



BALVANTRAY MEHTA VIDYA BHAWAN (A.S.M.A.)
MID TERM EXAMINATION (2024-25)
CLASS: XII
SUBJECT: PHYSICS (042)

Time: 3Hr.

Max. Marks: 70

Name: Neelakshi

Roll Number 24

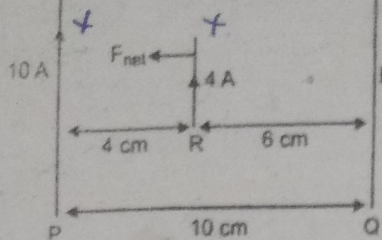
General Instructions:

Please read the following instructions carefully and follow them:

1. This question paper contains 33 questions in all. All questions are compulsory
2. Section A: Q1-Q16 carry 1 mark each.
3. Section B: Q17-Q21 carry 2 marks each.
4. Section C: Q22-Q28 carry 3 marks each.
5. Section D: Q29&Q30 are case based questions of 4 marks each.
6. Section E: Q31-Q33 carry 5 marks each.
7. There is no overall choice in the question paper. However, internal choice has been provided.

SECTION-A

Q1	<p>Two long and straight current carrying wires, P and Q are placed parallel to each other separated by a distance of 10cm. A wire R of length 8cm and carrying current of 4 A is placed between the wires P and Q as shown here:</p> <p>If the wire R, experiences a net force towards wire P, then which of the following is definitely true about the current I in wire Q?</p> <p>a) Current I cannot be in the upward direction. b) Current I can have any magnitude greater than 0A in the upward direction c) Current I can have any magnitude greater than 15A in the upward direction d) Current I can have any magnitude greater than 10A in the upward direction</p> <p>Fig:</p>	1

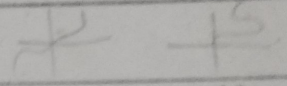


Q2. When an electron in an atom moves from the ground state to a higher energy level, what happens to its kinetic and potential energies?

1

	Kinetic energy	Potential Energy
a)	Increases	Increases
b)	Increases	Decreases
c)	Decreases	Increases
d)	Decreases	Decreases

Q3. Draw V-I characteristics of any two non-Ohmic devices.



1

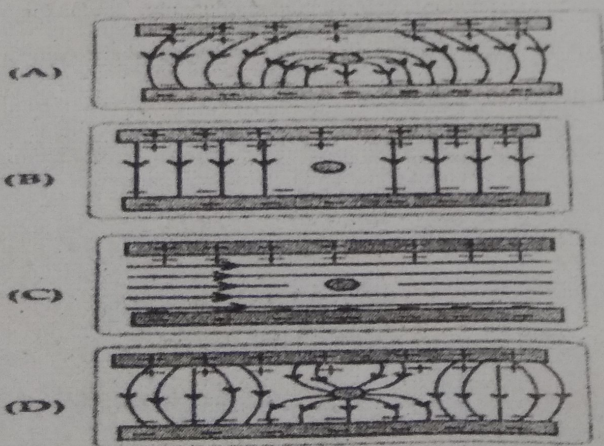
Q4. An electric dipole having a dipole moment of $4 \times 10^{-9} \text{ Cm}$ is placed in a uniform electric field such that the dipole is in stable equilibrium. If the magnitude of the electric field is $3 \times 10^3 \text{ N/c}$. The work done in rotating the dipole to a position of unstable equilibrium is

1

Q5. Which of the following diagrams correctly represents the electric field between two charged plates if a neutral conductor is placed in between the plates?

1

Fig:



Q6. A proton and an alpha particle move in circular orbits in a uniform magnetic field. Their speeds are in the ratio of 9:4. The ratio of their circular orbits $r_p : r_\alpha$ is

1

- a) 3:4
- b) 4:3

c) 8:9

d) 9:8

Q7

Which of the following is not the property of an equipotential surface?

a) They do not cross each other.

b) The work done in carrying a charge from one point to another on an equipotential surface is zero.

c) For a uniform electric field, they are concentric spheres.

d) They can be imaginary spheres.

Q8

A metallic plate exposed to white light emits electrons. For which of the following colors of light, the stopping potential will be maximum?

a) Blue

b) Yellow

c) Red

d) Violet

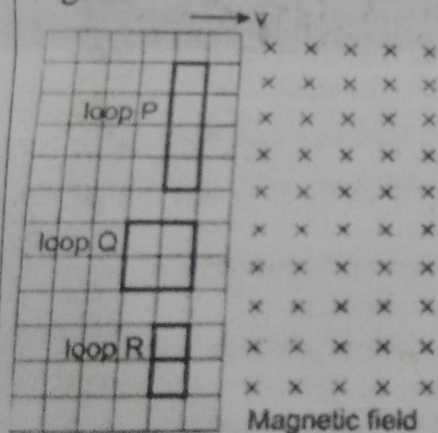
VIBGYOR

v
r

Q9

Three loops are as shown below move into the magnetic field with a velocity v :

Fig:



In which of the loop(s) will the induced emf be the largest at the instant when the loops enter the magnetic field?

a) Only P

b) Only Q

c) Only P and Q

d) Only Q and R

Q10

An alpha particle is accelerated through a potential difference of 100V. The speed acquired by the alpha particle is

a) 10^4 m/s

b) 10^5 m/s

c) 10^6 m/s

	d) None of the above	1
Q11	<p>Which of the above represents the correct variation for a metallic conductor?</p>	1
Q12	<p>An ammeter gives full scale deflection when current of 1A is passed in it. It is converted into a 10A range ammeter. What will be the ratio of the shunt resistance and its resistance?</p> <p>a) 1:9 b) 9:1 c) 1:11 d) 11:1</p>	1
Q13	<p>For questions Q13-Q15, there are two statements given-one labeled Assertion (A) and the other labeled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.</p> <p>(a) Both A and R are true and R is the correct explanation of A. (b) Both A and R are true but R is NOT the correct explanation of A. (c) A is true but R is false. (d) A is false and R is also false</p> <p>Assertion: For the radiation of frequency greater than threshold frequency, photoelectric current is proportional to the intensity of the radiation. Reason : Greater the number of energy quanta available, greater is the number of electrons coming out of the metal.</p>	1
Q14	<p>Assertion: Putting p type semiconductor slab directly in physical contact with n type semiconductor slab cannot form the p-n junction. Reason : The roughness of the contact will be much more than interatomic crystal spacing and continuous flow of electric charges is not possible.</p>	1
Q15	<p>Assertion: Density of all nuclei is same. Reason Radius of nucleus is directly proportional to the square root of mass number.</p>	1
Q16	<p>If the back emf induced in a coil, when current changes from 1A to zero in one milli second, is 5 volts, the self inductance of the coil is</p> <p>a) 5H b) 1H c) 5×10^{-3} H d) 5×10^3 H</p>	1

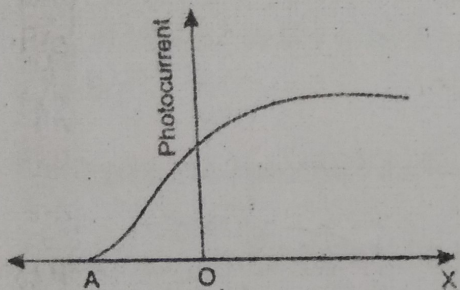
Tl Pb Bi

SECTION-B

Q17 Two crystals C_1 and C_2 , made of pure silicon, are doped with arsenic and aluminium respectively.
 a) Identify the extrinsic semiconductors formed.
 b) Why is doping of intrinsic semiconductors necessary?

Q18 Two identical point charges, q each are kept $2m$ apart in the air. A third charge Q of unknown magnitude and sign is placed on the line joining the charges such that the system remains in equilibrium. Find position and nature of Q .

Q19 The graph shows the variation of photoelectric current for a photosensitive metal.
 Fig:



- a) What does X and A on the horizontal axis represent?
 b) Draw this graph for three different values of frequencies of incident radiation ν_1, ν_2 and ν_3 ($\nu_3 > \nu_2 > \nu_1$) for the same intensity.
 c) Draw this graph for three different values of intensities of incident radiation I_1, I_2 and I_3 ($I_3 > I_2 > I_1$) having the same frequency.

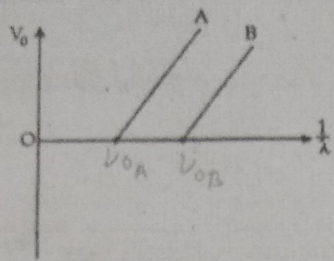
Q20 A light bulb and a solenoid are connected in series across an ac source of voltage. Explain, how the glow of the light bulb will be affected when an iron rod is inserted in the solenoid.

Q21 a) What do you understand by de-Broglie wavelength?
 b) A proton and an alpha -particle are accelerated by the same potential difference. Find the ratio of their de- Broglie wavelengths ($\lambda_p : \lambda_\alpha$)

OR

- a) What do you understand by the term "stopping potential"?
 b) If the distance between the light source and surface of metal A is increased, how will the stopping potential from electrons emitted from it be affected? Justify your answer briefly.

Fig:



SECTION-C

Q22 With the help of circuit diagram, discuss the working of pn-junction as a rectifier. Draw input and output wave forms as well.

3

Q23 A storage battery is of emf 8V and internal resistance 0.5Ω is being charged by supply of 120V using a resistor of 15.5Ω .
 a) Draw the circuit diagram and calculate current
 b) Calculate the potential difference across the battery
 c) What is the purpose of having a series resistance in the circuit?

3

OR

Deduce the expression of equivalent emf and equivalent internal resistance when two cells are connected in parallel combination. Also generalize the result and find the expression for maximum current for "m" identical cells connected in parallel combination.

Q24 i) Obtain the expression for the torque experienced by an electric dipole of dipole moment p in a uniform electric field E .

3

ii) What will happen if the field were not uniform?

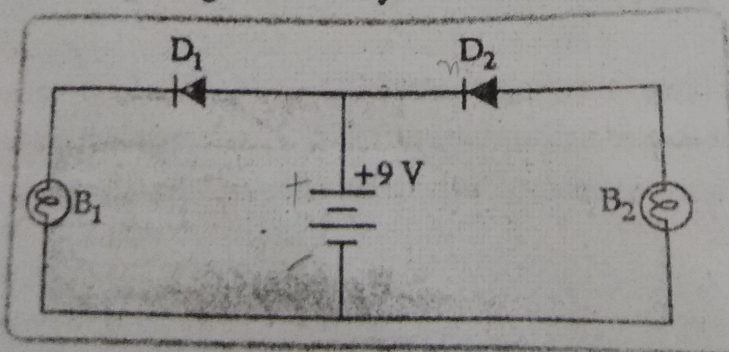
Q25 a) With the help of necessary circuit diagrams used to study the forward and reverse biasing of pn-junction diode.

3

b) Draw the characteristics curves in the two cases.

c) In the following diagram, which bulb out of B_1 and B_2 will glow and why?

Fig:



Q26 a) Draw a graph showing the variation of de-Broglie wavelength of a particle of charge 'q' and mass 'm' with accelerating potential "V".

3

b) Proton and deuteron have the same de-Broglie wavelength. Explain which has

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more kinetic energy.

Q27 What is a moving coil galvanometer? Describe, working principle and construction of the same. Also give significance of radial magnetic field.

3

Q28 a) Draw Binding Energy /nucleon verses mass number.

b) A heavy nucleus P of mass number 240 and binding energy 7.6MeV per nucleon splits into two nuclei Q and R of mass numbers 110 and 130 and binding energy per nucleon 8.5MeV and 8.4MeV respectively. Calculate the energy released in the fission.

3

SECTION-D

Q29 Energy of an electron in hydrogen atom is partly kinetic and partly potential and the total energy E is equal to their sum. Total energy E is least, having a value of -13.6eV , in orbit closest to the nucleus i.e for which $n=1$. For $n=2,3,4\dots$ energy is given by $E_{\text{nth}} = 13.6/n^2$.

4

The hydrogen spectrum series is as follows:

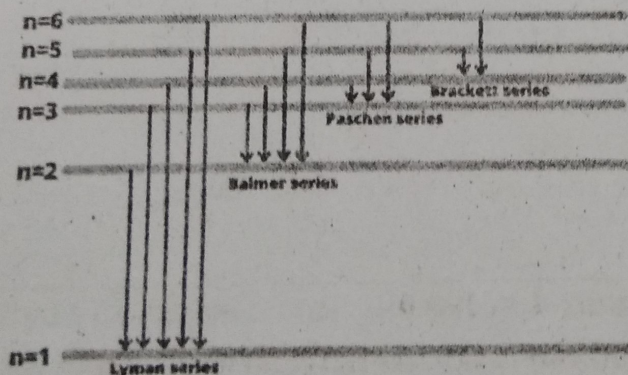
Lyman series= First shell to any other shell electron transition

Balmer series= Second shell to any other shell electron transition

Paschen series= Third shell to any other shell electron transition

Bracket series= Fourth shell to any other shell electron transition

Pfund series= Fifth shell to any other shell electron transition.



Energy transitions for the Hydrogen Atom

Q1 Negative value of atomic energy signifies that

a) an electron is a negatively charged particle

b) an electron is revolving in clockwise direction

c) electron is bound in atom due to attractive force experienced on account of coulombic attraction due to the nucleus

d) electron is experiencing a repulsive force

Q2 The energy required to excite an electron in a hydrogen atom from its ground state to 1st excited state is

a) 13.6eV

b) 3.4eV

c) -10.2eV

d) +10.2eV

* Q3 Ionization energy of hydrogen is

a) -13.6eV

b) +13.6eV

c) 3.4eV

d) 10.2eV

Q4 Transition of an electron from $n=4$ to $n=2$ state leads to emission of a spectral line belonging to

a) Lyman series

b) Balmer series

c) Paschen series

d) Brackett series

Q30 We know that circulating electron in an atom has magnetic moment. In a bulk material these moments add up vectorially and give a net magnetic moment. From that consideration we define certain magnetic terms and on the basis of these terms we classify substances in diamagnetic, paramagnetic and ferromagnetic substances.

4

Q1 The magnetic moment of a diamagnetic atom is

* a) >1

b) 1

c) between 0 and 1

d) zero

Q2 Magnetic permeability is maximum for

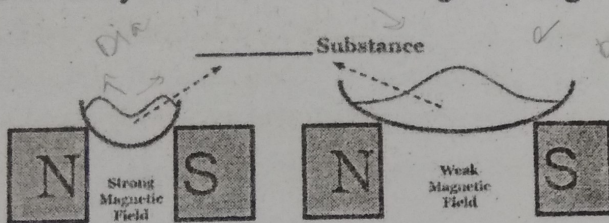
a) diamagnetic substance

b) paramagnetic substance

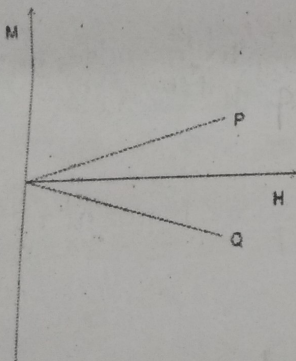
c) ferromagnetic substances

d) ferrites

Q3 Identify the substance in the given diagram:



Q4 Identify the materials P and Q



SECTION-E

Q31 a) Using the concept of free electrons in a conductor, derive the expression for the drift velocity and its relation with current. And hence deduce the expression for the resistivity.

$$v_d = -\frac{eE\tau}{m} \text{ or } \frac{eV}{ml} \quad | \quad I = neAv_d$$

Handwritten notes on the right side of the page:
 $l = \text{speed} \times \text{time}$
 $\Rightarrow v_d \times t$
 $v_d = \dots$
 $n = \dots$
 $N = \dots$
 $a = \dots$

b) Two metallic wires P_1 and P_2 of the same material and same length but different cross-sectional areas A_1 and A_2 are joined together and then connected to a source of emf. Find the ratio of the drift velocities of free electrons in the wires P_1 and P_2 , if the wires are connected

i) in series, and

ii) in parallel.

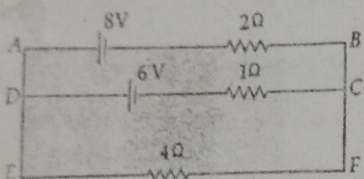
OR

a) State Kirchoff's loop rule. ~~KCL~~

b) Using Kirchoff's rules to obtain conditions for the balance condition in a Wheatstone bridge.

c) Calculate the potential difference across the 4Ω resistor in the given electrical circuit using Kirchoff's rules

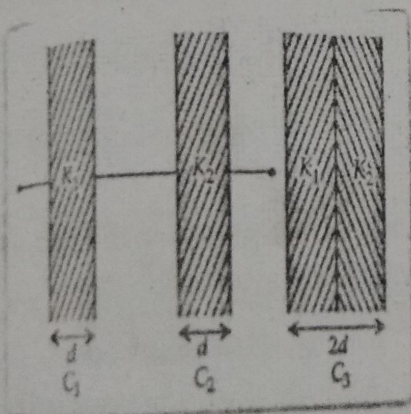
Fig:



Q32 a) Deduce an expression for capacitance when a dielectric is filled in the plates of a parallel plate capacitor. $\epsilon_0 = \frac{\sigma}{E_0}$

b) The capacitors C_1 and C_2 having plates of area A each, are connected in series, as shown. Compare the capacitance of the combination with the capacitor C_3 , again having plates of area A each but "made up" as shown in the figure.

Fig:



a) Using Gauss' law deduce the expression for the electric field due to a uniformly charged spherical conducting shell of radius R at a point i) outside and ii) inside the shell. Plot a graph showing the variation of the electric field as a function of $r > R$ and $r < R$ (r being the distance from the center of the shell).

b) Two large charged plane sheets of charge densities σ and $-\sigma$ C/m² are arranged

vertically with a separation of d between them. What is the electric field at the points

- i) to the left of the first sheet
- ii) to the right of second sheet
- iii) between the two sheet

Q33 a) Derive an expression for the force acting on a current carrying conductor placed in a uniform magnetic field. Write the condition for which this force will have 5

- (i) maximum and
- (ii) minimum value.

b) Two infinitely long straight wires A_1 and A_2 carrying current I and $2I$ flowing in the same direction are kept ' d ' distance apart. Where should a third wire A_3 carrying current $1.5I$ be placed between A_1 and A_2 so that it experiences no net force due to A_1 and A_2 ? Does the net force acting on A_3 depend on the current flowing through it?

OR

a) Using Biot Savart's law, deduce the expression for magnetic field due to circular current carrying loop of radius a , at point r from it.

b) Two identical loops P and Q each of radius 5 cm are lying in perpendicular planes such that they have a common center as shown in the figure. Find the magnitude and direction of the net magnetic field at the common center of the two coils, if they carry currents equal to $3A$ and $4A$ respectively.

Fig:

