# Section A

*Answer **all** questions*

## Question 1

(A) Choose the correct alternative (a), (b), (c) or (d) for each of the questions given below: **[5×1]**

(i) A point charge '*q*' is kept at each of the vertices of an equilateral triangle having each side 'a'. Total electrostatic potential energy of the system is:

(a) $\left(\frac{1}{4\pi\varepsilon_o}\right)\frac{3q^2}{a^2}$ (b) $\left(\frac{1}{4\pi\varepsilon_O}\right)\frac{3q}{a}$

(c) $\left(\frac{1}{4\pi\varepsilon_o}\right)\frac{3q^2}{a}$ (d) $\left(\frac{1}{4\pi\varepsilon_o}\right)\frac{3q}{a^2}$

(ii) **Curie** temperature is the temperature above which:

(a) a ferromagnetic substance behaves like a paramagnetic substance.

(b) a paramagnetic substance behaves like a diamagnetic substance.

(c) a ferromagnetic substance behaves like a diamagnetic substance.

(d) a paramagnetic substance behaves like a ferromagnetic substance.

(iii) In an **astronomical telescope** of **refracting** type:

(a) Objective should have small focal length.

(b) Objective should have large focal length.

(c) Eyepiece should have large focal length.

(d) Both objective and eyepiece should have large focal length.

(iv) In **photoelectric effect** experiment, the slope of the graph of the **stopping potential** versus **frequency** gives the value of:

(a) $\frac{h}{e}$ (b) h

(c) $\frac{e}{h}$ (d) $\frac{hc}{e}$

(v) In a nuclear reactor, **cadmium** rods are used as:

(a) Control rods

(b) Fuel rods

(c) Coolant

(d) Moderator

(B) Answer the following questions **briefly** and to the point: **[7×1]**

(i) State **Gauss**' theorem.

(ii) A metallic wire having a resistance of 20Ω is bent in order to form a complete circle. Calculate the resistance between *any two* diametrically opposite points on the circle.

(iii) How can a moving coil galvanometer be converted into a **voltmeter**?

(iv) Write **Biot-Savart's law** in vector form.

(v) What is the **phase difference** between *any two* points lying on the **same** wavefront?

(vi) Name the physical **principle** on the basis of which **optical fibres** work.

(vii) What is ***Pair production***?

| Comments of Examiners | Suggestions for Teachers |
|---|---|
| (A) (i) Many candidates wrote an expression for force which had $r^2$ in the denominator.<br>(ii) Several candidates wrote that Curie temperature is the temperature above which a paramagnetic substance behaves like a ferromagnetic substance<br>(iii) Many candidates could not choose the correct alternative for an astronomical telescope of refracting type which clearly indicated that many of them had no idea of the difference between a telescope and a microscope and this showed in a variety of answers.<br>(iv) Most candidates chose either option (b) or option (c), both of which were incorrect.<br>(v) One of the common answers was 'coolant', which was incorrect.<br>(B) (i) In Gauss' theorem, a commonly missing term was 'closed surface enclosing a charge'. Some candidates also used the term *magnetic flux* instead of *electric flux*.<br>(ii) Most of the candidates could not calculate the resistance between *any two* diametrically opposite points on the circle. A few candidates also wrote *zero* also as they thought that it would be a short circuit. | ▪ *Explain electric field, electric potential, and electric potential energy with numerical problems to calculate potential energy of a system of charges.*<br>▪ *Discuss Curie's law and temperature thoroughly. Also, differentiate between dia, para and ferromagnetic substances on the basis of susceptibility versus temperature graphs.*<br>▪ *Point out the effect of focal length of a compound microscope and telescope on the objective and eyepiece.*<br>▪ *Explain the construction and resolving power of an astronomical telescope with the function of objective and eye piece.*<br>▪ *In the photo electric effect experiment, teach the importance of slope of graph thoroughly.*<br>▪ *Discuss thoroughly the use of Control rods, Fuel rods, Coolant and Moderator by drawing schematic diagram of a nuclear reactor in class.* |

(iii) Many candidates wrote that a resistance was connected in series to convert galvanometer into a voltmeter but missed the key term **high resistance**. Some used the word shunt in place of resistance without understanding the meaning and context of the word shunt.

(iv) Several candidates showed magnetic field as scalar and many did not use arrow on vector/unit vector.

(v) Many candidates could not write the correct answer. A few of them answered *same* or *constant phase* difference instead of **zero**.

(vi) This subpart of the question was attempted correctly by most of the candidates.

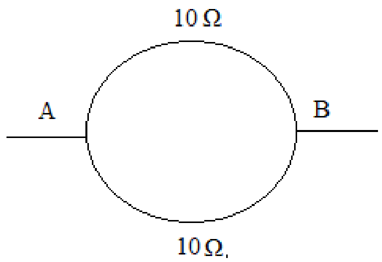
(vii) Some candidates simply wrote *energy is converted to mass* instead of giving the correct definition. Many candidates wrote mass energy equivalence as the answer. Some gave an incorrect equation of Pair Production -instead of one gamma radiation wrote two gamma radiations.

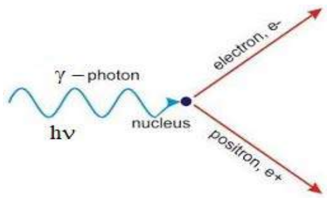
- *Spell out the Gauss' theorem clearly, laying stress on the common key words.*
- *Give sufficient practice of simple circuits based numerical problems. Allow students to solve a few numerical problems on series and parallel combinations for resistances and capacitors. Also, emphasise on writing units.*
- *Point out the difference between the conversion of a galvanometer into an ammeter and a voltmeter.*
- *Train students to express the Biot- Savart's law in vector form.*
- *Clarify the concept of phase difference between any two points lying on the same wavefront.*
- *Teach uses and applications of various phenomena using diagrams, like the role of total internal reflection, difference between reflection and refraction, etc.*
- *Discuss Pair production with respect to Einstein's mass energy equivalence formula. Lay emphasis on what mass energy equivalence means.*
- *Teach topics based on modern physics with special emphasis on conceptual understanding.*

## MARKING SCHEME

### Question 1

| | | |
|---|---|---|
| **(A)** | (i) | (c) **or** $\left(\frac{1}{4\pi\varepsilon_o}\right)\frac{3q^2}{a}$ |
| | (ii) | (a) **or** a ferromagnetic substance behaves like a paramagnetic substance. |
| | (iii) | (b) **or** objective should have large focal length. |
| | (iv) | (a) **or** h/e |

| | | |
|---|---|---|
| | (v) | (a) **or** Control rods |
| **(B)** | (i) | **Gauss**' theorem:<br>Electric flux passing through a **closed surface/** Gaussian surface is a ratio of the **net charge enclosed** by the surface to the permittivity of vacuum. **OR**<br>It is $^{1}/_{\epsilon_0}$ the net charge enclosed by the surface. **OR**<br>$\phi_E = \frac{\sum q}{\epsilon_o}$<br>**OR**<br>$\phi_E = \frac{q_{net}}{\epsilon_o}$<br>**OR**<br>$\oint \vec{E}.\vec{dA} = \frac{\Sigma q}{\epsilon_0}$ or $q/\epsilon_0$ |
| | (ii) | Two 10 Ω wires are in parallel as shown in the diagram below<br><br>$\frac{1}{R} = \frac{1}{10} + \frac{1}{10} = \frac{2}{10} = \frac{1}{5}$<br>**OR** $R = \frac{10\times10}{10+10}$<br>$\therefore R = 5\,\Omega$ |
| | (iii) | By connecting a high resistance in series with the galvanometer.<br>**OR**<br> |
| | (iv) | $d\vec{B} = \frac{KI\,(\vec{dl}\times\vec{r})}{r^3}$<br>**OR**<br>$d\vec{B} = \frac{KI\,(\vec{dl}\times\hat{r})}{r^2}$<br>**OR** |

| | | |
|---|---|---|
| | | $d\vec{B} = \frac{\mu_0}{4\pi}\frac{I\,(\vec{dl}\times\vec{r})}{r^3}$ |
| | (v) | Zero or no phase difference. |
| | (vi) | Total Internal Reflection / (TIR) |
| | (vii) | ***Pair production***:<br>Production of an electron – position pair from a gamma ray (or radiation)<br>**OR**<br>Conversion of a gamma ray photon into an electron – position pair.<br>**OR**<br>(hν) / $\gamma \rightarrow {}^{0}_{-1}e + {}^{0}_{1}e$<br>**OR**<br> |

## Section B

*Answer **all** questions*

## Question 2

**[2]**

(a) A uniform copper wire having a cross sectional area of $1mm^2$ carries a current of 5A. Calculate the **drift speed** of free electrons in it.

(Free electron number density of copper = $2\times10^{28}/m^3$.)

**OR**

(b) An electric bulb is rated as 250V, 750W. Calculate the:

(i) Electric current flowing through it, when it is operated on a 250V supply.

(ii) Resistance of its filament.

| Comments of Examiners | | Suggestions for Teachers |
|---|---|---|
| (a) | Most of the candidates attempted this question well but a few did not convert the area into SI units, which gave incorrect power of 10. Also, the unit was not written by many candidates.<br>Some candidates did not substitute the value of 'e' hence, got the incorrect answer. A few were not clear about the use of electron number density of copper. | ▪ *Clarify the concept of the drift speed of electrons in a wire.*<br>▪ *Train students to express every physical quantity with proper unit and up to the correct number of significant digits.*<br>▪ *Familiarise students with the relation between power, voltage, current and resistance for an electric bulb.*<br>▪ *Teach students to write the data available in the given problem, convert units, if required, think, and apply the correct formula and correct substitution followed by the correct unit assigned to the answer.* |
| (b) | This part was attempted correctly by most of the candidates, but many did not write the unit. Some candidates used ohm's law to solve this numerical while a few candidates used incorrect formula. | |

## MARKING SCHEME

### Question 2

| | | |
|---|---|---|
| (a) | Correct formula $J = neAv_d$<br>or $= \frac{I}{nAe} = \frac{5}{2\times10^{28}\times1\times10^{-6}\times1\cdot6\times10^{-19}}$<br>i.e. $v_d = 1\cdot56 \times 10^{-3}$ m s$^{-1}$ | |
| | **OR** | |
| (b) | (i) | $P = V I$ i.e. $I = \frac{750}{250} = 3A$ |
| | (ii) | $R = \frac{V}{I} =/ \frac{250}{3} = 83\cdot3\Omega$ |
| | **OR** | |
| | (i) | $R = \frac{V^2}{P} = \frac{250\times250}{750} = 83\cdot3\Omega$ |

| | | |
|---|---|---|
| | (ii) | $I=\frac{V}{R}=\frac{250}{83\cdot 3}=3\cdot 00A$ |

## Question 3

**[2]**

Write an expression for **force per unit length** between two long current carrying wires, kept parallel to each other, in vacuum and hence define an **ampere,** the SI unit of current.

| Comments of Examiners | Suggestions for Teachers |
|---|---|
| Many candidates did not write force per unit length and gave the expression without length. Some candidates defined current using i=q/t instead of using the defining equation written by them in first part of this question. Therefore, they could not give the standard definition of an ampere. Some candidates were confused between equation of force due to straight conductor and two parallel conductors. In defining ampere, many candidates did not write the unit of force per unit length correctly i.e., 2 x$10^{-7}$ N/m. Key words were missing in many answers. | ▪ *Teach the force between two parallel currents after doing the topic force on a current carrying conductor placed in the magnetic field thoroughly. From the equation, define an ampere. Also, give direction of force on passing current through two parallel conductors in same direction or in opposite direction.* |

### MARKING SCHEME

### Question 3

F′ or $\frac{F}{l}=\frac{\mu_0}{2\pi}\frac{ii'}{r}$

Definition of ampere: One ampere is that current which while flowing through each of two long conductors kept parallel to each other **1m** apart **in vacuum (**attract or repel each other with) experience a force of **2 ×$10^{-7}$ N $m^{-1}$**

## Question 4

**[2]**

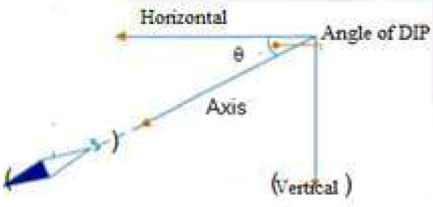
(i) Define *angle of dip*.

(ii) State the relation between **magnetic susceptibility** $(\chi)$ and **relative permeability** $(\mu_r)$ of a magnetic substance.

| Comments of Examiners | Suggestions for Teachers |
|---|---|
| (i) Majority of the candidates did not write the correct definition of angle of dip. A few candidates did not write the *axis of magnetic needle* or *axis of a magnet* in the definition of angle of dip.<br>(ii) Most of the candidates answered this correctly except for some who got confused with the relation and wrote $\chi_m = 1+\mu_r$ instead of $\mu_r=1+\chi_m$. | ▪ *Discuss angle of dip with diagrams and if possible, with experiments, images, and videos.*<br>▪ *Revise the concept of planes, (X-Y plane, Y-Z plane, X-Z plane) frequently in class.*<br>▪ *Lay stress on the importance of key words and key terms in definitions.*<br>▪ *Teach students all the three components of Earth's magnetic field.*<br>▪ *Explain the relation between magnetic susceptibility and relative permeability thoroughly to students.* |

## MARKING SCHEME

### Question 4

| | |
|---|---|
| (i) | Angle of dip: It is the angle made by the magnetic axis of a freely suspended magnetic needle with the horizontal.<br>**OR**<br>It is the angle between the direction of the earth's magnetic field and the horizontal in the magnetic meridian at that place.<br>**OR**<br>It is the angle made by the freely suspended magnet with the horizontal. OR<br><br><br>*(Any alternate correct definition)* |
| (ii) | $\mu_r = 1 + \chi$ |

# Question 5

[2]

(a) ***Figure 1*** below shows a metallic rod MN of length $l$ = 80cm, kept in a uniform magnetic field of flux density B = 0·5T, on two parallel metallic rails **P** and **Q**. Calculate the emf that will be induced between its two ends, when it is moved towards right with a constant velocity $v$ of 36 km/hr.

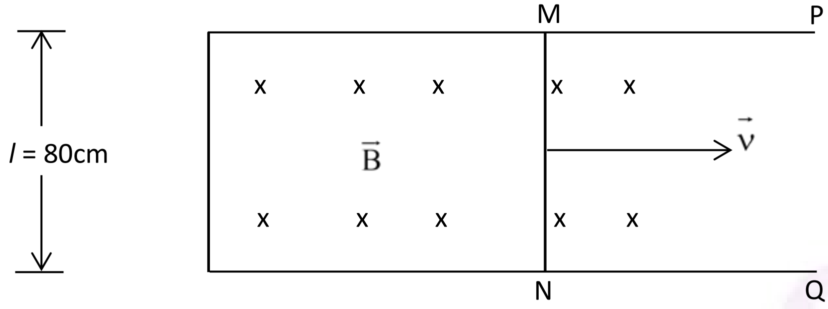



***Figure 1***

**OR**

(b) When current flowing through one coil changes from 0 Amp to 15 Amp in 0·2 s, an emf of 750 V is induced in an adjacent coil. Calculate the coefficient of mutual inductance of the two coils.

## Comments of Examiners

(a) A number of candidates were able to answer this question satisfactorily. Common errors made by candidates were:

- Incorrect conversion of unit km/h into m/s
- Incorrect formula
- Incorrect substitution
- Missing unit.

(b) This was answered correctly by most candidates. Some of them made following errors:

- Wrote incorrect formula
- Did incorrect substitution
- Did calculation mistakes
- Expressed the final answer without unit.

## Suggestions for Teachers

- *Clarify the concept of Motional electromotive force and factors on which it depends with numerical problems.*
- *Advise students to express every physical quantity with proper unit.*
- *Explain the concept of mutual inductance and its formula to students.*
- *Give adequate practice in correct usage of the formula, substitution, and units. Also, explain the significance of the symbol used.*
- *Teach the difference between mutual induction and self-induction.*

## MARKING SCHEME

### Question 5

| | |
|---|---|
| (a) | $e = B\,l\,v$<br>**OR**<br>$e = 0 \cdot 5 \times 80 \times 10^{-2} \times 10$<br>$e = 4\text{V}$ **OR** |
| (b) | $e = M\frac{di}{dt}$<br>$750 = \text{M}\left(\frac{15-0}{0 \cdot 2}\right)$ *Correct substitution with **or** without the formula.*<br>Coefficient of mutual inductance of the two coils, M = 10 H |

## Question 6

**[2]**

(i) State *any one* use of **infrared** radiations.

(ii) State *any one* source of **ultraviolet** radiations.

| Comments of Examiners | Suggestions for Teachers |
|---|---|
| (i) Many candidates wrote the source or properties of infrared radiations instead of mentioning the use of infrared radiations.<br>(ii) Some candidates wrote the uses or properties of ultraviolet radiations instead of writing the source of ultraviolet radiations. | ▪ *Train students to read the question carefully and answer as per the requirement of the question.*<br>▪ *Explain clearly about the sources, properties, uses, and applications of different electromagnetic radiations.* |

## MARKING SCHEME

### Question 6

| | |
|---|---|
| (i) | 1. To relieve muscular pain.<br>2. In green houses to keep plants warm.<br>3. In warfare, to look through haze.<br>4. For night vision.<br>5. Solar Heater or Cooker<br>6. Photography Or any other correct application<br>*(Or any other correct use)* |
| (ii) | Sun **Or** Arc (lamp) **Or** Vacuum spark **Or** Ionised gases<br>*(Or any other correct source)* |

## Question 7

**[2]**

Where will you keep an object in front of a:

(i) Convex lens in order to get a **virtual** and **magnified** image?

(ii) Concave mirror to get a **real** and **diminished** image?

| Comments of Examiners | Suggestions for Teachers |
|---|---|
| A number of candidates attempted subparts (i) & (ii) correctly. Some common errors observed in both the subparts were as follows:<br>• Usage of the terms:<br>- pole and optical centre inter changeably<br>- convex lens and concave mirror inter changeably<br>• Confusion between lens and mirror<br>• Not drawing the ray diagram to know the right answer. | ▪ *Point out the distinction between a lens and a mirror clearly to the students.*<br>▪ *Teach the meaning of the terms related to spherical mirrors and lenses.*<br>▪ *Explain the image formation in different types of lenses and mirrors at different positions along with sign convention and formulae.*<br>▪ *Explain real and virtual image by using relevant ray diagrams in lens and mirror.* |

### MARKING SCHEME

### Question 7

| | |
|---|---|
| (i) | Between optical centre and focus. **Or** Between O and F Or distance less than *f* |
| (ii) | Beyond centre of curvature. **Or** Beyond C **Or** Beyond 2F Or beyond R |

## Question 8

**[2]**

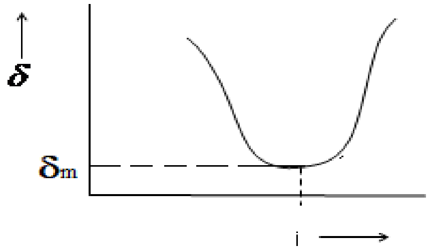
Draw a **labelled** graph of angle of deviation $(\delta)$ versus angle of incidence ($i$) for a prism.

| Comments of Examiners | Suggestions for Teachers |
|---|---|
| Some candidates did not label the axis correctly. In some scripts the graph drawn was a straight line or any other shape. Several candidates drew current versus frequency graph. A large number of the candidates interchanged the physical quantities on the X-axis and Y-axis. | ▪ *Train students to draw graphs with correct labelling.*<br>▪ *Spell out the nature of graph, (its variation).* |

## MARKING SCHEME

### Question 8

Axes correctly labelled i.e. $(\delta)$ on Y axis and $(i)$ on X axis




## Question 9

**[2]**

(i) State **de Broglie** hypothesis.

(ii) What conclusion can be drawn from **Davisson** and **Germer's** experiment?

| Comments of Examiners | Suggestions for Teachers |
|---|---|
| (i) Most candidates wrote the formulae instead of stating the de Broglie's hypothesis. Many did not mention *moving particles* but wrote about dual nature of light.<br>(ii) Many candidates wrote just the opposite that light behaves like particles and cited the photoelectric experiment. Results of Davisson and Germer were not written by several candidates. *Conclusions* were misunderstood for *assumptions* by a few; many did not mention moving particles but wrote about the dual nature of light. Some wrote about diffraction of light as their answer. | ▪ *Emphasise physical significance of the de Broglie hypothesis and the significance of the words 'moving particle' with respect to the Heisenberg's Uncertainty Principle and how it's not possible to describe a static particle.*<br>▪ *Discuss experiments thoroughly so that students understand the purpose behind a particular experiment.* |

## MARKING SCHEME

### Question 9

| | |
|---|---|
| (i) | The waves associated with moving material particles are called matter waves / de Broglie waves.de Broglie wavelength (λ)associated with a moving particle is related to its momentum *p as*<br>$\lambda = \frac{h}{p}$ **or** $\lambda = \frac{h}{mv}$ *(Or any other correct statement)* |
| (ii) | Moving electrons behave like waves/ moving particles exhibit dual nature. |

| | |
|---|---|
| | **Or**<br>Wave nature of moving particles.<br>**Or**<br>Electron Diffraction / verified and confirmed the wave nature of electrons<br>*(Or any other correct statement)* |

# Question 10

**[2]**

Calculate binding energy of oxygen nucleus $\left({}^{16}_{8}\mathrm{O}\right)$ from the data given below:

Mass of a proton = 1·007825 u

Mass of a neutron = 1·008665 u

Mass of $\left({}^{16}_{8}\mathrm{O}\right)$ = 15·994915 u

| Comments of Examiners | Suggestions for Teachers |
|---|---|
| Several candidates could not solve the problem correctly due to the following reasons:<br>• Δm was calculated using only one of each proton and neutron. After that students multiplied it by $c^2$ to get energy, while the masses were given in 'u' and not in kg.<br>• The mass number was not taken into consideration in calculating the total mass of proton and mass of neutron. | ▪ *Clearly explain the various terms like mass defect, binding energy, etc. and ensure by giving ample practice that students can solve a variety of numerical problems.*<br>▪ *Discuss how to find energy equivalent of one atomic mass unit in SI unit of energy and eV / MeV.* |

## MARKING SCHEME

## Question 10

$\Delta m = \left(8\ m_p + 8\ m_n\right) - M\left({}^{16}_{8}O\right)$

$= \left(8\times1\cdot007825\right)+8\left(1\cdot008665\right)-15\cdot994915$

$= 0\cdot137u$

B.E. $= 0\cdot137 \times 931$

$= 127\cdot6$ MeV     Range 127.5 MeV to 127.6 MeV

# Question 11

**[2]**

For a **radioactive substance**, write the relation between:

(i) Half life (T) and disintegration constant ($\lambda$).

(ii) Mean life ( $\tau$ ) and disintegration constant ($\lambda$).

| Comments of Examiners | Suggestions for Teachers |
|---|---|
| Majority of the candidates wrote the relations asked in subparts (i) & (ii) correctly. However, in some cases, following inaccuracies were observed:<br>• For average life, some candidates used as 1/T and 0.693/$\lambda$.<br>• A few candidates gave the correct relation but did not write the meaning of each symbol.<br>• Several candidates could not differentiate between natural log and the logarithm of ***x*** to base *b*.<br>• Many candidates did not understand the difference between mean life and half-life.<br>• Many candidates wrote the relation of 'T' and '$\lambda$' correctly but made mistakes in the relation of mean life and disintegration constant. | • *Clarify various terms like half-life, mean life, law of radioactive decay, disintegration constant, etc.*<br>• *Derive the relation between half-life and decay constant and mean life and disintegration constant.*<br>• *Familiarise students by giving ample practice so that they can apply different formulae judiciously in a variety of numerical problems.* |

## MARKING SCHEME

## Question 11

| | |
|---|---|
| (i) | $T = \frac{ln2}{\lambda}$ **or** $T = \frac{0\cdot693}{\lambda}$ |
| (ii) | $\tau = \frac{1}{\lambda}$ |

# Question 12

**[2]**

With reference to **communication systems**, what is meant by:

(i) modulation?

(ii) demodulation?

| Comments of Examiners | Suggestions for Teachers |
|---|---|
| A number of candidates attempted this question well, but some common anomalies observed in the reported answers were:<br>• Not correlating the terms modulation, demodulation, and superposition of wave.<br>• Not differentiating between audio and carrier frequency.<br>• Using the terms carrier waves, signal, low frequency, high frequency, modulated wave, modulating wave, etc. incorrectly.<br>• Writing that demodulation is the opposite of modulation and vice versa without defining the term. | ▪ *Explain modulation, the types of modulation, and demodulation with examples, using diagrams, graphs, power point presentations, etc.*<br>▪ *Clarify terms like message signals, signal bandwidth, carrier wave, modulating wave, modulated wave, etc. to students.*<br>▪ *Explain superposition concept by taking the example of sound wave and hence, explain modulation and demodulation.* |

## MARKING SCHEME

### Question 12

| | |
|---|---|
| (i) | The process of superimposition/ overlapping of low frequency (signal wave)/ modulating wave/audio wave on a high frequency (carrier wave), in order to transmit the signal to large distance is called modulation. |
| (ii) | The process of separating low frequency (signal wave)/ modulating wave/audio wave from the modulated wave is called demodulation. |

# Section C

*Answer **all** questions*

## Question 13

**[3]**

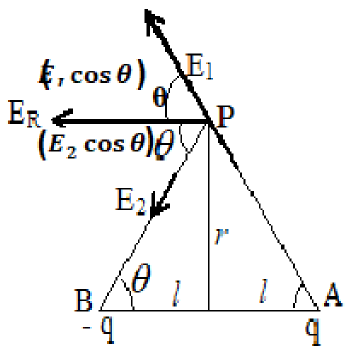
Show that intensity of electric field **E** at a point in **broadside on** position is given by:

$E = \left(\frac{1}{4\pi \in_o}\right)\frac{p}{\left(r^2 + l^2\right)^{3/2}}$, where the terms have their usual meaning.

| Comments of Examiners | Suggestions for Teachers |
| --- | --- |
| Many candidates derived the expression for electric field at a point in an end on position, instead of broad side on position of an electric dipole. A few could not do the vector addition and direction of $E_+$ and $E_-$ correctly. Some candidates derived **E** without drawing a labelled diagram. The angles were also missing in quite a few diagrams. Several candidates did not draw arrows to show electric field as a vector quantity. Many candidates derived electric field due to a point charge. Some candidates wrote the final expression for a short dipole. | ▪ *Emphasise on a well-defined labelled diagram to reduce the chances of error.*<br>▪ *Explain electric dipole, electric field with their equation and direction.*<br>▪ *Point out clearly the broad on position, end on position and resolution of electric field component.*<br>▪ *Train students to express the final answer of a vector quantity with direction of net electric field.* |

## MARKING SCHEME

### Question 13




$$E_R = E_1 \text{Cos}\theta + E_2 \text{Cos}\theta$$

$$= 2\, E\text{Cos}\theta \quad \text{as } E_1 = E_2$$

$$= 2\, \frac{q}{4\pi \in_0 \left(r^2 + l^2\right)} \frac{l}{\left(r^2 + l^2\right)^{1/2}}$$

$$= \frac{2\, q\, l}{4\pi \in_0 \left(r^2 + l^2\right)^{3/2}} \qquad (p = q \times 2l)$$

$$= \frac{p}{4\pi \in_0 \left(r^2 + l^2\right)^{3/2}}$$

*(Or any alternate correct method)*

## Question 14

**[3]**

A **parallel plate capacitor** is charged by a battery, which is then disconnected. A dielectric slab having **dielectric constant** (relative permittivity) K, is now introduced between its two plates in order to occupy the space completely.

State, in terms of K, its effect on the following:

(i) The capacitance of the capacitor.

(ii) The potential difference between its plates.

(iii) The energy stored in the capacitor.

| Comments of Examiners | Suggestions for Teachers |
|---|---|
| The effect on the capacitance of the capacitor was expressed correctly by most candidates but the concept of potential and energy stored in a capacitor was not comprehended by most of the candidates.<br>(i) Many candidates ignored the dielectric constant for finding the capacitance. Some candidates did not express in terms of dielectric constant K. They just wrote *increases* or *decreases*.<br>(ii) Many candidates did not understand the question properly. Majority of them did not express the potential difference between the capacitor's plates in terms of dielectric constant K. They simply guessed and wrote *increases* or *decreases*.<br>(iii) A large number of candidates did not express the energy stored in the capacitor in terms of dielectric constant K. They simply surmised and wrote *increases* or *decreases*. | ▪ *Discuss the behavior of dielectric and its relation to electric field intensity, electric potential, energy, etc. taking some conceptual/ numerical problems.*<br>▪ *Teach students how to derive the equation of a parallel plate capacitor clarifying the relationship between electric potential and hence electric field.*<br>▪ *Teach the students how the capacitance varies by inserting a dielectric slab in between plates. Show them how capacitance varies with dielectric constant.* $C = kC_0$ *and energy* $U' = U/K$ *and also show them how we have reached this formula.* |

## MARKING SCHEME

### Question 14

| | |
|---|---|
| (i) | Capacitance becomes K times. Or Increases K times. |
| (ii) | Potential difference becomes $\frac{1}{K}$ times. Or Decreases by K times. |
| (iii) | Energy becomes $\frac{1}{K}$ times. Or Decreases by K times. |

## Question 15

**[3]**

(a) $E_1$ and $E_2$ are two batteries having emfs of 3V and 4V and internal resistances of 2Ω and 1Ω respectively. They are connected as shown in ***Figure 2*** below. Using **Kirchhoff's Laws** of electrical circuits, calculate the currents $I_1$ and $I_2$.

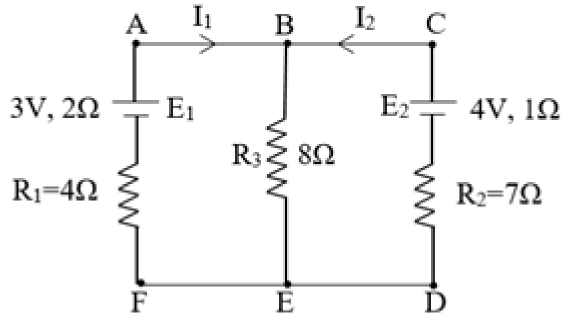



***Figure 2***

**OR**

(b) A **potentiometer** circuit is shown in ***Figure 3*** below. AB is a uniform metallic wire having length of 2m and resistance of 8Ω. The batteries $E_1$ and $E_2$ have emfs of 4V and 1·5V and their internal resistances are 1Ω and 2Ω respectively.

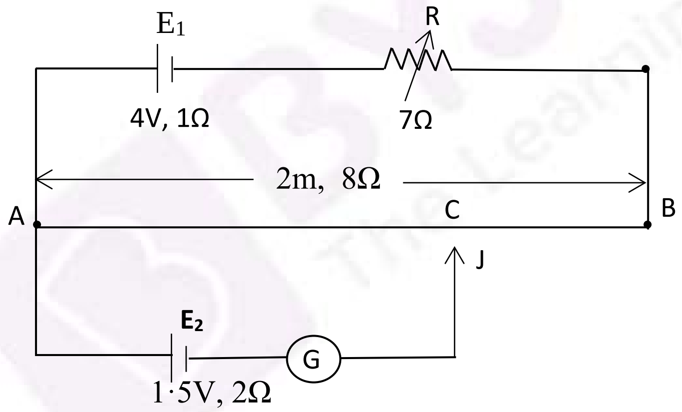



***Figure 3***

(i) When the jockey J does not touch the wire AB, calculate:

(a) the current flowing through the potentiometer wire AB.

(b) the potential gradient across the wire AB.

(ii) Now the jockey J is made to touch the wire AB at a point C such that the galvanometer (G) shows no deflection. Calculate the length AC.

| Comments of Examiners | Suggestions for Teachers |
|---|---|
| (a) Kirchhoff's law was not applied correctly by many candidates as the sign convention was not applied while using loop rule. In some cases, even after applying the loop rule correctly, the mathematical solution was not obtained correctly by many candidates. Some candidates did not include the internal resistance while framing the equation. A few candidates framed the equations, solved and got the correct answer but did not write the correct unit.<br><br>(b) Several candidates could not find the current flowing through the potentiometer wire. Some calculated the total resistance incorrectly. Mainly, the following errors were observed:<br>(i) To find current many candidates used the formula (V = IR) instead of E = I (R+r).<br>(ii) Some candidates used the formula for potential gradient.<br>(iii) Many candidates were unaware of the formula E = kl. | ▪ *Explain Kirchhoff's rules with sign convention for analysis of electrical circuits thoroughly to students giving adequate number of conceptual / numerical problems.*<br>▪ *Teach the formulas with focus on the derivation so that students understand the purpose and the usage of the formula.*<br>▪ *Explain what is meant by potential gradient and give the difference between potential gradient with electric field.*<br>▪ *Teach students the principle and working of potentiometer. Give enough practice of different type of numerical problems on potentiometer.* |

## MARKING SCHEME

## Question 15

| | | | |
|---|---|---|---|
| (a) | In loop ABEFA $8(I_1+I_2)+6I_1=3$ -------(i)<br>In loop BCDEB $8(I_1+I_2)+8I_2=4$ -------(ii)<br>$14I_1+8I_2=3$ --------(i) × 2<br>$8I_1+16I_2=4$ --------(ii) × 1<br>$\therefore I_1=0{\cdot}1A$, $I_2=0{\cdot}2A$<br>Correct answer with unit.<br>**OR** | | |
| (b) | (i) | (a) | $I=\frac{\in}{R+r}=\frac{4}{7+8+1}=\frac{4}{16}=0\cdot25A$ |
| | | (b) | Potential gradient = $\frac{V}{l}=\frac{IR}{l}=\frac{0\cdot25\times8}{2}=1\cdot0V/m$ |

| | (ii) | $\varepsilon = kl$<br>$1{\cdot}5 = 1{\cdot}0\,l$<br>$\therefore \quad l = \frac{1.5}{1} = 1.5m$ |
|---|---|---|

## Question 16

**[3]**

For two **thin lenses** kept in **contact** with each other, show that:

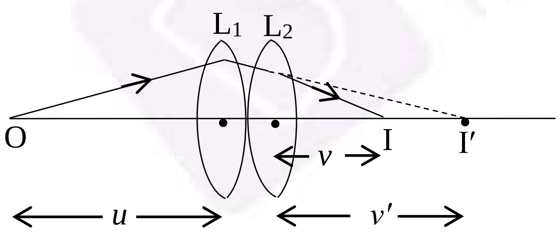
$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$$

where the terms have their usual meaning.

| Comments of Examiners | Suggestions for Teachers |
|---|---|
| Majority of the candidates did not mark the arrows in the ray diagram. Some candidates showed distance between the lenses. Many candidates did not mark the positions of u, v and v' or O, I and I'. Several candidates derived the asked relation without drawing a ray diagram, wrote equations randomly without following any sign convention. | ▪ *Advise students to draw well labelled ray diagram with arrows marked on the rays.*<br>▪ *Teach sign convention and its usage in derivations/numerical problems.*<br>▪ *Train students to write final equation in derivation.* |

## MARKING SCHEME

## Question 16




For 1st Lens:

$$\frac{1}{u} + \frac{1}{v'} = \frac{1}{f_1} \qquad \textbf{OR} \qquad \frac{1}{v'} - \frac{1}{u} = \frac{1}{f_1}$$

For 2nd Lens:

$$\frac{1}{-v'} - \frac{1}{v} = \frac{1}{f_2}$$

**OR**

$$\frac{1}{v} - \frac{1}{-v'} = \frac{1}{f_2}$$

On adding:

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f_1} + \frac{1}{f_2}$$

**OR**

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f_1} + \frac{1}{f_2}$$

i.e. $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$

***Note***: **All sign conventions are acceptable**.

## Question 17

**[3]**

(a) A **compound microscope** consists of two convex lenses having focal length of 1·5cm and 5cm. When an object is kept at a distance of 1·6 cm from the objective, the final image is virtual and lies at a distance of 25cm from the eyepiece. Calculate **magnifying power** of the compound microscope in this set-up.

**OR**

(b) In **Young's double slit experiment**, the screen is kept at a distance of 1·2m from the plane of the slits. The two slits are separated by 5mm and illuminated with monochromatic light having wavelength 600nm. Calculate:

(i) Fringe width i.e. fringe separation of the interference pattern.

(ii) Distance of $10^{th}$ bright fringe from the centre of the pattern.

| Comments of Examiners | Suggestions for Teachers |
| --- | --- |
| (a) Many candidates did not find the object at distance 'u'. They used the mirror formula instead of lens formula. Even after finding 'u', some candidates could not use the right expression for magnifying power. Several candidates got confused with the magnifying power of a telescope and some made errors in applying sign convention. Some candidates did not express the magnifying power of the compound microscope with proper unit. | ▪ *Advise students to comprehend the symbols before memorising the formulas.*<br>▪ *Train students by giving them regular practice in class to solve the conceptual / numerical problems related to magnifying power of the compound microscope.*<br>▪ *Give adequate practice on conceptual / numerical problems* |

| | | |
|---|---|---|
| (b) | This question was attempted correctly by most of the candidates. Some candidates interchanged d and D and used expression dλ/D instead of Dλ/d. Some candidates, to calculate distance of the $10^{th}$ bright fringe from the centre of the pattern, used 9 times fringe width instead of 10 times, which was incorrect. Many candidates did not convert all the data to the same system of units. Some did not write their answers with units. | *based on Young's double slit experiment.* |

## MARKING SCHEME

## Question 17

(a)

$$\frac{1}{v_0} - \frac{1}{u_0} = \frac{1}{f_0}$$ **OR**

$$\frac{1}{v_0} = \frac{1}{f_0} + \frac{1}{u_0}$$

$$= \frac{1}{1\cdot5} - \frac{1}{1\cdot6} = \frac{0\cdot1}{240}$$

$v_0$ = 23·8 cm to 24 cm

**OR**

$$M = \frac{v_0}{u_0}\left[1 + \frac{D}{fe}\right] \Big/ \quad M = \frac{24}{1\cdot6}\left[1 + \frac{25}{5}\right]$$

= 15 × 6

= 89·25 to 90

**OR**

$$m_0 = \frac{f_0}{u_0 - f_0} \therefore \frac{1.5}{1.6 - 1.5} = 15$$

$$m_e = \frac{D}{u_e} = \left(1 + \frac{D}{f_e}\right) \therefore \left(1 + \frac{25}{5}\right) = 6$$

$m = m_o \times m_e = 15 \times 6 = 90$ *(or any alternate correct method)*

| | | |
|---|---|---|
| (b) | (i) | $\beta = \frac{\lambda D}{d}$ <br> $= \frac{600 \times 10^{-9} \times 1 \cdot 2}{5 \times 10^{-3}}$ <br> $= 120 \times 10^{-6} \times 1 \cdot 2$ <br> $\beta = 1 \cdot 44 \times 10^{-4} m$ |
| | (ii) | $y_{10} = 10 \times \beta$ <br> $= 10 \times 1 \cdot 44 \times 10^{-4} = 1 \cdot 44 \times 10^{-3}$ m = 1.44 mm *(or any alternate correct method)* |

## Question 18

**[3]**

Draw the **energy level diagram** of hydrogen atom and show the transitions responsible for:

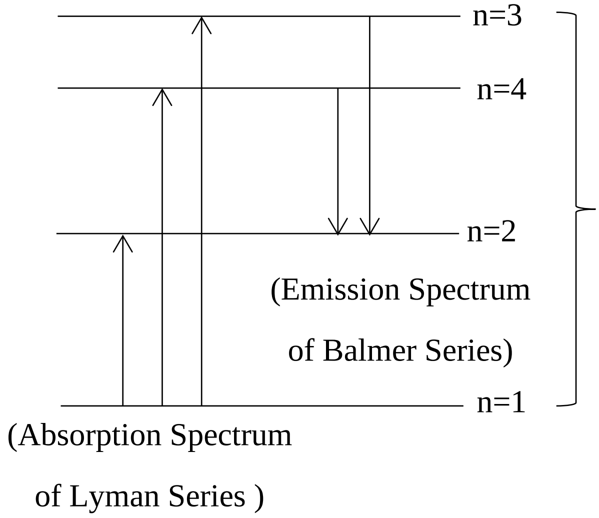
(i) absorption lines of **Lyman** series.

(ii) emission lines of **Balmer** series.

| Comments of Examiners | Suggestions for Teachers |
|---|---|
| Some common errors observed in this question were: <br> • Inability to differentiate between *absorption* and *emission spectrum* <br> • Spacing between energy diagrams not shown correctly <br> • Incorrect labelling <br> • Spacing of energy lines incorrect <br> • Lack of idea of quantum numbers <br> • Energy values ($-13.6/n^2$) not marked correctly <br> • Starting by putting n=0 <br> • Marking the arrows of absorption and emission lines incorrect. | *Teach in detail:* <br> - *the equation of energy and how energy changes for different orbits.* <br> - *spacing between energy level diagrams.* <br> - *difference between absorption and emission of energy.* <br> - *different types of energy spectrum released in each transition.* |

## MARKING SCHEME

### Question 18




## Question 19

**[3]**

(i) State *any one* difference between energy band diagram of conductors and that of insulators.

(ii) Give a relation between $\alpha$ and $\beta$ for a transistor.

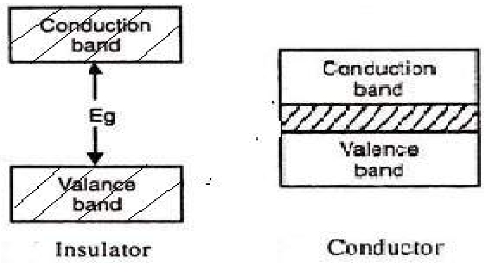
(Derivation is **not** required.)

(iii) What is the **advantage** of an LED bulb over the filament electric bulb?

| Comments of Examiners | Suggestions for Teachers |
|---|---|
| (i) The difference between energy band diagram of conductors and that of insulators was stated correctly by most candidates. Some candidates interchanged the positions of the valance band and the conduction band.<br>(ii) This subpart was attempted well by all the candidates.<br>(iii) The **advantage** of an LED bulb over the filament electric bulb was written correctly by most candidates. | ▪ *Explain formation of conduction band, valance band, and energy gap with the suitable diagram.*<br>▪ *Define current gain for common base (C-B) and common emitter(C-E) transistors and explain the relationship between them. Give sufficient number of numerical problems for practice in class.*<br>▪ *Point out advantages of LED* bulb *over the filament electric bulb in class.* |

## MARKING SCHEME

### Question 19

| | |
|---|---|
| (i) | The conduction band and valence band overlap in a conductor whereas there is a forbidden gap between conduction band and valence band in a conductor.<br>**OR**<br>Diagram<br><br> |
| (ii) | $\beta = \frac{\alpha}{1-\alpha}$ **OR** $\alpha = \frac{\beta}{\beta+1}$ |
| (iii) | Power consumption in an LED is much less as compared to that in a filament bulb.<br>**OR**<br>Life span of LED is much greater as compared to that of a filament bulb. **OR**<br>Less heating effect **OR** work effectively on low voltage *(or any correct answer)* |

# Section D

*Answer **all** questions*

## Question 20

[5]

(a) (i) A 400Ω resistor, a 3H inductor and a 5μF capacitor are connected in series to a 220V, 50Hz ac source. Calculate the:

(1) Impedance of the circuit.

(2) Current flowing through the circuit.

(ii) Draw a **labelled** graph showing the variation of **impedance** (Z) of a series LCR circuit versus **frequency** *(f)* of the ac supply.

**OR**

(b) (i) When an alternating emf e = 310 sin (100$\pi$t)V is applied to a series LCR circuit, current flowing through it is i = 5 sin(100$\pi$t + $\pi/3$)A.

(1) What is the **phase difference** between the current and the emf?

(2) Calculate the **average power** consumed by the circuit.

(ii) Obtain an expression for the **resonant** frequency ($f_o$) of a series LCR circuit.

| Comments of Examiners | Suggestions for Teachers |
|---|---|
| (a) (i) Many candidates did not calculate $X_c$ as microfarad was not converted with the right power. Most of the candidates calculated impedance of LR circuit instead of calculating impedance of LCR circuit. To calculate current flowing through the circuit, many candidates used *V/R* instead of *V/Z.* Many candidates calculated *I* incorrectly due to the error in *Z.* Some did not write the unit for impedance and current.<br>(ii) Many candidates did not label the axis correctly. Some candidates did not draw the correct shape of the graph. Several candidates showed the reactance $X_L$ – frequency graph instead of the impedance – frequency graph, as asked. Some candidates drew the impedance graph like the resonance graph.<br>(b) (i) This subpart was attempted correctly by most candidates.<br>To calculate the average power consumed by the circuit, several candidates used rms value instead of peak value and got double the required value. Many candidates were not able to differentiate between *phase* and *phase difference* term. Some candidates used the formula for power dissipation. Several candidates wrote an incorrect unit of phase.<br>(ii) This subpart was attempted correctly by most candidates. Some candidates were unable to derive the equation for resonant frequency. A few left the equation at $\omega_o$. | ▪ *Train students by giving them regular practice in class to solve conceptual/numerical problems related to A.C. circuits based on variation in voltage and current with time, average current, rms current, average voltage, rms voltage, reactance, impedance, power factor, resonance in an LCR series circuit, etc.*<br>▪ *Lay stress on writing all parts and sub parts of a numerical problem and to mention the unit.*<br>▪ *Stress on drawing and practicing all the graphs of A.C. circuits - $X_L$ versus f, $X_C$ versus f, Z versus f, etc.*<br>▪ *Explain the condition of series resonance in L-C-R circuits and its applications.* |

# MARKING SCHEME

## Question 20

**(a) (i)**

$X_L = \omega L = 2\pi f L$/

$= 2 \times 3{\cdot}14 \times 50 \times 3$

$= 942\ \Omega$ / $943\ \Omega$

**AND**

$X_c = \dfrac{1}{\omega C} = \dfrac{1}{2\pi f C}$ /

$= \dfrac{1}{2 \times 3{\cdot}14 \times 50 \times 5 \times 10^{-6}}$

$= 636\ \Omega$ / $637\ \Omega$

$Z = \sqrt{(X_L - X_C)^2 + R^2}$ /

$= \sqrt{(942 - 637)^2 + (400)^2}$

$= (\sqrt{305^2 + 400^2}$

$= \sqrt{93025 + 160000}$

$= \sqrt{253025}\ )$

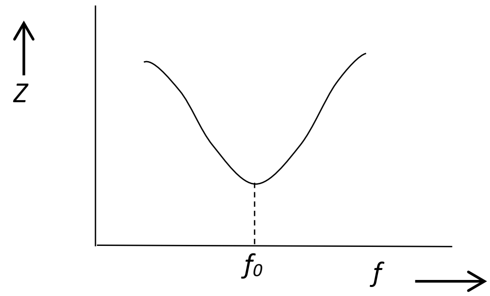
$\therefore\ Z = 503\Omega$ / $504.3\ \Omega$

$I = \dfrac{V_T}{Z} = \dfrac{220}{503}$

$= 0.43$ to $0{\cdot}44$ A

**OR**

**(ii)**



| | | | |
|---|---|---|---|
| (b) | (i) | (1) | $\frac{\pi}{3}$ radian OR 60° |
| | | (2) | $P_{avg} = \frac{1}{2} V_m I_m \text{Cos}\,\theta$ OR $P_{(avg)} = \frac{1}{2} V_0 I_0 \cos\emptyset$<br>$= \frac{310 \times 5}{2} \times \frac{1}{2}$<br>$= 387{\cdot}5$ W |
| | (ii) | At resonance.<br>$X_L = X_C$ **Or** $\omega_0 L = \frac{1}{\omega_0 C}$<br>$2\pi f_0 L = \frac{1}{2\pi f_0 C}$ **OR** $\omega_0^2 = \frac{1}{LC}$<br>$f_0 = \frac{1}{2\pi\sqrt{LC}}$<br>*(or any alternate correct method)* | |

## Question 21

**[5]**

(a) (i) **Derive** an expression for refraction at a single (convex) spherical surface, i.e. a relation between *u*, *v*, *R*, $n_1$ (rarer medium) and $n_2$ (denser medium), where the terms have their usual meaning.

(ii) Name the **phenomenon** due to which the sun appears reddish at sunset.

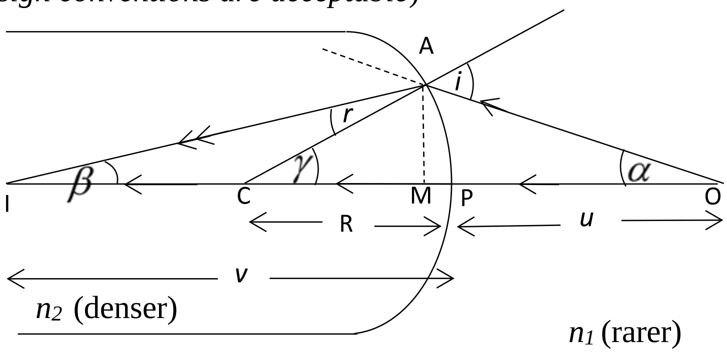
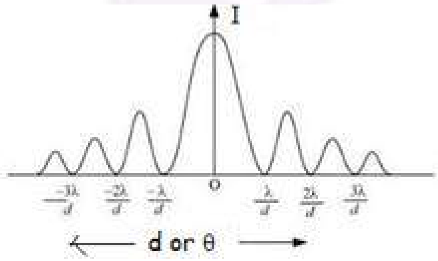
**OR**

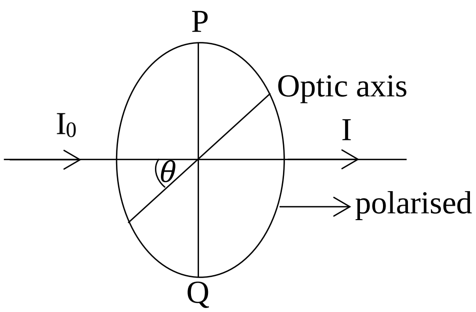
(b) (i) Draw a **labelled** graph of intensity of diffracted light (I) versus angle $(\theta)$ in the **Fraunhofer** diffraction experiment for a single slit diffraction.

(ii) State the law of **Malus**.

(iii) How will you distinguish **experimentally** between ordinary light and plane polarized light?

| Comments of Examiners | Suggestions for Teachers |
|---|---|
| (a) (i) Some candidates derived Lens maker's formula instead of refraction at a spherical surface. Angles were not marked in some scripts. *Sin i=i* and *Sin r=r* was not mentioned in few places, i.e. candidates did not consider the aperture to be small. Some other common errors observed in this question were:<br>• The ray diagram was not drawn.<br>• Several candidates did not mark the rays with arrows.<br>• Many candidates did not show the rarer and denser medium clearly.<br>• Important steps in the derivation were not written.<br>• Some candidates wrote the final formula, skipping some important steps.<br>• Many candidates did not use the thin lens concept.<br>(ii) This subpart was attempted correctly by most candidates except for some who named this phenomenon as *refraction* / *polarization* / *Total internal reflection*, etc.<br>(b) (i) The shape of the graph was mostly correct, though the decreasing intensity was not taken care of by many candidates.<br>(ii) I $\alpha$ $\cos^2\theta$ was done correctly by many though the angle 'θ' was not defined at all.<br>(iii) Many candidates did not differentiate between polarized and unpolarized light. They did not mention rotation and fall of intensity (zero and maximum) twice in one complete rotation. | ▪ *Give ample practice in drawing ray diagrams.*<br>▪ *Teach students derivations with assumptions, proper sign conventions and complete steps.*<br>▪ *Emphasise the following while doing the derivation:*<br>- *Importance of assumptions to be considered for the derivation*<br>- *Importance of ray diagram*<br>- *Correct steps for the derivation*<br>- *Importance of thin lens in this derivation*<br>- *Movement of light from denser to rarer medium and vice-versa*<br>- *Steps in deriving expression for refraction at a single spherical surface from denser to rarer and another derivation from rarer to denser medium*<br>▪ *Teach definition, phenomenon, and laws in detail to the students.*<br>▪ *Correct labelling of the axis while drawing a graph and other tips for drawing the correct shape of the graph should be explained to students.*<br>▪ *Clarify the difference between interference and diffraction pattern. Also, show students how intensity varies graphically in both the phenomena.*<br>▪ *Teach Malus law while teaching variation of intensity with angle. If possible, explain with the help of diagram and graph.*<br>▪ *Teach students the concept of polarization and how they can differentiate between an unpolarized light, partially polarized and plane polarized light.* |

<table>
<tr><td colspan="3">MARKING SCHEME<br>Question 21</td></tr>
<tr><td>(a)</td><td>(i)</td><td>(All sign conventions are acceptable)<br>
<br>
Since the aperture is small, Snell’s Law:<br>
$\frac{\mu_2}{\mu_1} = \frac{Sin\, i}{Sin\, r} \approx \frac{i}{r}$ (angles $i$ and $r$ are small)<br>
$i = \alpha + \gamma$ and $r = \gamma - \beta$, and<br>
$\alpha = \tan \alpha = \frac{AM}{u}$<br>
$\beta = \tan \beta = \frac{AM}{u}$<br>
$\Upsilon = \tan \gamma = \frac{AM}{u}$<br>
Final equation:<br>
$\frac{\mu_1}{u} \pm \frac{\mu_2}{\upsilon} = \frac{\mu_2 - \mu_1}{R}$ or $\frac{{}^1\mu_2}{v} \pm \frac{1}{u} = \frac{{}^1\mu_2 - 1}{R}$</td></tr>
<tr><td></td><td>(ii)</td><td>Scattering of light OR Rayleigh Scattering<br>OR</td></tr>
<tr><td>(b)</td><td>(i)</td><td>
</td></tr>
</table>

| | | |
|---|---|---|
| | (ii) | It states that intensity I of light transmitted by a polaroid is given by<br>$I = I_o \, Cos^2\theta$ **OR**<br>In words: Where θ is the angle between the direction of incident light and optic axis of the polaroid. (angle between the plane of transmission of the analyser and the polariser)<br>**OR**<br><br> |
| | (iii) | Given beam of light is passed through a polaroid or a lamina of tourmaline, which is then rotated. If the intensity of transmitted light:<br>(a) remains constant, incident light is ordinary light or unpolarized light.<br>(b) varies from 0 to maximum, or from darkness to brightness, incident light is plane polarized. |

## Question 22

**[5]**

(a) (i) In a semiconductor diode, what is meant by **potential barrier**?

(ii) Draw a **labelled** circuit diagram of a **Zener** diode as a **voltage regulator**.

(iii) Show with the help of a diagram, how you will obtain an **AND** gate using only **NAND** gates. (Truth table is **not** required.)

**OR**

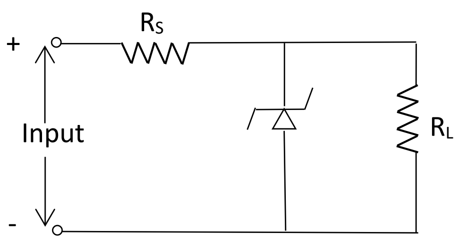
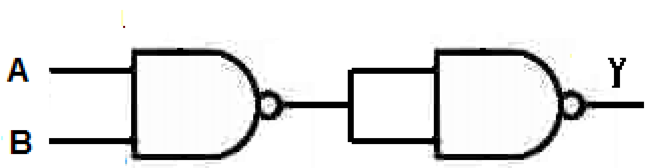
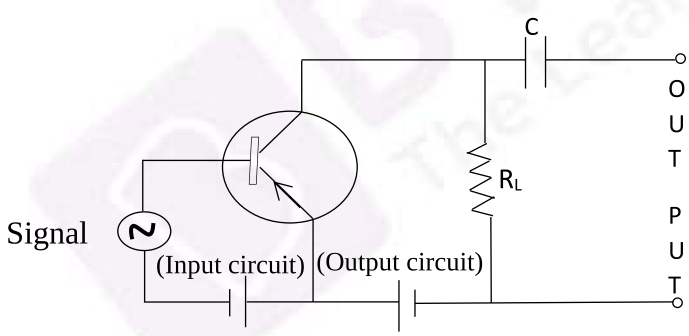
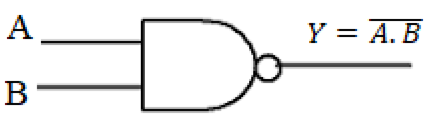
(b) (i) Draw a **labelled** circuit diagram of a transistor acting as a **common emitter amplifier**. What is meant by *phase reversal*?

(ii) Draw the symbol of a **NAND** gate and write its truth table.
Useful Constant and Relation:

| Comments of Examiners | Suggestions for Teachers |
|---|---|
| (a) (i) This part was incorrectly answered by most candidates. Many candidates wrote about 'potential' or 'potential difference'.<br>(ii) Several candidates showed incorrect reverse biasing on Zener diode.<br>Some other common errors observed in this question were:<br>- Series limiting resistor was missing or connected in parallel.<br>- Incorrect symbol of Zener diode was drawn.<br>- The direction of current was not shown in the circuit diagram.<br>- Load resistance was not shown in the circuit diagram.<br>(iii) Some candidates did not draw the symbol of NAND gate correctly. Several candidates did not obtain AND gate using only NAND gates. A few candidates were not able to differentiate between NAND gate and AND gate.<br>(b) (i) In the circuit diagram, biasing at emitter base and emitter collector was not correctly done by many candidates. Some candidates did not mark arrow in emitter to show whether it was PNP or NPN transistor. In several scripts, either the input signal was not shown, or input and output waveform was not opposite.<br>(ii) NAND gate was done correctly by most candidates, but some did not draw the truth table correctly. | ▪ *Explain clearly the meaning of the term 'potential barrier'.*<br>▪ *Teach students the labelled circuit diagram of a Zener diode as a voltage regulator. Explain the correct biasing of Zener diode and the use of it.*<br>▪ *Clarify the five common logic gates AND, OR, NOT, NAND and NOR with symbols, diagrams, boolean expressions and the truth tables.*<br>▪ *Advise students to practice drawing the labelled circuit diagram including the variation of input and output waveforms of common emitter amplifier.* |

## MARKING SCHEME

### Question 22

| | | |
|---|---|---|
| (a) | (i) | Potential barrier: The potential difference across the depletion region is called the potential barrier. |
| | (ii) |   |
| | (iii) |   **OR** |
| (b) | (i) |   Phase reversal means: Output waveform is out of phase to input wave by 180° or π. |
| | (ii) |   |

| A | B | C |
|---|---|---|
| 0 | 0 | 1 |
| 1 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 1 | 0 |

**NOTE: For questions having more than one correct answer/solution, alternate correct answers / solutions, apart from those given in the marking scheme, have also been accepted.**

# GENERAL COMMENTS

**Topics found difficult/ confusing by candidates**

- Gauss' Theorem
- Kirchhoff's Law
- Numerical problems on Potentiometer.
- Curie temperature
- Angle of dip
- Numerical problems on alternating current.
- Ray diagrams of lenses and mirrors
- Sign convection in lenses/compound microscope
- Labelling of ray diagrams and graphs
- Diffraction
- Davisson – Germer experiment
- Mean life and Half-life of a radioactive substance
- Binding energy
- Pair production
- Modulation and demodulation
- Zener diode, common emitter amplifier their circuit diagrams and biasing, and other related topics
- Relation between "alpha" and "beta" of a transistor
- Alternating and direct current phenomena
- Phase and phase difference
- Impedance and inductance in ac circuit
- Refraction and Scattering

- Polarizer and Analyzer
- Absorption and Emission Spectrum
- Pair Production and Pair annihilation
- Forward and reverse biasing
- Numerical problems on mass defect
- Symbol of PNP / NPN transistor and Zener diode
- Communication system

**Suggestions for Students**

- Make a list of definitions, principles, and formulae.
- Memorise the technical terms / laws / key words, principles, and derivations etc. only after comprehension.
- Refer to the scope of syllabus for clarity.
- Follow the steps while doing a numerical (write the data, make conversion of units, if required in SI., write the correct formula, make correct substitution and write correct the answer with the correct unit and the direction in case of a vector quantity).Be careful with the units, such as: mm, cm, nm, μC and μF, mA, electron volt, etc. These must be converted to SI units.
- Draw a ray diagram with arrow heads.
- Draw a graph with properly labelled axes.
- Take notes in class to summarize lectures in your own words to remember the concept/ideas/derivations.
- Create Mind Maps/flow charts to consolidate your knowledge for quick revision before examinations.
- If you find it easier to recall images rather than text, associate learnt concepts with pictures, ray diagrams, graphs, and drawings.
- Practice the difficult topics regularly.