple choice questions numbered 31 to 39. Each question has 4 choices (a), (b), (c) and (d), out of which ONLY ONE is correct.

Q 31.

The equilibrium constant of $CH_3COOH + H_2o \rightleftharpoons CH_3COO^- + H_3O^+ \; is \; 1.8 \times 10^{-5}$. Hence the equilibrium constant for $CH_3COOH + OH^- \rightleftharpoons CH_3COO^- + H_2O$ is

a. 1.8×10^{-9}

b.1.8×10^{9}

c.5.55×10^{10}

d. 5.55×10^{-10}

Q 32.

$A \rightleftharpoons nB$

A decomposes to give B (in a one litre container). If degree of dissociation is $\propto$ then K_{eq} will be

a. $\frac{n\propto}{1-\propto}$

b. $\frac{(n\propto)^n}{1-\propto}$

c.$\frac{n\propto}{(1-\propto)^n}$

d.$\frac{n\propto^n}{1-\propto}$

Q 33

For a real gas at low pressure for 3 moles of the gas the simplified expression would be

a. $\frac{PV}{RT-\frac{3a}{V}} = 3$

b. $\frac{PV}{RT+bp} = 3$

c. $\frac{PV}{RT-\frac{a}{V}} = 3$

d. $\frac{PV}{RT-3bp} = 1$

Q 34.

When H_2S is passed through H_2^{2+}, we get

a. $HgS + Hg_2S$

b. $HgS + Hg$

c. HgS

d. Hg_2S

Q 35.

Two vessels of volume V and 3V contain gases A and B separately at 1 atm, 6 atm respectively. If the vessels are connected through a link. What is the total pressure of gaseous mixture ?

a. $\frac{7}{2}atm$

b. $\frac{19}{4}atm$

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

d. $\frac{7}{4}atm$

Q 36.

Fe reacts with steam at high temperature to give H_2 and $fe_3\ O_4$. What is the correct expression for K ?

a. $\frac{P_{H_2}^4}{P_{H_2O}^4}$

b. $\frac{P_{H_2}^2}{P_{H_2O}^2}$

c. $\frac{[Fe_3O_4]}{[Fe]}$

d. $\frac{P_{H_2}^4[Fe_3O_4]}{P_{H_2O}^4[Fe]}$

Q 37.

10 g of a binary electrolyte ($M_o = 100$) are dissolved in 250 g of H_2O. The freezing point of solution is 0.77°C. $K_f = 1.86\ Km^{-1}$

Hence $\propto$ =

a. 0

b. 75%

c. 50%

d. 100%

Q 38.

The radius of 1 st Bohr orbit is `r', then the de Broglie wavelength of electrons in 2nd orbit is

a. $4\ \pi\ r$

b. $\pi\ r$

c. $4\ r$

d. $\frac{r}{3}$

Q 39.

A certain compound has molecular formula X_4O_6. If 10 g of X_4O_6 has 5.72 g X. Atomic mass of X is

a. 37 amu

b. 32 amu

c. 98 amu

d. 42 amu

Section-II

Multiple Objective Type

This section contains 8 multiple choice questions numbered 40 to 47. Each question has 4 choices (a), (b), (c) and (d), out of which MORE THAN ONE may be correct.

Q 40.

Which of the following statement related to XeF_6 is correct?

a. It is reduced to Xe with H_2.

b. On complete hydrolysis it gives XeO_3.

c. It can't be stored in glass but can be stored in nickel alloy (Monel metal).

d. It has a trigonal bipyramidal structure.

Q 41.

Which of the following reactions involve carbanions?

a. Aldol condensation

b. cannizzaro's reaction

c. perkin condensation

d. Haloform reaction

Q 42.

Which of the following statements are correct for ionic velocity ?

a. It depends upon the voltage across the electrodes.

b. Higher the voltage, higher is the velocity.

c. Lower the voltage, higher the velocity.

d. Higher the hydration of ion, lesser will be velocity.

Q 43.

which of the following are true about van't Hoff factor ?

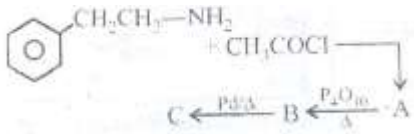
a. $i = \frac{\Delta P_{obs}}{\Delta P_{cal}}$

b. $i = \frac{M_{obs}}{M_{cal}}$

c. $i = \frac{\Delta T_{b(obs)}}{\Delta T_{b(cal)}}$

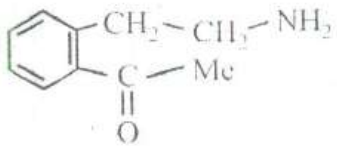
d. $i = \frac{\Delta T_{f(obs)}}{\Delta T_{f(cal)}}$

Q 44.

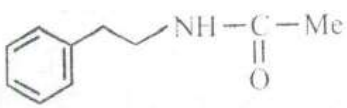


When In this reaction sequence.

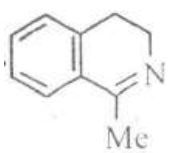
a. Compound (A) which is acid insoluble is



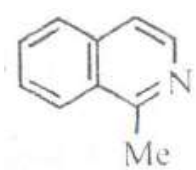
b. Compound (A) which is acid insoluble is



c. Compound (B) which is acid soluble is



d. Compound (C) is



Q 45.

Benzene diazonium chloride, on reduction under suitable conditions can give

a. Benzene

b. Phenylhydrazine hydrochloride

c. Phenol

d. Aniline

Q 46

Which of the following are correct about helium ?

a. It has highest I.E. in the whole periodic table.

b. Its electronegativity is highest if calculated by Muliken's formula.

c. It is used in cryosurgery.

d. it is most reactive noble gas.

Q 47.

the two different forms of alumina known are

a. $\propto -Al_2O_3$

b. $\beta - Al_2O_3$

c. $y - Al_2O_3$

d. $\delta - Al_2O_3$

Section-III

Linked Comprehension Type

This section contains 2 paragraphs $C_{48\text{-}50}$ and $C_{51\text{-}53}$. 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.

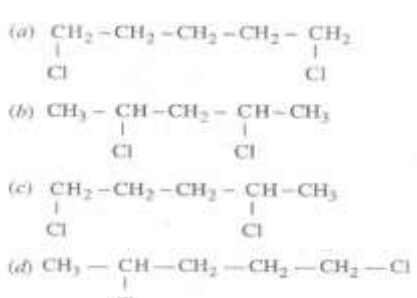
$C_{48\text{-}50}$: Paragraph for question Nos. 48 to 50

When excess of HCl was added to 1, 4-pentadiene in the presence of benzoy1 peroxide, a compound P was formed. Compound P on treatment with excess of Mg in dry ether forms Q.

Compound Q on treatment with methy1 acetate followed by hydrolysis with dilute acids gave R and S.

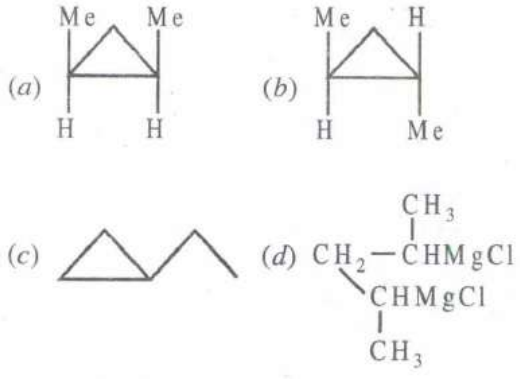
Q 48.

Compound P in the experiment is



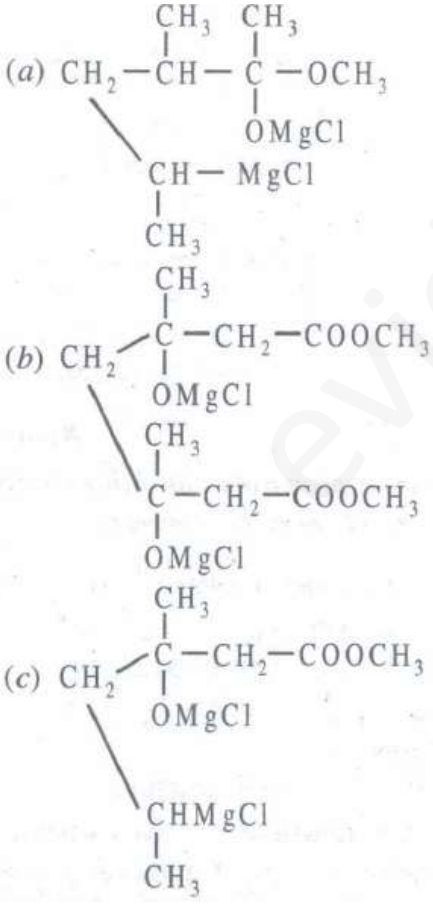
Q 49

The compound Q in the experiment



Q 50.

The compound R formed is



d. No reaction possible. It is misleading information from Q → R.

C_{51-53} : Paragraph for question Nos. 51 to 53

Observe the following graph between progress of reaction vs energy and answer the questions given below :

Q 51.

ΔH of reaction is equal to

a. -5 kJ

b. +5 kJ

c. 15 kJ

d. -15 kJ

Q 52.

$(E_a)_f$ for the reaction is

a. 30 kJ mol^{-1}

b. 20 kJ mol^{-1}

c. 25 kJ mol^{-1}

d. -20 kJ mol^{-1}

Q 53.

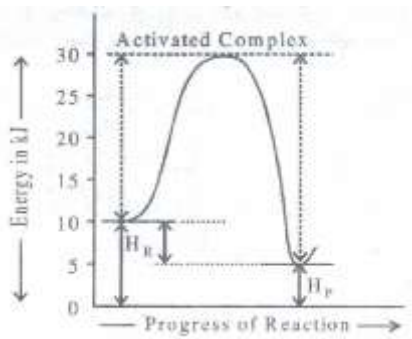
$(E_a)_r$ for the reaction is

a. 20 kJ

b. 30 kJ

c. 25 kJ

d. 15 kJ



Section-IV

Subjective Type

***This section contains 4 questions. Write the answer of the questions (wherever possible) from the following combinations*:**

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**
☐	☐	☐	☐

Q 54.

An indicator is a weak acid with a pH range of its color change is 4.1 to 5.5. If the neutral point of the indicator lies in the centre of the hydrogen ion concentrations corresponding to the given pH range. Then calculate the ionization constant of the indicator.

Q 55.

Metallic tin in the presence of HCI is oxidized by $K_2Cr_2O_7$ to stannic chloride. What volume of decinormal dichromate would be reduced by 1 g of Sn?

Q 56.

Chromium metal crystallizes with a body centred cubic lattice. The length of the unit edge is found to be 287 pm. Calculate the atomic radius if density of Cr is 7.3 g cm^{-3}.

Q 57.

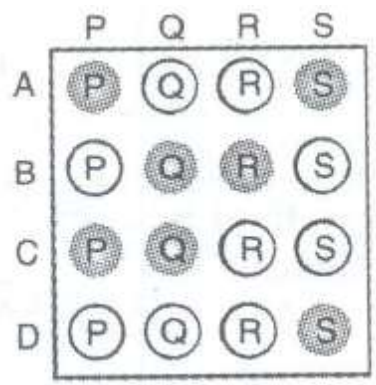
If a man submits to a diet of 9500 kJ/mol and expends energy in all forms to a total of 12,000 kJ/day. What is the change in internal energy per day ? If the energy lost was stored as sucrose (1632 kJ/100 g). How many days should it take to lose 1 kg ? Ignore water loss.

Section-V

Matrix-Match Type Question

This section contains 3 questions. Each question contains statements given in two column which have to be matched. Statements (A, B, C, D) in Column I have to be matched with statements (P, Q, R, S) in Column II. The answers to these question have to be appropriately bubbled as illustrated in the following example.

If the correct matched are A-P, A-S, B-Q, B-R, C-P, C-Q and D-s, then the correctly bubbled 4 x 4 matrix should be as given:



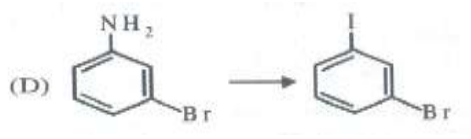
Q 58.

Column I	Column II
a. $NCI_3 + H_2O \rightarrow$	p. No reaction
b. $NF_3 + H_2O \rightarrow$	q. NH_3
c. $BiCI_3 + H_2O \rightarrow$	r. H_3AsO_3
d. $AsCI_3 + H_2O \rightarrow$	s. BiOCl

Q 59.

Column I	Column II
a. CH_3NO_2	p. Composition propellant
b. Monomethy1 hydrazine and N_2O_4	q. Liquid mono propellant
c. Polyurethane+Mg + ammonium per chlorate	r. Hybrid propellant
d. acrylic rubber + liquid N_2O_4.	s. Biliquid propellant

Q 60

Column I	Column II
a. m-Dinitrobenzene to m-nitroaniline	p. $NaBH_4$
b. $CH_3CH = CHCHO \rightarrow CH_3CH = CHOOH$	q. Tollen's reagent
c. $C_6H_5CH = CHCHO \rightarrow C_6H_5CH = CHCH_2OH$	r. $\xrightarrow[KI]{NaNO_2+HCl,0-5^\circ C}$
d. 	s. $(NH_4)_2S$

Part-III (Mathematics)

Section-I

Straight Objective Type

This section contains 9 multiple choice questions numbered 61 to 69. Each question has 4 choices (a), (b), (c) and (d), out which ONLY ONE is correct.

Q 61.

If the graphs of the function $y = \ln x \ and \ y = ax$ intersect at exactly two points, then a must be

a. $(0, e)$

b. $\left(\frac{1}{e}, 0\right)$

c. $\left(0, \frac{1}{e}\right)$

d. None of these

Q 62.

The value of the $\lim_{n\to\infty}\left(\frac{n!}{mn^2}\right)^{\frac{1}{n}}$ must be

a. 1/em

b. -1/3 tan ϕ

c. m/e

d. None of these

Q 63

Consider a line with slope tan ϕ which is intersected by $y = 1 - 3x^2$ at A and B. Let AM and BN be perpendiculars on x-axis then abscissa of mid-point of MN must be

a. -1/2 tan ϕ

b. -1/3 tan ϕ

c. -1/6 tan ϕ

d. None of these

Q 64.

The number of integers lying between 3000 and 8000 (including 3000 and 8000) which have at least two digits equal to.

a. 2481

b. 4384

c. 2755

d. 1977

Q 65.

P(x) is a quadratic polynomial whose values at $x = 1$ and at $x = 2$are equal in magnitude but opposite in sign. If -1 is a root of the equation $P(x) = 0$, then the other root is

a. $\frac{8}{5}$

b. $\frac{13}{7}$

c. $\frac{7}{6}$

d. None of these

Q 66

If ∝, β, γ roots of $ax^3 + 3bx^2 + 3cx + d = 0$, then the value of $(\propto^2+1)(\beta^2+1)(\gamma^2+1)$ must be equal to

a. $\frac{(a-3c)^2+(3b-d)^2}{a^2}$

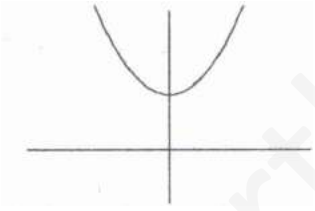
b. $\frac{(a+3c)^2+(3b+d)^2}{a^2}$

c. $\frac{a^2+b^2+c^2+d^2}{a^4}$

d. None of these

Q 67.

The adjoining figure is the graph of



a. $y = 2e^{-x}$

b. $y = e^x - e^x + 2$

c. $y = e^x + e^x$

d. $y = 2e^x$

Q 68. The area bounded by the curve $y = log_e x$, the x-axis and the straight line $x = e$ equlas

a. $1 - \frac{1}{e}$

b. 1

c. e

d. None of these

Q 69. The value of the integral $\int_0^u \sqrt{1 + sin\frac{x}{2}}dx$, where $0 \leq u \leq \pi$, is

a. $4 + 4\left(sin\frac{u}{4} - cos\frac{u}{4}\right)$

b. $4 + \frac{1}{4}\left(sin\frac{u}{4} - cos\frac{u}{4}\right)$

c. $4 + 4\left(cos\frac{u}{4} - sin\frac{u}{4}\right)$

d. $4 + \frac{u}{4}\left(\cos\frac{u}{4} - \sin\frac{u}{4}\right)$

Section-II

Multiple Objective Type

This section contains 8 multiple choice questions numbered 70 to 77. Each question has 4 choices (a), (b), (c) and (d), out of which MORE THAN ONE may be correct.

Q 70.

If $\tan\gamma = \sec\propto\sec\beta + \tan\propto\tan\beta$ then

a. $cos^2\propto cos^2\beta - (1+\sin\propto\sin\beta)^2 = -(sin\propto + sin\beta)^2$

b. $cos^2\propto cos^2\beta - (1+\sin\propto\sin\beta)^2 = -(cos\propto + cos\beta)^2$

c. $\cos 2\gamma \leq 0$

d. $\cos 2\gamma \geq 0$

Q 71.

If $x^2y^2 + x^2 + y^2 - 1 = 0$ then

a. $\frac{dx}{\sqrt{1-x^2}} = \frac{dy}{\sqrt{1-y^2}}$

b. $\frac{dx}{\sqrt{1-x^4}} + \frac{dy}{\sqrt{1-y^4}} = 0$

c. $\frac{dy}{dx} = -\frac{xy^2}{x^2y+y}$

d. $\frac{dy}{dx} = -\frac{x}{y}$

Q 72.

If ω, ω^2 are non-real cube roots of unity then the value of $(a-b)(b-c)(c-a) + (b-\omega c)(c-\omega a)(a-\omega b) + (b-\omega^2 c)(c-\omega^2 a)(a-\omega^2 b)$ must be

a. independent of a, b, c

b. depending on a, b, c

c. $ab + bc + ca$

d. zero

Q 73.

If x, y, z are positive real numbers such that $x^2 + y^2 + z^2 + 2xyz$=1, then

a. there exist a triangle ABC such that $x = \sin A/2,\ y = \sin B/2,\ z = \sin C/2$

b. there exist a triangle ABC such that $x = \cos A/2,\ y = \cos B/2, z = \cos C/2$

c. there exist a triangle ABC such that $x = \tan A/2, y = \tan\ B/2,\ z = \tan C/2$

d. $xyz \leq 1/8$

Q 74

$y = \int_{-1}^{1}(z^2 - 1)^{n-1}e^{xz}dz$

a. y is an odd function of x

b. y is an even function of x

c. y is neither odd nor even

d. $xy" + 2ny' - xy = 0$

Q 75.

The equation $(x + a)^4 + (x + b)^4 = c$ where $y = x + \frac{a+b}{2}$

a. is reducible to $y^4 + 6\left(\frac{a-b}{2}\right)^2 y^2 + \left(\frac{a-b}{4}\right)^4 - \frac{c}{2} = 0$

b. is reducible to $y^4 + \frac{3}{2}(a-b)^2y^2 + \left(\frac{a-b}{4}\right)^4 \frac{c}{2} = 0$

c. cannot have four real roots if $a = b$

d. can have four real roots if $a = b$

Q 76.

If $x + y + z = u + v + w, x^2 + y^2 + z^2 = u^2 + v^2 + w^2, x^3 + y^3 + z^3 = u^3 + v^3 + w^3$, then

a. $x^{13} + y^{13} + z^{13} = u^{13} + v^{13} + w^{13}$

b. $x^4 + y^4 + z^4 = u^4 + v^4 + w^4$

c. $x^{2007} + y^{2007} + z^{2007} = u^{2007} + v^{2007} + w^{2007}$

d. $x^n + y^n + z^n = u^n + v^n + w^n$ for all n

Q 77.

The minimum value of $x + \frac{1}{x} + |x + 2006| + |x - 1| + |x - 2007|(Takex > 0)$

a. is 4013

b. is zero

c. must be attained at $x = 1$

d. must be attained at $x = -2004$

Section-III

Linked Comprehension Type

This section contains 2 paragraphs $M_{78\text{-}83*}$ and $M_{81\text{-}83*}$ 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.

M $_{78\text{-}80}$: Paragraph Question Nos. 78 to 80

Certain algebraic expansions retain their form when they get multiplied for instance $(a^3 + b^3 + c^3 - 3abc)(x^3 + y^3 + z^3 - 3xyz)(A^3 + B^3 + C^3 - 3ABC)$, where $A = ax + by + cz, B = bx + cy + az, C = cx + ay + bz$. Answer the following questions

Q 78.

If $(a^2 + ab + b^2)(x^2 + xy + y^2) = A^2 + AB + B^2$ then A may be equal to

a. $ax + by + ay$

b. $bx + ay + by$

c. $ax + by$

d. None of these

Q 79.

In Q. 78 above B may be equal to

a. $bx + ay$

b. $bx - ay$

c. $ax - by$

d. None of these

Q 80.

If $(a^2 + b^2 + c^2 - ab - bc - ca)(x^2 + y^2 + z^2 - xy - yz - zx) = A^2 + B^2 + C^2 - AB - BC - CA$, then one of the three

a. $a + b\omega + c\omega^2$

b. $a + b\omega^2 + c\omega$

c. $ax + by + cz$

d. None of these

M $_{81\text{-}83}$: Paragraph Question Nos. 81 to 83

A and B are two fixed points on a given circle of radius R where AB=a. C is any point in the major segment given that $\angle CAB = \beta$.

Answer the following questions :

Q 81.

sinθ must be same as

a. $\frac{a}{aR}$

b. $\frac{a}{2\sqrt{2}R}$

c. $\frac{a}{2\sqrt{3}R}$

d. None of these

Q 82.

If $f(\beta) = AC^2 + BC^2$, then $f(\beta)$ must be

a. $4R^2[1 - \sin(2\beta + \theta)\sin\theta]$

b. $4R^2[1 - \cos(2\beta + \theta)\cos\theta]$

c. $2R^2[1 - \cos(2\beta + \theta)\cos\theta]$

d. None of these

Q 83.

The greatest value of $f(\beta)$ must be

a. $2R\left(2R + \sqrt{4R^2 - a^2}\right)$

b. $2\sqrt{2R}\left(2R + \sqrt{4R^2 - a^2}\right)$

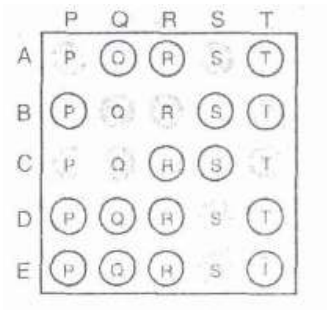
c. $2R\left(2\sqrt{2}R + \sqrt{4R^2 - a^2}\right)$

d. None of these

Section-IV

Subjective Type

This section contains 4 questions. Write the answer of the questions (84 - 87) from the following combinations:



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

0 0 0 0

☐ ☐ ☐ ☐

Q 84.

Let P$(\propto_1, \beta_1), Q(\propto_2, \beta_2)$and $R\ (\propto_2, \beta_3)$ be the centroid, orthocenter and circumcentre of a scalene triangle having its vertices P, Q, R on the curve $y^2 = x^3$, then $\propto_1/\beta_1 + \propto_2/\beta_2 + \propto_3/\beta_3$ is equal to

Q 85.

If $x_0, x_1, x_2, \ldots\ldots\ldots x_{10}$ are eleven 11th roots of unity then the value of $\sum_{k=0}^{10} x_k^5 \sum_{k=0}^{10} x_k^5$ must be equal to

Q 86

Element of a 2×2 determinant are four distinct positive integers from 1 to 10 (both inclusive) then the least positive value of the determinant must be

Q 87.

If $a + b + c = 0, a^2 + b^2 + c^2 = 1$ then the numerical value of $(a^4 + b^4 + c^4)$ must be equal to

Section-V

Matrix-Match Type

Q 88.

Let $f(x) = Pe^{2s} + Qe^x + Rx$ satisfies $f(0) = -1, f'(\log 2) = 31, \int_0^{In4} \big(f(x) - R(x)\big)dx = 19.5$, then match the following

Column I	Column II
a. P	p. – 6
b. Q	q. 5
c. R	r. 2
d. P + Q + R	s. 3

Q 89.

If $x^3 + (3y + 1)x^2 + (4y + y^2)x + 5y^2 - 5y^2 \equiv (x + ay + b)(x^2 + cxy + dy^2)$, where a, b, c, d are constants then match the following :

Column I	Column II
a. a	p. 4
b. b	q. – 1
c. c	r. 5
d. d	s. 1

Q 90.

The root of the equation $x^2 + Px + q = 0$ is $\sqrt[3]{Aq + \sqrt{Bq^2 + Cp^3}} + \sqrt[3]{Aq\sqrt{Bq^2 + Cp^3}}$. Then match the values of $A.B.C$.

Column I	Column II
a. A	p. 1/27
b. B	q. 1/2
c. C	r. 1/4

PAPER-II

Part-I (Physics)

Straight Objective Type

This section contains 9 multiple choice questions numbered 1 to 90. Each question has 4 choices (a), (b), (c) and (d), out of which ONLY ONE is correct.

Q 1.

In a sonometer wire, the tension is maintained by suspending a 50.7 Kg mass from the free end of the wire. The suspended mass has a volume of 0.0075 m^3. The fundamental frequency of the wire is 260 Hz. If the suspended mass is completely submerged in water, the fundamental frequency will become :

a. 1200 Hz

b. 1220 Hz

c. 1230 Hz

d. 240 Hz.

Q 2.

A system `S' receives heat continuously from an electrical heater of power 10 W. the temperature of `S' becomes constant at 50 °C when the surrounding temperature is 20°C. after the heater is switched off `S' cools from 23.1°C to 37.9°C in 1 min. The heat capacity of `S' is

a. 400 J/°C

b. 1300 J/°C

c. 1750 J/°C

d. 1500 J/°C

Q 3.

Equal masses of three liquids A, B and C have temperatures 10°C, 25°C and 40°C respectively. If A and B are mixed, the mixture has a temperature of 15°C. If B and C are mixed the mixture has temperature of 30°C. If A and C are mixed, the mixture will have a temperature of :

a. 16°C

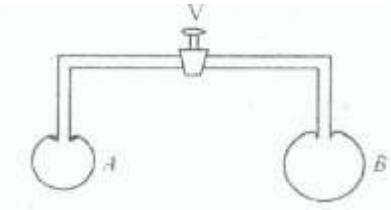
b. 120°C

c. 85°C

d. 29°C

Q 4

The valve V in the bent tube as shown is initially kept closed. Two soap bubbles A (smaller) and B (larger) are formed at the two open ends of the tube. V is now opened, and air can flow freely between the bubbles.



a. There will be no change in the size of the bubbles.

b. The bubbles will become of equal size.

c. `A' will become smaller and `B' will become larger.

d. Bubbles interchange their size.

Q 5.

A uniform rod of mass m length l makes a constant angle 0 with an axis of rotation which passes through one end of the rod. Its moment of inertia about this axis is

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

b. $\frac{MI^2}{3}\sin\theta$

c. $\frac{MI^2}{3}sin^2\theta$.

d. $\frac{MI^2}{3}cos^2\theta$.

Q 6.

A thin prism P_1 of angle 4°, and made from a glass of refractive index 1.54, is combined with another thin prism P_2 made from a glass of refractive index 1.72, to produce dispersion without deviation. The angle of $P_2$is :

a. 5.33°

b. 14°

c. 3°

d. 12.6°.

Q 7

A large flat metal suface has a uniform charge density +σ. An electron at mass m, and returns to it at point B. disregard gravity. The maximum value of $AB$is :

a. $\frac{\mu^2 m\, \epsilon_0}{\sigma e}$

b. $\frac{\mu^2 e\, \epsilon_0}{m\sigma}$

c. $\frac{\mu^2 e}{\epsilon_0 \sigma m^2}$

d. $\frac{\mu^2 \sigma e}{\epsilon_0 m^2}$

Q 8.

A and B are two points on a uni9form ring of resistance R. The $\angle ABC = \theta$, where C is the centre of the ring. The equivalent resistance between A and B is :

a. $\frac{R}{4\pi^2}\theta(2\pi - \theta)$

b. $R\left(1 - \frac{\theta}{2\pi}\right)$

c. $R\frac{\theta}{2\pi}$

d. $R\frac{2\pi - \theta}{4\pi}$

Q 9.

A horizontal straight conductor of mass m and length l is placed in a uniform vertical magnetic field of magnitude B. An amount of charge Q passes through the rod in a very short time such that the conductor begins to move only after all the charge has passed through it. Its initial velocity will be :

a. $BQlm$

b. $\frac{BQ}{lm}$

c. $\frac{BQl}{m}$

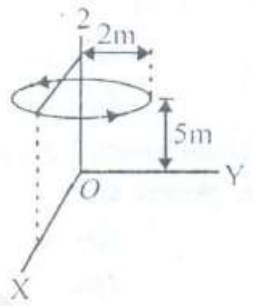
d. $\frac{Bl}{MQ}$.

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 upper end of the string of a simple pendulum is fixed to a vertical z-axis, and set in motion such that the bob moves along a horizontal circular path of radius 2 m, parallel to the xy plane, 5 m above the origin. The bob has a speed at 3 m/s. The string breaks when the bob is vertically above the $3x$-axis, and it lands on the xy plane at a point(x, y):

a. $x = 2\ m$,

b. $x > 2\ m$

c. $y = 3\ m$

d. $y = 15\ m$.

Q 11.

A man who can swim at a speed v relative to the water wants to cross a river of width d, flowing with a speed u. the point opposite to him across the river is P.

a. The minimum time in which he can cross the river is d/v

b. He can reach the point P in time d/v

c. He can reach the point P in time $d/\sqrt{v^2 - u^2}$

d. He cannot reach P if u > v.

Q 12.

A ball of mass m is attached to the lower end of a light vertical spring of force constant K. The upper end of the spring is fixed. The ball is released from rest with the spring after descending through a distance x.

a. $x = mg/K$

b. $x = 2\ mg/K$

c. The ball will have no acceleration at the position where it has descended through x/2.

d. The ball will have an upward acceleration equal to g at its lowermost position.

Q 13

In a one-dimensional collision between two identical particles A and B, B is stationary and A has momentum P before impact. During impact, B gives impulse J to A.

a. The total momentum of the `$A$' plus `B' system is P before and after the impact and $(P - J)$ during the impact.

b. During the impact, A gives impulse J to B.

c. The coefficient of restitution is 2 $J/P + 1$.

d. the coefficient of restitution is $J/P - 1$.

Q 14.

A coin placed on a horizontal platform, which undergoes vertical simple harmonic motion of angular frequency ω. The amplitude of oscillation is gradually increased. The coin will leave contact with the platform for the first time.

a. At the highest position of the platform.

b. At the mean position at the platform.

c. For an amplitude at g/ω^2.

d. For an amplitude at $\sqrt{g}/\omega$.

Q 15.

A wheel of radius r rolls without slipping with a speed v on a horizontal road. When it is at a point A on the road, a small ball of mud separates from the wheel at its highest point and lands at point B on the road.

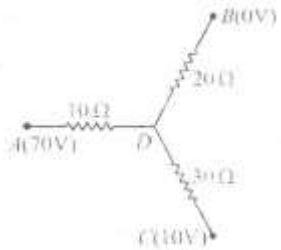
a. Time of travel from highest point to $B = 2\sqrt{r/g}$

b. $AB = 2v\sqrt{r/g}$

c. $AB = 4v\sqrt{r/g}$

d. It $v > \sqrt{4rg}$, the ball of mud will land on the wheel and not on the road.

Q 16



In the network shown, points A, B and C are at potentials at $70\ V, 0\ V$ and 10 V respectively.

a. Point D is at a potential of 40 V.

b. The currents in the section AD, DB, DC are in the ratio 3 : 2 : 1.

c. The currents in the sections AD, DB, DC are in the ratio 1 : 2 : 3.

d. The network draws a total power of 200 W.

Q 17.

The magnetic field perpendicular to the plane of conducting ring of radius r changes at the rate dB/dt :

a. The emf induced in the ring is $\pi r^2 \frac{dB}{dt}$.

b. The emf induced in the ring is $2\pi r\ dB/dt$.

c. The potential difference between diametrically opposite points on the ring is half at the induced emf.

d. All points on the ring are at the same potential.

Section-III

Linked Comprehension Type

This contains 2 paragraphs $P_{18\text{-}20}$ and $P_{21\text{-}23*}$ 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.

$P_{18\text{-}20}$: Paragraph for Question Nos. 18 to 20

Power (P) of a lens is given by the reciprocal of focal length (f) of the lens i.e. $P = 1/f$ when f is in meter, P is in dipotre . For a convex lens, power is positive and for a concave lens power is negative. When a number at thin lenses of powers, P_1, P_2, P_3 … are held in contact with one another, the power of the combination is given by algebraic sum of the power of all the lenses $i.e\ P = P_1 + P_2 + P_3 + \ldots$

With the help of the passage given above, choose the most appropriate alternative for each at the following questions :

Q 18.

Two thin lenses are in contact and the focal length of the combination is 80 cm. If the focal length of one lens is 20 cm, the focal length of the other would be :

a. -26.7

b. 60 cm

c. 80 cm

d. 20 cm

Q 19.

Power of second lens is :

a. -3.75 D

b. 0.5 D

c. -5 D

d. 1.25 D.

Q 20.

When a third lens of focal length -20 cm is placed in contact with the two lenses, power of the three would be

a. -3.750 D

b. 13.75 D

c. 15.0 D

d. -5.0 D.

P $_{21\text{-}23}$: Paragraph for Question Nos. 21 to 23

When a charged particle of charge q while moving with a velocity $\vec{v}$ enters a uniform magnetic field of magnetic induction $\vec{B}$, it experiences a force $\vec{F} = q(\vec{v} \times \vec{B}) = \mathrm{qvB} \sin\theta \hat{n}$, where $\hat{n}$ is a unit vector whose direction is given by right hand rule. For $\theta = 0°\ or\ 180°$, the force experienced by charged particle is zero and the particle goes undeviated.For $\theta = 90°$, the force experienced by the charged particle is maximum $(-qvB)$ which provides the required centripetal force and the particle moves along with a circular path. For other values at $\theta(\theta \neq 180°, 90°)$ the charged particle moves along a helical path which is the resultant motion of simultaneous circular and translator motion.

If a particle of charge `q' having mass 4×10^{-15} Kg is moving with a velocity, $\vec{v} = (8\hat{i} - 6\hat{j} + 4\hat{k}) \times 10^6$ m/s is subjected to a uniform magnetic field $\vec{B} = -0.4\hat{k}$ Tesla, the magnitude at the force on the particle is 1.6 N.

Q 21

The magnitude of charge q on the particle is :

a. $0.3\ \mu C$

b. $0.4\ \mu C$

c. $0.5\ \mu C$

d. $0.8\ \mu C$

Q 22.

The angular frequency of rotation of particle in the magnetic field is :

a. $2 \times 10^7\ rad/s$

b. $4 \times 10^7\ rad/s$

c. $8 \times 10^7\ rad/s$

d. $12.5 \times 10^7\ rad/s$

Q 23.

The radius of curvature of the curved path of the particle in the magnetic field is

a. 25 cm

b. 30 cm

c. 42.5 cm

d. 35 cm.

Section-IV

Subjective Type

This section contains 4 questions. Write the answer of the questions (24 - 27) from the following combinations:

Q 24.

Light of wavelength of 180 nm ejects photoelectrons from a plate of a metal whose work function is 2 eV. If a uniform magnetic field of 5×5^{-5} tesla is applied parallel to plate, what would be the readius of the pat5h followed by electrons ejected normally form the plate with maximum energy. Given $h = 6.62 \times 10^{-34} Js; e = 1.6 \times 10^{-19}\ C [in 10^{-3}\ m]$

Q 25

In young's experiment, two coherent sources are 1.5 mm apart and the fringes are obtained at a distance of 2.5 m from them. If the sources produce light of wavelength 589.3 nm, find the number of fringes in the interference pattern, which is 4.9×10^{-3} m long

Q 26.

When an objected is placed at a distance of 60 cm from a convex spherical mirro, the magnification produced is 1/2 . Where should the objected be placed to get a magnification of 1/3 ?

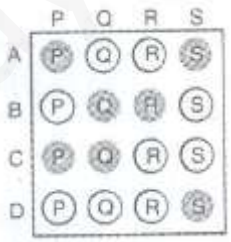
Q 27.

A potentiometer wire of length 100 cm has a resistance of 10 Ω. It is connected in series with a resistance and an accumulator of e.m.f 2 V and negligible internal resistance. A source of e.m.f 10 mV is balanced against a length of 40 cm of the potentiometer wire. What is the value of the external resistance ?

Section-V

Matrix-Match Type Question

This section contains 3 questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in Column I have to be matched with statements (P, Q, R, S) in Column II. The answered to these question have to be appropriately bubbled as illustrated in the following example.



Q 28.

In the following column-I mass of each object is m and circular of raidus R. colum – II represents moment of inertia.

Column I	Column II
a. Full ring	p. $m R^2$
b. Half ring	q. $\frac{m R^2}{2}$
c. Quarter ring	r. $\frac{m R^2}{4}$
d. Arc making an angle θ at the centre	s. $\frac{\theta}{2\pi} m R^2$

Q 29

Three concentric spherical metallic shells A, B and C of radii a, b and $c(a < b < c)$ have charge densities of $\sigma, -\sigma \; and \; \sigma$ respectively, then :

Column I	Column II
a. the potential of A.	p. $\frac{1}{\epsilon_0}\left(\frac{a^2}{c} - \frac{b^2}{c} + c\right)\sigma$
b. The potential of B.	q. $\frac{1}{\epsilon_0}\left(\frac{a^2}{b} - b + c\right)\sigma$
c. the potential of C.	r. $\frac{\sigma}{\epsilon_0}$
d. The electric field at surface of A.	s. $\frac{1}{\epsilon_0}(a - b + c)\sigma$

Q 30.

Regarding the trajectory of a charged particle, match the following :

Column I	Column II
a. In electric field	p. Straight line path
b. In magnetic field	q. Circular path
c. In crossed field	r. Helical path
d. In mutually perpendicular electric and magnetic field, charge being at rest	s. cycloidal path
	t. Parabolic path

PART-II (Chemistry)

Section-I

Straight Objective Type

This section contains 9 multiple choice questions numbered 31 to 39. Each question has 4 choices (a), (b), (c) and (d), out of which ONLY ONE is correct.

Q 31.

A sample of oleum is labeled 109% The % free SO_3 in the sample is

a. 60%

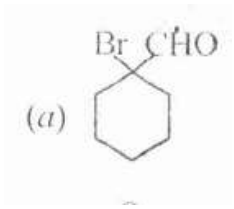
b. 9%

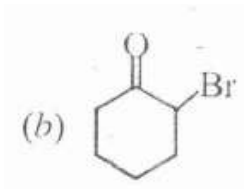
c. 40%

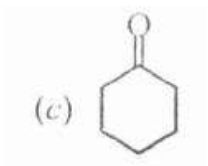
d. 50%

Q 32

Which of the following will be hydrated to maximum extent ?

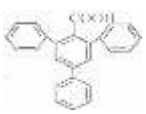


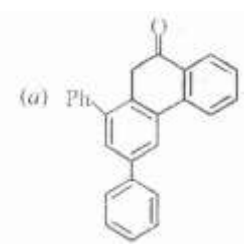


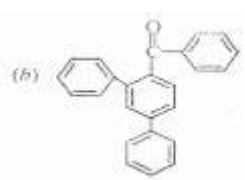


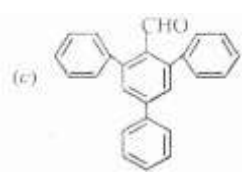
d. All are equal

Q 33.

When  is treated with H^+ then the product will be







d. None of these

Q 34

In which of the following cases does the electrophile E^+ attack meta position ?

a. (i) and (iv) only

b. (i), (ii), (iii)

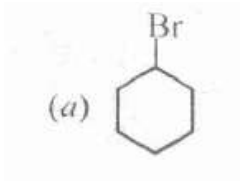
c. (ii) and (iii) only

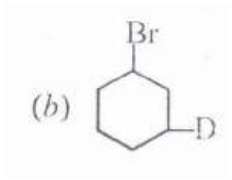
d. (i) and (iii) only

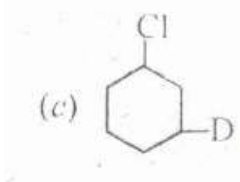
Q 35.

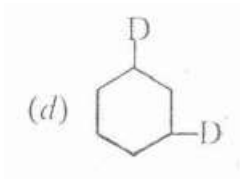
When  $\xrightarrow[ether]{1eqMg} \xrightarrow{D_2O}$ A

A is



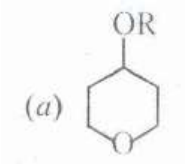


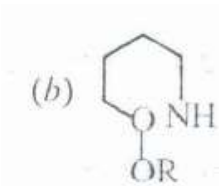


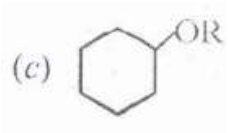


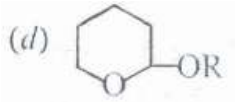
Q 36

What is the major product when  is reacted with ROH in^{+} medium ?









Q 37.

What will be the [OH] when 0.2A electricity is passed for 6.033 min through 50 ml of 0.100 M NaCl solution ?

a. 0.0159 M

b. 0.030 M

c. 0.0199 M

d. 0.1 M

Q 38.

What is the ΔG° for the process

$$Cu^{+} + I \rightarrow CuI$$

If E° = 0.17 V
E° = 0.53 V
For CuI + e → Cu + I
For Cu + e → Cu

a. -67.55 kJ

b. -1.75 J

c. 135.1 J

d. 1.78 J

Q 39

The shortest interionic distance in CsBr crystal if edge length 4.3 pm is

a. 4.3 pm

b. 3.72 pm

c. 1.86 pm

d. 7.44 pm

Section-II

Multiple Objective Type

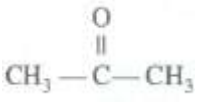
This section contains 8 multiple choice question numbered 40 to 47. Each question has 4 choices (a), (b), (c) and (d), out of which MORE ONE may be correct.

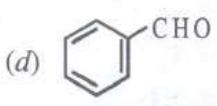
Q 40.

Which of the following don't form stable hydrate forms?

a. CH_3CHO

b. CCI_3CHO

c. 

d. 

Q 41.

Which of the following are optically active, optically inactive and which are colored due to charge transfer spectra and which due to d → d transition and which are colorless?

1. $[Fe(en)_3]^2$

2. $[Pt(NH_3)(H_2O)(CI)(Br)]^{2+}(3)\ M(a-a')_2$trans form

4. $[Ti(H_2O)_6]^{4+}$

5. $[Ti(H_2O)_6]^{3+}$

6. MnO_4^-

7. AgI

a. (1)- optically active, (2) – optically active

b. (1) – optically active, (2), (3) – optically inactive

c. $[Ti(H_2O)_6]^{4+}$ colourless, optically inactive

$[Ti(H_2O)_6]^{3+}$coloured due to d → d transition and optically inactive

d. (6), (7) coloured due to charge transfer

Q 42.

Acetaldehyde on treatment with few drops of H_2SO_4 under suitable conditions can give

a. Paraldehyde

b. Metaldehyde

c. Trioxane

d. Paraformaldehyde

Q 43.

$\overset{226}{88} \xrightarrow{-\alpha} Rn \xrightarrow{-\alpha} Po \xrightarrow{-\alpha} Pb \xrightarrow{-\beta} Bi$ Point out the incorrect statements

a. Ra, Rn, Po, Pb are isodiaphers, PbandBi are isobars

b. Ra and Rn (isotopes), Po, Pb, Bi (isobars)

c. Rn, Po, Pb (isotopes), Ra, Pb, Bi (isobars)

d. All of these

Q 44.

Which of the following statement are true about N_2O_5 ?

a. It is anhydride of HNO_3

b. It is a powerful oxidizing agent

c. It is colourless

d. It has N → O bond

Q 45

The addition of acetic anhydride to benzaldehyde in presence of CH_3COONa at 180° gives

a. Cinnamic acid

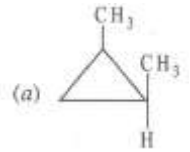
b. It is Perkin reaction

c. It is Claisen condensation

d. It is Cross Aldol condensation

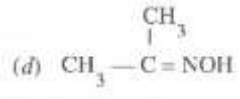
Q 46.

Which of these will not show geometrical isomerism ?

a. 

b. $C_6H_5CH = NOH$

c. $C_6H_5\text{-}N{=}N\text{-}C_6H_5$

d. 

Q 47.

$AlCl_3$ dissolves in

a. NH_4OH

b. NaOH

c. Na_2CO_3

d. H_2O

Section-III

Linked Comprehension Type

This section contains 2 paragraphs $C_{48\text{-}50}$ and $C_{51\text{-}33}$ 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.

$C_{48\text{-}50}$: Paragraph for Question Nos. 48 to 50

In a fuel cell, chemical energy of fuel is used for producing electricity, H_2 is used as a fuel and oxygen is used as oxidiser. The standard enthalpy of combustion of hydrogen is -241 kJ mol^{-1}. The $E^o_{cell} = 1.23\ V$

Q 48.

The value of ΔG for fuel cell is

a. -229 kJ

b. -227.0 kJ

c. -237.39 kJ

d. 237. 39 kJ

Q 49.

The thermodynamic efficiency of above cell is

a. 95%

b. 70%

c. 98.4%

d. 100%

Q 50.

The equilibrium constant of the above cell is [log 4.169 = 0.62]

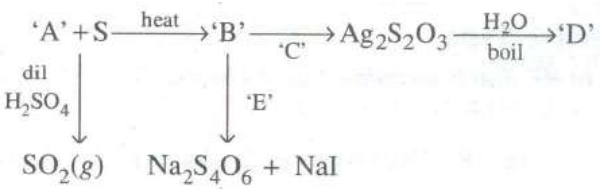
a. 4.7×10^{41}

b. 3.7×10^{41}

c. 4.169×10^{41}

d. 4.169×10^{40}

$C_{51\text{-}53}$: Paragraph for Question Nos. 51 to 53



Q 51

`A' is

a. Na_2S

b. $Na_2S_2O_3$

c. Na_2SO_4

d. Na_2S_2

Q 52.

`B' is

a. $Na_2S_2O_3$

b. Na_2S_2

c. Na_2SO_4

d. Na_2s

Q 53.

`E' is

a. I_2

b. Cl_2

c. KI

d. Br_2

Section-IV

Subjective Type

This section contains 4 questions. Write the answer of the questions (wherever possible) from the following combinations

Q 55.

The solubility product $K_{sp}$of $Ca(OH)_2$ at 25°C is 4.42×10^{-5}. A 500 ml of saturated solution of $ca(OH)_2$ is mixed with equal volume of 0.4M NaOH. How much $Ca(OH)_2$ in milligrams is precipitated ?

Q 56.

Using van der Waals' equation calculate the value of `a' when two moles of a gas confined in a four litre flask exerts a pressure of 11.0 atm at a temperature of 300 K. the value of `b' is 0.05 L mol^{-1}

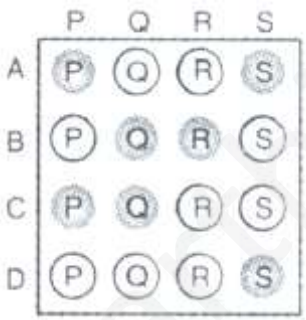
Q 57

A 2.15 g sample containing a mixture of XO and X_2O_3. It takes 0.015 moles of $K_2Cr_2O_7$ to oxidize the sample to form XO_4^- and Cr^{+3}. If 0.0187 moles of XO_4^- is formed. What is the atomic mass if X ?

Section-V

Matrix-Match Type Questions

This section contains 3 questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in Column I have to be matched with statement (P, Q, R, S) in Column II. The answers to these questions have to be appropriately bubbled as illustrated in the following example.



Q 58.

Column I	Column II
a. $F^- > CI^- > Br^- > I^-$	p. Oxidising power.
b. $CIO_4^- > CIO_3^- > CIO_2^- > CIO^-$	q. Nucleophilicity in polar protic medium.
c. $BrO_3^- > CIO_3^-$	r. Basic strength
d. $I^- > Br^- > CI^- > F^-$	s. Stability

Q 59.

Column I	Column II
a. Coagulation	p. Gel
b. solid foam	q. Due to neutralization of charge
c. Cheese	r. Due to adsorption of ions of electrolytes of precipitate
d. Peptization	s. Pumice stone

Q 60

Column I	Column II
a. Bohr	p. $H\Psi = E\Psi$
b. de Broglie	q. $\Delta x.\, \Delta p \geq \frac{h}{4\pi}$
c. Heisenberg	r. $mvr = \frac{nh}{2\pi}$.
d. schrodinger	s. $\lambda = h/p$

PART – III (MATHEMATICS)

SECTION – I

Straight Objective Type

This section contains 9 multiple choice questions numbered 61 to 69. Each question has 4 choices (a), (b), (c) and (d), out of which ONLY ONE is correct.

Q 61.

n boys B_1, B_2, ... B_n and n girls G_2, G_2, ... line up. The number of arrangements in which G_i is ahead of B_1 for all i

(a) $\frac{(2n)!}{n!}$

(b) $\frac{(2n)!}{2^n}$

(c) $\frac{(2n)!}{(n!)^2}$

(d) None of these

Q 62.

If A and B are two square matrices of order 3 x 3 , each such that AB = A and BA = B then (A + B)" must be equal to

a. 2^n (A + B) – A – B

b. 2^{N+1} (A + B) – 3A – 3B

c. 2^{N-1} (A + B)

d. None of these

Q 63

Six persons A, B, C, D, E, F are to be seated at a circular table. The number of ways in which A always has either B or C on her right and B always has either C or D on his right must be

(a) 12
(b) 16
(c) 18
(d) None of these

Q 64.

The sum of the series

$\frac{n_{C_0}}{2.3}\frac{n_{c_1}}{3.4}+\frac{n_{c_2}}{4.5}\ldots.+=(-1)^n\ \frac{n_{C_n}}{(n+2)(n+3)}$ must be

(a) $\frac{1}{(n+1)(n+2)}$
(b) $\frac{1}{(n+2)(n+3)}$
(c) $\frac{1}{2\,(n+2)(n+3)}$
(d) $None\ of\ these$

Q 65.

The digit in the unit position of the integer 1! + 2! + 3! + ... + 99! Is

(a) 3
(b) 7
(c) 0
(d) 1

Q 66.

The number of pairs of positive integers (x, y), where x and y are prime numbers and $x^2 - 2y^2 = 1$ is

(a) 8
(b) 1
(c) 0
(d) 2

Q 67.

Let $(1 + x + x^2)^9 = \alpha_0 + \alpha_1 x + \ldots\ldots \alpha_{18}x^{18}$. Then

(a) $\alpha_0 + \alpha_2 + \ldots\ldots\ldots\ldots\alpha_{18}$ is divisible by 3 but not by 9
(b) $\alpha_0 + \alpha_2 + \ldots\ldots\ldots\ldots\alpha_{18}$ is even
(c) $\alpha_0 + \alpha_2 + \ldots\ldots\ldots\ldots\alpha_{18}$ is divisible by 9
(d) $\alpha_0 + \alpha_2 + \ldots\ldots\ldots\ldots\alpha_{18} = \alpha_1 + \alpha_3 + \ldots\ldots\ldots \alpha_{17}$

Q 68

The sum $1 + \binom{n}{1}\cos\theta + \binom{n}{2}\cos 2\theta + \ldots\ldots + \binom{n}{n}\cos n\theta$ equals

(a) $\left(2\cos\frac{\theta}{2}\right)^n \cos\frac{n\theta}{2}$

(b) $\left(2\cos^2\frac{n\theta}{2}\right)^n$

(c) $\left(2\cos^2\frac{\theta}{2}\right)^n$

(d) $None\ of\ these$

Q 69 .

The maximum value attained by the function

$y - 10 - |x|$ in the range $-9 < x < 9$ is

(a) $+\infty$

(b) 9

(c) 1

(d) 10

SECTION II

Multiple Objective Type

This section contains 8 multiple choice questions numbered 70 to 77. Each question has 4 choices (a), (b), (c) and (d), out of which MORE THAN ONE may be correct.

Q 70.

If a, b, m, n real numbers given that $a^2 + b^2 = 1$, $m^2 + n^2 - 1$ then

(a) $|am + bn|$ can be zero

(b) $|am + bn|$ can never be zero

(c) $|am + bn| \leq 1$

(d) $|am + bn| \geq 1$

Q 71.

If $a + b(x + y) + cxy = m(x - y)$ then

(a) $\frac{dx}{a+2bx+cx^2} = \frac{dy}{a+2by+cy^2}$

(b) $\frac{dx}{a+bx+cx^2} = \frac{dy}{a+by+cy^2}$

(c) $\frac{dy}{dx} = \frac{m-cy-b}{b+cx+m}$

(d) $\frac{dy}{dx} = \frac{m+cy+b}{m+cx+b}$

Q 72

If the equation $x^4 - 12x^2 + 12x - 3 = 0$ has real roots x_1 and x_2, where $x_1 < x_2$ then

(a) $[x_1] = -3$
(b) $[x_1] = -4$
(c) $[x_2] = 3$
(d) $[x_2] = 2$

Q 73.

Triangle ABC is isosceles

(a) If $a \cos B + b \cos C + c \cos A = \frac{a+b+c}{2}$
(b) Only if $a \cos B + b \cos C + c \cos A = \frac{a+b+c}{2}$
(c) If a = b
(d) Only if a = b

Q 74.

Let $y = \int_0^x \frac{e^{-x2}}{(1+z^2)^{n+1}} dz$ then

(a) y as function of x is increasing
(b) y as a function of x is decreasing
(c) $xy'' - 2ny' + xy = 1$
(d) $xy'' - 2xy + xy + 1 = 0$

Q 75. The value of the $\lim_{n \to x} a_n$, where

$A_n = \frac{1}{\sqrt{2}} \sqrt{\frac{1}{2} + \frac{1}{2} - \frac{1}{2}} \sqrt{\frac{1}{2} + \frac{1}{2}\sqrt{\frac{1}{2} + \frac{1}{2} - \frac{1}{\sqrt{2}}}}$ (up to n terms) must be

(a) less than I
(b) greater than I
(c) $2/\pi$
(d) $\pi/2$

Q 76.

If $A = \tan^{-1}\frac{1}{7}$, $B = \tan^{-1}\frac{1}{3}$ then

(a) cos 2A = sin 4B
(b) sin 2A = cos 4B
(c) $A + B > \frac{\pi}{6}$
(d) $A + B < \frac{\pi}{6}$

Q 77

The values of x for which $f'(x) = 0$ and $x^2 + 19.5\,x - 10 < 0$ where $f(x) = 2\sin^2 x/6 \ \sin x / 3$ is (are)

(a) -6π
(b) $-9\pi/2$
(c) 6π
(d) 0

SECTION – III

Linked Comprehension Type

This section contains 2 paragraphs $M_{78\text{-}80}$ and M_{81-83*} 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.

M_{78-80} : Paragraph for Question Nos. 78 to 80

Let the pairs of numbers (a, b); (a_1, b_1); (a_2, b_2) be obtained according to the following recursion relations:

$a_1 = \frac{a+b}{2}, b_1 = \frac{a_1+b}{2}, a_2 = \frac{a_1+b_2}{2}$, ... , then answer the following questions :

Q 78.

A_n must be equal to

(a) $\frac{2}{3}$ (b -a) + $\left(1 - \frac{1}{4^n}\right)$
(b) $a + \frac{2}{3}(b-a)\left(1 - \frac{1}{4^n}\right)$
(c) $a + \frac{2}{3}\left(1 - \frac{1}{2^n}\right)$
(d) $None\ of\ these$

Q 79.

B_n must be equal to

(a) $a + \frac{2}{3}(b-a)\left(1 + \frac{1}{2.4^n}\right)$
(b) $a + \frac{2}{3}(b-a)\left(1 - \frac{1}{4^n}\right)$
(c) $a + \frac{2}{3}(b-a)\left(1 - \frac{1}{2.4^n}\right)$
(d) $None\ of\ these$

Q 80

$\lim_{n\to x}$ ($a_n - b_n$) must be equal to

(a) 1
(b) $\frac{1}{3}(b-a)$
(c) $zero$
(d) None of these

$M_{81\text{-}83}$: Paragraph for Question Nos. 81 to 83

Consider the inequality $\frac{x}{2+x} < \sqrt{1+x} - 1 < \frac{x}{2}$ which is true for x > - 1 . Answer the following questions for the summation S_n $\sum_{k-1}^{n}\left(\sqrt{1+\frac{k}{n^2}}-1\right)$

Q 81.

S_n is cssentially less than

(a) $\frac{(n+1)}{4n}$
(b) $\frac{(n+1)}{8n}$
(c) $\frac{n+1}{16n}$
(d) None of these

Q 82.

$\lim_{n\to 1}\sum_{k-1}^{n}\frac{k}{2n^2+k}$ must be equal to

(a) 1/2
(b) 1/4
(c) 1/8
(d) None of these

Q 83.

$\lim_{n\to 1} S_n$ must be equal to

(a) 1/2
(b) 1/4
(c) 1/8
(d) None of these

SECTION –IV

This section contains 4 questions. Write the answer of the questions (84 - 87) from the following combinations :

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

□ □ □ □

Q 84.

If the curve when reflecting the ellipse

$\frac{(x-4)^2}{16} + \frac{(y-3)^2}{9}$ 1 in the line x, y, 2 – 0 is $16x^2 + 9y^2 + n_1 x - 36 y + n_2 0$. Then $n_1 + n_2$ is

Q 85.

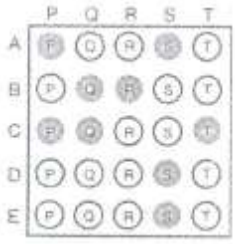
If cos α + i sin α is the solutions of the equation $x^n + p_1x^n + p_2x^{n-2} + \ldots\ldots + P_n 0$ then the value of P_1 sin α + P_2 sin 2α + ... 1 p_n sin nα. Where (p_1, p_1, ... p_n) are real numbers) must be

Q 86.

The minimum value of a + b + c + d where $\log_3 (a + b) + \log_3 (c + d) > 4$ must be

Q 87.

The value of $\lim_{n \to 1} n^{2008} \left(\frac{1}{2008}\right)^n$ must be equal to



SECTION –V

Matrix – Match Type

This section contains 3 questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D, E) in Column I have to be matched with statements (P, Q, R, S, T) in Column II. The answers to these questions have to be appropriately bubbled as illustrated in the following example:

If the correct matches are A-P, A-S, B-Q, B-R, C-P, C-Q, D-S and C-T, then the correctly bubbled 5 x 5 matrix should be as follows.

Column I	Column II
(A) The period the function 3x – [3x]	(P) 180
(B) The distance between the points on the Circle $x^2 + y^2 + 2x - 19 = 0$ which are Points of contact of tangents from (1,6)	(Q) 2008
(C) The value of the integral $\int_{-2008}^{2008} \frac{dx}{1+x^9\sqrt{1+x^{18}}}$	(R) $\sqrt{40}$
(D) The shortest distance between origin and the curve $x^2 + y^2 xy = 60$	(S) $\sqrt{24}$

Q 89.

Let a sequence u_n be defined by $u_1 = u_2 - 1$, $u_n = u_{n-1} + u_{n-2}$ for $n > 2$. then match the following :

Column I	Column II
(A) $u_1^2 + u_2^2 + \ldots\ldots + u_n^2 - u_n u_{n+1}$	(P) 1
(B) $u_n^2 - u_{n+1}\, u_{n+1}$	(Q) -1
(C) $u_{n+1}u_{n+2} - u_n u_{n+3}$	(R) 0
(D) $u_n^2 + u_{n-1}^2 - u_{2n-1}$	

Q 90.

The angle A of the isosceles triangle ABC (AB = BC) I $\tan^{-1}\frac{8}{15}$. A circle with centre O and radius 1 touches the sides AB and BC at points E and K (E lies between A and K) M is the point of contact of the circle with the line AB and AM = 15/8. Match the following if BH is the altitude of the triangle ABC :

Column I	Column II
(A) OH	(P) 289/120
(B) BH	(Q) 17/15
(C) AK	(R) 25/8
(D) AB	(S) 275/272
(E) Area ΔAMK	(T) 0