

रोल नं.

Roll No.

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परीक्षार्थी कोड को उत्तर-पुस्तिका के मुख-पृष्ठ पर अवश्य लिखें ।

Candidates must write the Code on the title page of the answer-book.

- कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ 15 हैं ।
- प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए कोड नम्बर को छात्र उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें ।
- कृपया जाँच कर लें कि इस प्रश्न-पत्र में 30 प्रश्न हैं ।
- कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, प्रश्न का क्रमांक अवश्य लिखें ।
- इस प्रश्न-पत्र को पढ़ने के लिए 15 मिनट का समय दिया गया है । प्रश्न-पत्र का वितरण पूर्वाह्न में 10.15 बजे किया जायेगा । 10.15 बजे से 10.30 बजे तक छात्र केवल प्रश्न-पत्र को पढ़ेंगे और इस अवधि के दौरान वे उत्तर-पुस्तिका पर कोई उत्तर नहीं लिखेंगे ।
- Please check that this question paper contains 15 printed pages.
- Code number given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.
- Please check that this question paper contains 30 questions.
- Please write down the Serial Number of the question before attempting it.
- 15 minutes time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the students will read the question paper only and will not write any answer on the answer-book during this period.

## भौतिक विज्ञान (सैद्धान्तिक)

### PHYSICS (Theory)

निर्धारित समय : 3 घंटे ]

[ अधिकतम अंक : 70

Time allowed : 3 hours ]

[ Maximum Marks : 70

सामान्य निर्देश :

- (i) सभी प्रश्न अनिवार्य हैं ।
- (ii) इस प्रश्न-पत्र में कुल 30 प्रश्न हैं । प्रश्न 1 से 8 तक के प्रश्न अति-लघुउत्तरीय प्रश्न हैं और प्रत्येक एक अंक का है ।
- (iii) प्रश्न 9 से 18 में प्रत्येक प्रश्न दो अंक का है, प्रश्न 19 से 27 में प्रत्येक प्रश्न तीन अंक का है तथा प्रश्न 28 से 30 में प्रत्येक प्रश्न पाँच अंक का है ।
- (iv) तीन अंकों वाले प्रश्नों में से एक मूल्य आधारित प्रश्न है ।
- (v) प्रश्न-पत्र में समग्र पर कोई विकल्प नहीं है । तथापि, दो अंकों वाले एक प्रश्न में, तीन अंकों वाले एक प्रश्न में और पाँच अंकों वाले तीनों प्रश्नों में आन्तरिक चयन प्रदान किया गया है । ऐसे प्रश्नों में आपको दिये गये चयनों में से केवल एक प्रश्न ही करना है ।

(vi) कैलकुलेटर के उपयोग की अनुमति नहीं है। तथापि यदि आवश्यक हो तो आप लघुगणकीय सारणी का प्रयोग कर सकते हैं।

(vii) जहाँ आवश्यक हो आप निम्नलिखित भौतिक नियतांकों के मानों का उपयोग कर सकते हैं :

$$c = 3 \times 10^8 \text{ m/s}$$

$$h = 6.63 \times 10^{-34} \text{ Js}$$

$$e = 1.6 \times 10^{-19} \text{ C}$$

$$\mu_0 = 4\pi \times 10^{-7} \text{ T mA}^{-1}$$

$$\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ Nm}^2 \text{ C}^{-2}$$

$$m_e = 9.1 \times 10^{-31} \text{ kg}$$

**General Instructions :**

- (i) *All questions are compulsory.*
- (ii) *There are 30 questions in total. Question Nos. 1 to 8 are very short answer type questions and carry one mark each.*
- (iii) *Question Nos. 9 to 18 carry two marks each. Question Nos. 19 to 27 carry three marks each and question nos. 28 to 30 carry five marks each.*
- (iv) *One of the questions carrying three marks weightage is value based question.*
- (v) *There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all three questions of five marks each weightage. You have to attempt only one of the choices in such questions.*
- (vi) *Use of calculators is not permitted. However, you may use log tables if necessary.*
- (vii) *You may use the following values of physical constants wherever necessary :*

$$c = 3 \times 10^8 \text{ m/s}$$

$$h = 6.63 \times 10^{-34} \text{ Js}$$

$$e = 1.6 \times 10^{-19} \text{ C}$$

$$\mu_0 = 4\pi \times 10^{-7} \text{ T mA}^{-1}$$

$$\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ Nm}^2 \text{ C}^{-2}$$

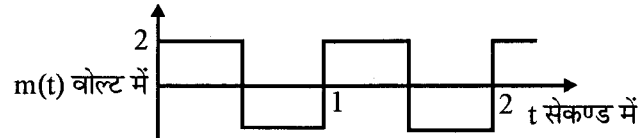
$$m_e = 9.1 \times 10^{-31} \text{ kg}$$

1. किसी चालक की वैद्युत चालकता की परिभाषा और उसका S.I. मात्रक लिखिए । 1  
Define the term 'electrical conductivity' of a metallic wire. Write its S.I. unit.

2. किसी वाहक तरंग (सिग्नल) को इस प्रकार निरूपित किया गया है : 1

$$C(t) = 5 \sin(10\pi t) \text{ volt}$$

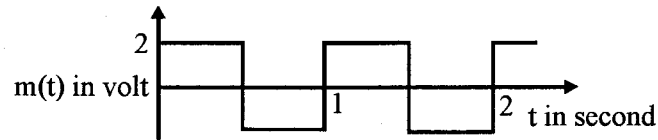
कोई मॉडुलन सिग्नल दर्शाए अनुसार वर्ग तरंग है । मॉडुलन सूचकांक ज्ञात कीजिए ।



The carrier wave is represented by

$$C(t) = 5 \sin(10\pi t) \text{ volt}$$

A modulating signal is a square wave as shown. Determine modulation index.



3. ग्राफ में ताप के साथ Si की प्रतिरोधकता का विचरण दर्शाइए । 1

Show variation of resistivity of Si with temperature in a graph.

4. किसी उत्तल लेंस को किसी समतल दर्पण के सम्पर्क में रखा गया है । इस संयोजन के अक्ष पर संयोजन से 20 cm दूरी पर स्थित किसी बिन्दुवर्तित बिम्ब का प्रतिबिम्ब इसी बिम्ब के संपाती हैं । लेंस की फोकस दूरी क्या है ? 1

A convex lens is placed in contact with a plane mirror. A point object at a distance of 20 cm on the axis of this combination has its image coinciding with itself. What is the focal length of the lens ?

5. “किसी भी आवेश विन्यास के लिए, किसी बिन्दु से गुजरने वाला, समविभव पृष्ठ विद्युत क्षेत्र के अभिलम्बवत होता है ।” इस कथन की पुष्टि कीजिए । 1

“For any charge configuration, equipotential surface through a point is normal to the electric field.” Justify.

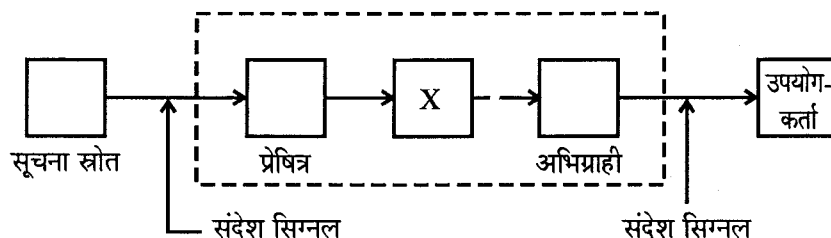
6. चुम्बकीय क्षेत्र  $\vec{B}$  में वेग  $\vec{V}$  से गतिमान किसी आवेश के कारण लोरेन्ट्स चुम्बकीय बल  $\vec{F}$  के लिए सदिश रूप में व्यंजक लिखिए। इस चुम्बकीय क्षेत्र की दिशा क्या है ?

1

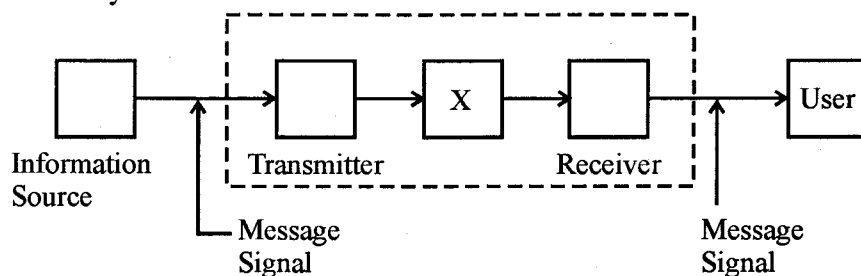
Write the expression, in a vector form, for the Lorentz magnetic force  $\vec{F}$  due to a charge moving with velocity  $\vec{V}$  in a magnetic field  $\vec{B}$ . What is the direction of the magnetic force ?

7. नीचे किसी व्यापक संचार व्यवस्था का ब्लॉक आरेख दिया गया है। 'X' द्वारा नामांकित अवयव को पहचानिए और इसका कार्य लिखिए।

1



The figure given below shows the block diagram of a generalized communication system. Identify the element labelled 'X' and write its function.



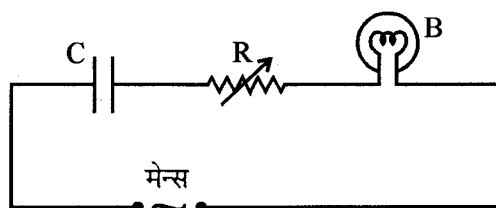
8. समान साइज़ के दो गोलक, जिनमें एक धातु का तथा दूसरा काँच का है, मुक्त रूप से समान ऊँचाई से धरती पर गिराए जाते हैं। इनमें से कौन सा गोलक धरती पर पहले पहुँचेगा और क्यों ?

1

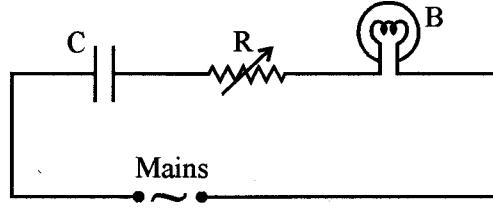
Two spherical bobs, one metallic and the other of glass, of the same size are allowed to fall freely from the same height above the ground. Which of the two would reach earlier and why ?

9. दर्शाए अनुसार किसी परिपथ में ac मेन्स के साथ श्रेणीक्रम में संधारित्र 'C', परिवर्ती प्रतिरोधक 'R' तथा कोई बल्ब 'B' संयोजित हैं। बल्ब कुछ चमक के साथ जलता है। यदि (i) प्रतिरोधक R को समान रखकर, संधारित्र की पट्टिकाओं के बीच कोई परावैद्युत पट्टिका रख दी जाए, (ii) धारिता को समान रखकर प्रतिरोधक R में वृद्धि कर दी जाए, तो बल्ब की चमक में क्या परिवर्तन होगा ?

2



A capacitor 'C', a variable resistor 'R' and a bulb 'B' are connected in series to the ac mains in circuit as shown. The bulb glows with some brightness. How will the glow of the bulb change if (i) a dielectric slab is introduced between the plates of the capacitor, keeping resistance R to be the same; (ii) the resistance R is increased keeping the same capacitance ?



10. 2 cm लम्बाई के किसी वैद्युत द्विध्रुव को जब किसी एकसमान विद्युत क्षेत्र में इस प्रकार रखा जाता है कि द्विध्रुव का अक्ष क्षेत्र से  $60^\circ$  का कोण बनाए, तब वह द्विध्रुव  $8\sqrt{3}$  Nm के बल आघूर्ण का अनुभव करता है। यदि इस द्विध्रुव पर आवेश  $\pm 4$  nC है, तो इसकी स्थितिज ऊर्जा परिकलित कीजिए।

2

An electric dipole of length 2 cm, when placed with its axis making an angle of  $60^\circ$  with a uniform electric field, experiences a torque of  $8\sqrt{3}$  Nm. Calculate the potential energy of the dipole, if it has a charge of  $\pm 4$  nC.

11. दो चुम्बकीय पदार्थों में से 'A' की आपेक्षिक चुम्बकशीलता एक से कुछ अधिक है, जबकि 'B' की एक से कम है। 'A' और 'B' पदार्थों की प्रकृति पहचानिए। इन पदार्थों की चुम्बकीय प्रवृत्तियाँ धनात्मक होगी अथवा ऋणात्मक ?

2

Out of the two magnetic materials, 'A' has relative permeability slightly greater than unity while 'B' has less than unity. Identify the nature of the materials 'A' and 'B'. Will their susceptibilities be positive or negative ?

12. साइक्लोट्रॉन का मूल सिद्धान्त लिखिए। संक्षेप में उल्लेख कीजिए कि इस मशीन का उपयोग आवेशित कणों को उच्च ऊर्जा के लिए त्वरित करने में किस प्रकार किया जाता है।

2

State the underlying principle of a cyclotron. Write briefly how this machine is used to accelerate charged particles to high energies.

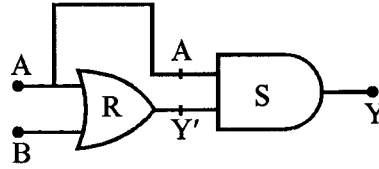
13. a चौड़ाई की एकल झिरी के लिए  $\lambda$  तरंगदैर्घ्य के किसी एकवर्णी प्रकाश स्रोत के व्यतिकरण पैटर्न का प्रथम निम्निष्ठ  $\frac{\lambda}{a}$  के कोण पर बनता है। इसी कोण  $\frac{\lambda}{a}$  पर हम 'a' दूरी के पृथकन वाली दो पतली झिरियों का उच्चिष्ठ प्राप्त करते हैं। व्याख्या कीजिए।

2

For a single slit of width "a", the first minimum of the interference pattern of a monochromatic light of wavelength  $\lambda$  occurs at an angle of  $\frac{\lambda}{a}$ . At the same angle of  $\frac{\lambda}{a}$ , we get a maximum for two narrow slits separated by a distance "a". Explain.

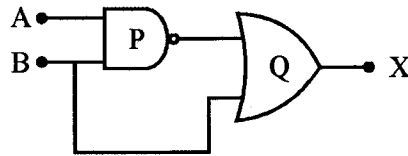
14. दर्शाए गए गेटों के संयोजन के लिए सत्यमान सारणी लिखिए । इन गेटों के नाम लिखिए ।

2

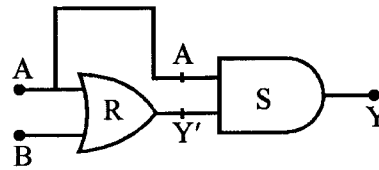


अथवा

दिए गए परिपथ में P तथा Q द्वारा अंकित लॉजिक गेटों को पहचानिए । इस संयोजन के लिए सत्यमान सारणी लिखिए ।

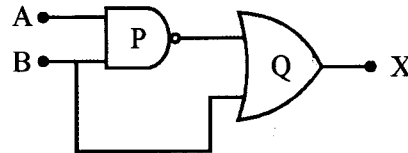


Write the truth table for the combination of the gates shown. Name the gates used.



OR

Identify the logic gates marked 'P' and 'Q' in the given circuit. Write the truth table for the combination.



15. किसी प्रोटॉन और किसी ऐल्फा कण को समान विभव से त्वरित किया गया है । इन दोनों में से (i) किससे सम्बद्ध, de-ब्राग्ली तरंगदैर्घ्य का मान अधिक होगा, और (ii) किसकी गतिज ऊर्जा कम होगी ? अपने उत्तर की कारण सहित पुष्टि कीजिए ।

2

A proton and an alpha particle are accelerated through the same potential. Which one of the two has (i) greater value of de-Broglie wavelength associated with it and (ii) less kinetic energy. Give reasons to justify your answer.

16. किसी एकसमान विद्युत क्षेत्र को  $\vec{E} = 2 \times 10^3 \hat{i}$  N/C द्वारा व्यक्त किया गया है । इस क्षेत्र के उस फ्लक्स को ज्ञात कीजिए जो 20 cm भुजा के वर्ग के उस पार्श्व से गुजरता है, जिसका तल y-z तल के समान्तर है । यदि तल x-अक्ष से  $30^\circ$  का कोण बनाए, तो इसी वर्ग से गुजरने वाले फ्लक्स का मान क्या होगा ?

2

Given a uniform electric field  $\vec{E} = 2 \times 10^3 \hat{i}$  N/C, find the flux of this field through a square of side 20 cm, whose plane is parallel to the y-z plane. What would be the flux through the same square, if the plane makes an angle of  $30^\circ$  with the x-axis ?

17. किरचोफ़ नियम लिखिए । संक्षेप में व्याख्या कीजिए कि ये नियम किस प्रकार न्यायसंगत हैं ।

2

State Kirchhoff's rules. Explain briefly how these rules are justified.

18. (i) किसी लेसर द्वारा  $6.0 \times 10^{14}$  Hz आवृत्ति का एकवर्णी प्रकाश उत्पन्न किया गया है । उत्सर्जित शक्ति का मान  $2.0 \times 10^{-3}$  W है । स्रोत द्वारा औसतन प्रति सेकण्ड उत्सर्जित फोटॉनों की संख्या का आकलन कीजिए ।

(ii) किसी दिए गए प्रकाश सुग्राही पृष्ठ पर आपतित विकिरणों की तीव्रता और प्रकाश वैद्युत धारा के बीच विचरण को दर्शाने वाला ग्राफ खींचिए ।

2

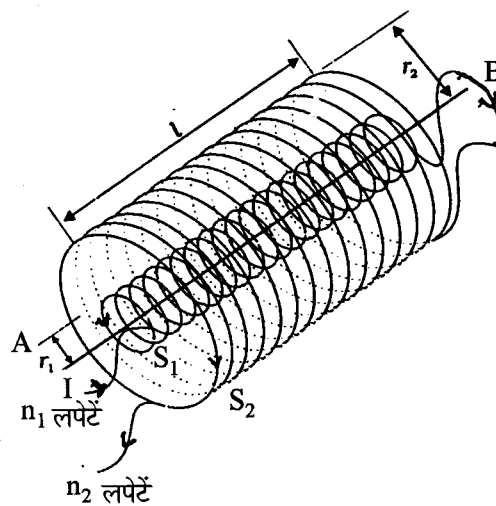
(i) Monochromatic light of frequency  $6.0 \times 10^{14}$  Hz is produced by a laser. The power emitted is  $2.0 \times 10^{-3}$  W. Estimate the number of photons emitted per second on an average by the source.

(ii) Draw a plot showing the variation of photoelectric current versus the intensity of incident radiation on a given photosensitive surface.

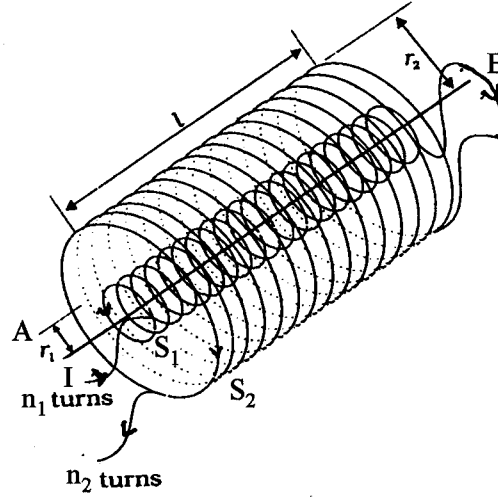
19. (a) समाकलन रूप में व्यक्त करते हुए ऐम्पियर का परिपथीय नियम लिखिए ।

(b) समान लम्बाई के दो लम्बे समाक्ष विद्युत्तरोधी सोलेनाइड  $S_1$  तथा  $S_2$  चित्र में दर्शाए अनुसार एक-दूसरे के ऊपर लिपटे हैं । कोई स्थायी धारा "I" भीतरी सोलेनाइड  $S_1$  से इसके दूसरे सिरे B तक प्रवाहित होती है, जो बाहरी सोलेनाइड  $S_2$  से संयोजित है तथा जिससे समान धारा "I" विपरीत दिशा में प्रवाहित होकर सिरे A से बाहर आती है । यदि इनमें प्रति इकाई लम्बाई लपेटों की संख्या  $n_1$  तथा  $n_2$  है, तो (i) अक्ष पर भीतर तथा (ii) संयुक्त निकाय के बाहर किसी बिन्दु पर कुल चुम्बकीय क्षेत्र का परिमाण और दिशा ज्ञात कीजिए ।

3



- (a) State Ampere's circuital law, expressing it in the integral form.
- (b) Two long coaxial insulated solenoids,  $S_1$  and  $S_2$  of equal lengths are wound one over the other as shown in the figure. A steady current "I" flow through the inner solenoid  $S_1$  to the other end B, which is connected to the outer solenoid  $S_2$  through which the same current "I" flows in the opposite direction so as to come out at end A. If  $n_1$  and  $n_2$  are the number of turns per unit length, find the magnitude and direction of the net magnetic field at a point (i) inside on the axis and (ii) outside the combined system.



20. कक्ष ताप पर गैसीय हाइड्रोजन पर बमबारी करने के लिए किसी 12.9 eV के इलेक्ट्रॉन पुंज का उपयोग किया गया है। हाइड्रोजन परमाणु किस ऊर्जा स्तर तक उत्तेजित होंगे ?

पाशन श्रेणी के पहले सदस्य तथा बामर श्रेणी के पहले सदस्य की तरंगदैर्घ्य परिकलित कीजिए।

3

A 12.9 eV beam of electrons is used to bombard gaseous hydrogen at room temperature. Upto which energy level the hydrogen atoms would be excited ?

Calculate the wavelength of the first member of Paschen series and first member of Balmer series.

21. (a) किसी संयुक्त सूक्ष्मदर्शी द्वारा अंतिम तथा स्पष्ट प्रतिबिम्ब निकटतम दूरी पर बनना दर्शाने के लिए नामांकित प्रकाश किरण आरेख खींचिए।
- (b) किसी संयुक्त सूक्ष्मदर्शी द्वारा उत्पन्न कुल आवर्धन 20 है। नेत्रिका द्वारा उत्पन्न आवर्धन 5 है। इस सूक्ष्मदर्शी को किसी निश्चित वस्तु पर फोकसित किया गया है। अभिदृश्यक और नेत्रिका के बीच की प्रेक्षित दूरी 14 cm है। यदि स्पष्ट दृश्यता के लिए अल्पतम दूरी 20 cm हो तो अभिदृश्यक और नेत्रिका की फोकस दूरी परिकलित कीजिए।

3



- (a) Draw a labelled ray diagram showing the formation of a final image by a compound microscope at least distance of distinct vision.
- (b) The total magnification produced by a compound microscope is 20. The magnification produced by the eye piece is 5. The microscope is focussed on a certain object. The distance between the objective and eyepiece is observed to be 14 cm. If least distance of distinct vision is 20 cm, calculate the focal length of the objective and the eye piece.

22. निम्नलिखित के उत्तर दीजिए :

3

- (a) उन वैद्युत-चुम्बकीय तरंगों का नाम लिखिए जिनका उपयोग कुछ निश्चित प्रकार के कैंसर्स के उपचार में लिए किया जाता है। इनका आवृत्ति-परास लिखिए।
- (b) समतापमण्डल के शीर्ष पर पतली ओजोन परत मानव की उत्तरजीविता के लिए अत्यन्त महत्वपूर्ण है। क्यों ?
- (c) किसी पृष्ठ पर आपतित वैद्युत-चुम्बकीय तरंगों द्वारा अन्तरित संवेग की मात्रा बहुत कम क्यों होती है ?

Answer the following :

- (a) Name the em waves which are used for the treatment of certain forms of cancer. Write their frequency range.
- (b) Thin ozone layer on top of stratosphere is crucial for human survival. Why ?
- (c) Why is the amount of the momentum transferred by the em waves incident on the surface so small ?

23. कक्षा XII की छात्रा, सुनीता को जब यह ज्ञात हुआ कि उसके पिताजी अपने मकान की छत को किसी मोबाइल कम्पनी को किराए पर देने की योजना बना रहे हैं, तो उसने इसका विरोध किया। उसने अपने माता-पिता को यह विश्वास दिलाने का भरसक प्रयास किया कि उनके ऐसा करने पर स्वास्थ्य संबंधित संकट उत्पन्न होंगे और अन्ततोगत्वा उसके माता-पिता उससे सहमत हो गए :

3

- (1) किसी आवासीय कॉलोनी में मोबाइल कम्पनी द्वारा प्रेषण-टॉवर स्थापित करना स्वास्थ्य के लिए क्षतिदायक किस प्रकार हो सकता है ?
- (2) अपने माता-पिता की योजना का विरोध करके सुनीता ने किस मूल्य को प्रदर्शित किया ?
- (3) 20 m ऊँचाई के किसी एन्टेना द्वारा कितने परिसर तक विद्युत चुम्बकीय तरंगें प्रेषित की जा सकती है, इसका आकलन कीजिए। (पृथ्वी की त्रिज्या = 6400 km)

When Sunita, a class XII student, came to know that her parents are planning to rent out the top floor of their house to a mobile company she protested. She tried hard to convince her parents that this move would be a health hazard.

Ultimately her parents agreed :

- (1) In what way can the setting up of transmission tower by a mobile company in a residential colony prove to be injurious to health ?
- (2) By objecting to this move of her parents, what value did Sunita display ?
- (3) Estimate the range of e.m. waves which can be transmitted by an antenna of height 20 m. (Given radius of the earth = 6400 km)

24. किसी पोटेंशियोमीटर के 1.0 m लम्बे तार का प्रतिरोध  $15\ \Omega$  है। यह श्रेणीक्रम में किसी 5 V की बैटरी और  $5\ \Omega$  के प्रतिरोधक से संयोजित है। उस प्राथमिक सेल की emf निर्धारित कीजिए जो 60 cm पर संतुलन बिन्दु प्रदान करता है।

3

A potentiometer wire of length 1.0 m has a resistance of  $15\ \Omega$ . It is connected to a 5 V battery in series with a resistance of  $5\ \Omega$ . Determine the emf of the primary cell which gives a balance point at 60 cm.

25. (a) रेडियोएक्टिव क्षयता के नियम के लिए व्यंजक,  $N = N_0 e^{-\lambda t}$  व्युत्पन्न कीजिए।
- (b) (i) प्रतीकात्मक रूप में  $^{22}_{11}\text{Na}$  के बीटा ( $\beta^+$ ) क्षय की प्रक्रिया को व्यक्त कीजिए। इस क्षय की मूल नाभिकीय प्रक्रिया का उल्लेख भी कीजिए।

(ii) इस क्षय के पश्चात बना नाभिक  $^{22}_{11}\text{Na}$  का समस्थानिक है अथवा समभारिक?

3

(a) Deduce the expression,  $N = N_0 e^{-\lambda t}$ , for the law of radioactive decay.

(b) (i) Write symbolically the process expressing the  $\beta^+$  decay of  $^{22}_{11}\text{Na}$ . Also write the basic nuclear process underlying this decay.

(ii) Is the nucleus formed in the decay of the nucleus  $^{22}_{11}\text{Na}$ , an isotope or isobar?

26. (a) कोई मोबाइल फोन किसी अवतल दर्पण के मुख्य अक्ष के अनुदिश रखा है। उपयुक्त आरेख की सहायता से इसका प्रतिबिम्ब बनना दर्शाइए। व्याख्या कीजिए कि आवर्धन एकसमान क्यों नहीं है।

(b) मान लीजिए किसी अवतल दर्पण के परावर्ती पृष्ठ का निचला आधा भाग किसी अपारदर्शी पदार्थ से ढक दिया गया है। इसका किसी बिम्ब के प्रतिबिम्ब पर क्या प्रभाव पड़ेगा? व्याख्या कीजिए।

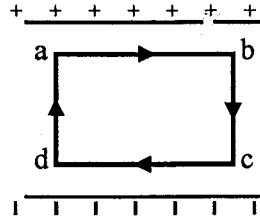
3

(a) A mobile phone lies along the principal axis of a concave mirror. Show, with the help of a suitable diagram, the formation of its image. Explain why magnification is not uniform.

(b) Suppose the lower half of the concave mirror's reflecting surface is covered with an opaque material. What effect this will have on the image of the object? Explain.

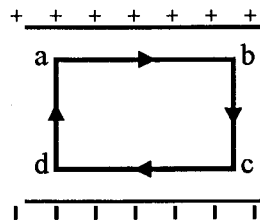
27. (a) किसी आवेशित समान्तर पट्टिका संधारित्र में प्रति इकाई आयतन भंडारित ऊर्जा के लिए व्यंजक प्राप्त कीजिए ।
- (b) किसी समान्तर पट्टिका संधारित्र के भीतर विद्युत क्षेत्र का मान  $E$  है । बन्द आयताकार लूप  $a b c d a$  के अनुदिश किसी आवेश  $q$  को गति कराने में किया गया कार्य ज्ञात कीजिए ।

3



अथवा

- (a) किसी समान्तर पट्टिका संधारित्र जिसकी पट्टिका का क्षेत्रफल  $A$  तथा पट्टिकाओं के बीच पृथक्कन  $d$  है, की धारिता के लिए व्यंजक व्युत्पन्न कीजिए ।
- (b)  $R_1$  तथा  $R_2$  त्रिज्याओं के दो आवेशित गोलीय चालकों को जब किसी चालक तार द्वारा संयोजित किया जाता है, तो वे क्रमशः  $q_1$  तथा  $q_2$  आवेश अर्जित कर लेते हैं । इन चालकों की त्रिज्याओं के पदों में इनके पृष्ठीय आवेश घनत्वों का अनुपात ज्ञात कीजिए ।
- (a) Obtain the expression for the energy stored per unit volume in a charged parallel plate capacitor.
- (b) The electric field inside a parallel plate capacitor is  $E$ . Find the amount of work done in moving a charge  $q$  over a closed rectangular loop  $a b c d a$ .



OR

- (a) Derive the expression for the capacitance of a parallel plate capacitor having plate area  $A$  and plate separation  $d$ .
- (b) Two charged spherical conductors of radii  $R_1$  and  $R_2$  when connected by a conducting wire acquire charges  $q_1$  and  $q_2$  respectively. Find the ratio of their surface charge densities in terms of their radii.

28. (a) किसी ऐसे सरल प्रयोग (अथवा क्रियाकलाप) का वर्णन कीजिए जो यह दर्शाता है कि किसी कुण्डली में प्रेरित विद्युत वाहक बल (emf) की ध्रुवता सदैव इस प्रकार होती है कि वह ऐसी धारा उत्पन्न करने का प्रयास करती है जो उसे उत्पन्न करने वाले चुम्बकीय फ्लक्स में परिवर्तन का विरोध करें ।
- (b) किसी प्रेरक जिसका स्वप्रेरकत्व  $L$  है, से प्रवाहित धारा में निरन्तर वृद्धि हो रही है । निम्नलिखित विचरणों को दर्शाने के लिए ग्राफ खींचिए :
- चुम्बकीय फ्लक्स और धारा के बीच
  - प्रेरित emf और  $dI/dt$  के बीच
  - संचित चुम्बकीय स्थितिज ऊर्जा और धारा के बीच

5

अथवा

- (a) मूल अवयवों का वर्णन करते हुए किसी ac जनित्र का व्यवस्था आरेख खींचिए । इसके कार्यकारी सिद्धान्त का संक्षेप में उल्लेख कीजिए । किसी चुम्बकीय क्षेत्र में घूर्णन करने वाले किसी लूप (पाश) द्वारा जनित
- चुम्बकीय फ्लक्स, तथा
  - प्रत्यावर्ती emf और समय के बीच विचरण को दर्शाने के लिए ग्राफ खींचिए ।
- (b) ac मेंस के साथ प्रतिदीप्ति नलिका के उपयोग में चोक कुण्डली की आवश्यकता क्यों होती है ?
- (a) Describe a simple experiment (or activity) to show that the polarity of emf induced in a coil is always such that it tends to produce a current which opposes the change of magnetic flux that produces it.
- (b) The current flowing through an inductor of self inductance  $L$  is continuously increasing. Plot a graph showing the variation of
- Magnetic flux versus the current
  - Induced emf versus  $dI/dt$
  - Magnetic potential energy stored versus the current.

OR

- (a) Draw a schematic sketch of an ac generator describing its basic elements. State briefly its working principle. Show a plot of variation of
- Magnetic flux and
  - Alternating emf versus time generated by a loop of wire rotating in a magnetic field.
- (b) Why is choke coil needed in the use of fluorescent tubes with ac mains ?

29. (a) p-n संधि बनने में सम्मिलित प्रक्रियाओं का संक्षेप में उल्लेख कीजिए और इसकी भी स्पष्ट रूप से व्याख्या कीजिए कि हासी क्षेत्र का निर्माण किस प्रकार होता है ।
- (b) आवश्यक परिपथ आरेखों की सहायता से यह दर्शाइए कि किसी p-n संधि के लिए
- अग्रदिशिक बायस
  - पश्चदिशिक बायस में V-I अभिलाक्षणिक किस प्रकार प्राप्त किए जाते हैं ।
- दिष्टकरण में इन अभिलाक्षणिकों का उपयोग किस प्रकार किया जाता है ?

5

अथवा

- (a) किसी ट्रांजिस्टर के तीन खण्डों के बीच उनके साइज़ और मादन-स्तर के आधार पर विभेदन कीजिए ।
- (b) किसी ट्रांजिस्टर को किस प्रकार बायसित करके सक्रिय अवस्था में लाया जाता है ?
- (c) आवश्यक परिपथ आरेख की सहायता से वर्णन कीजिए कि CE विन्यास में कोई n-p-n ट्रांजिस्टर, किस प्रकार किसी लघु ज्या वक्रीय निवेशी वोल्टता का प्रवर्धन करता है । ac धारा लब्धि के लिए सूत्र लिखिए ।
- (a) State briefly the processes involved in the formation of p-n junction explaining clearly how the depletion region is formed.
- (b) Using the necessary circuit diagrams, show how the V-I characteristics of a p-n junction are obtained in
- Forward biasing
  - Reverse biasing

How are these characteristics made use of in rectification ?

OR

- (a) Differentiate between three segments of a transistor on the basis of their size and level of doping.
- (b) How is a transistor biased to be in active state ?
- (c) With the help of necessary circuit diagram, describe briefly how n-p-n transistor in CE configuration amplifies a small sinusoidal input voltage. Write the expression for the ac current gain.
30. (a) (i) 'दो स्वतंत्र एकवर्णी प्रकाश स्रोत प्रतिपालित व्यतिकरण पैटर्न उत्पन्न नहीं कर सकते।' इसका कारण दीजिए।
- (ii) दो कलासंबद्ध प्रकाश स्रोतों से उत्सर्जित प्रकाश तरंगों जिनमें प्रत्येक का आयाम  $a$  तथा आवृत्ति  $\omega$  है, किसी बिन्दु पर अध्यारोपण करती हैं। यदि इन तरंगों के कारण विस्थापन  $y_1 = a \cos \omega t$  तथा  $y_2 = a \cos(\omega t + \phi)$ , यहाँ  $\phi$  दोनों के बीच कलान्तर हैं, हो, तो इस बिन्दु पर परिणामी तीव्रता के लिए व्यंजक प्राप्त कीजिए।
- (b) यंग के द्विझिरी प्रयोग, जिसमें  $\lambda$ , तरंगदैर्घ्य के एकवर्णी प्रकाश का उपयोग किया गया है, में पर्दे के किसी बिन्दु, जिस पर पथान्तर  $\lambda$  है, प्रकाश की तीव्रता  $K$  मात्रक है। किसी बिन्दु पर जहाँ पर पथान्तर  $\lambda/3$  है, प्रकाश की तीव्रता ज्ञात कीजिए।

5

#### अथवा

- (a) उपयुक्त आरेख की सहायता से यह कैसे निदर्शित किया जा सकता है कि अध्रुवित प्रकाश किसी पोलैराइड से गुजरने पर ध्रुवित हो जाता है ?
- (b) कोई अध्रुवित प्रकाश पुन्ज किसी काँच-वायु अन्तरापृष्ठ पर आपतित है। उपयुक्त किरण आरेख की सहायता से यह दर्शाइए कि इस अन्तरापृष्ठ से परावर्तित प्रकाश, यदि  $\mu = \tan i_B$  है, तो पूर्णतः ध्रुवित होता है, यहाँ  $\mu$  काँच का वायु के सापेक्ष अपवर्तनांक तथा  $i_B$  ब्रूस्टर कोण है।
- (a) (i) 'Two independent monochromatic sources of light cannot produce a sustained interference pattern'. Give reason.
- (ii) Light waves each of amplitude "a" and frequency " $\omega$ ", emanating from two coherent light sources superpose at a point. If the displacements due to these waves is given by  $y_1 = a \cos \omega t$  and  $y_2 = a \cos(\omega t + \phi)$  where  $\phi$  is the phase difference between the two, obtain the expression for the resultant intensity at the point.

- (b) In Young's double slit experiment, using monochromatic light of wavelength  $\lambda$ , the intensity of light at a point on the screen where path difference is  $\lambda$ , is  $K$  units. Find out the intensity of light at a point where path difference is  $\lambda/3$ .

OR

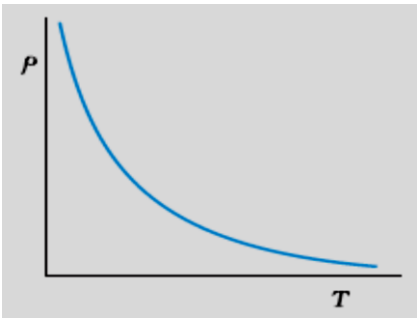
- (a) How does one demonstrate, using a suitable diagram, that unpolarised light when passed through a Polaroid gets polarised ?
- (b) A beam of unpolarised light is incident on a glass-air interface. Show, using a suitable ray diagram, that light reflected from the interface is totally polarised, when  $\mu = \tan i_B$ , where  $\mu$  is the refractive index of glass with respect to air and  $i_B$  is the Brewster's angle.
-

**Strictly Confidential (For Internal and Restricted Use only)**  
**Senior School Certificate Examination**  
**Marking Scheme - Physics (Code 55/1/2)**

1. The marking scheme provides general guidelines to reduce subjectivity in the marking. The answers given in the marking scheme are suggested answers. The content is thus indicated. If a student has given any other answer, which is different from the one given in the marking scheme, but conveys the meaning correctly, such answers should be given full weightage.
2. In value based questions, any other individual response with suitable justification should also be accepted even if there is no reference to the text.
3. Evaluation is to be done as per instructions provided in the marking scheme. It should not be done according to one's own interpretation or any other consideration. Marking scheme should be adhered to and religiously followed.
4. If a question has parts, please award in the right hand side for each part. Marks awarded for different part of the question should then be totaled up and written in the left hand margin and circled.
5. If a question does not have any parts, marks are to be awarded in the left hand margin only.
6. If a candidate has attempted an extra question, marks obtained in the question attempted first should be retained and the other answer should be scored out.
7. No marks are to be deducted for the cumulative effect of an error. The student should be penalized only once.
8. Deduct  $\frac{1}{2}$  mark for writing wrong units, missing units, in the final answer to numerical problems.
9. Formula can be taken as implied from the calculations even if not explicitly written.
10. In short answer type question, asking for two features / characteristics / properties if a candidate writes three features, characteristics / properties or more, only the correct two should be evaluated.
11. Full marks should be awarded to a candidate if his / her answer in a numerical problem is close to the value given in the scheme.
12. In compliance to the judgement of the Hon'ble Supreme Court of India, Board has decided to provide photocopy of the answer book(s) to the candidates who will apply for it along with the requisite fee from 2012 examination. Therefore, it is all the more important that the evaluation is done strictly as per the value points given in the marking scheme so that the Board could be in a position to defend the evaluation at any forum.
13. The Examiner shall also have to certify in the answer book that they have evaluated the answer book strictly in accordance with the value points given in the marking scheme and correct set of question paper.
14. Every Examiner shall also ensure that all the answers are evaluated, marks carried over to the title paper, correctly totaled and written in figures and words.
15. In the past it has been observed that the following are the common types of errors committed by the Examiners
  - Leaving answer or part thereof unassessed in an answer script.
  - Giving more marks for an answer than assigned to it or deviation from the marking scheme.
  - Wrong transference of marks from the inside pages of the answer book to the title page.
  - Wrong question wise totaling on the title page.
  - Wrong totaling of marks of the two columns on the title page.
  - Wrong grand total.
  - Marks in words and figures not tallying.
  - Wrong transference to marks from the answer book to award list.
  - Answer marked as correct (  $\checkmark$  ) but marks not awarded.
  - Half or part of answer marked correct (  $\checkmark$  ) and the rest as wrong (  $\times$  ) but no marks awarded.
16. Any unassessed portion, non carrying over of marks to the title page or totaling error detected by the candidate shall damage the prestige of all the personnel engaged in the evaluation work as also of the Board. Hence in order to uphold the prestige of all concerned, it is again reiterated that the instructions be followed meticulously and judiciously.




# MARKING SCHEME SET 55/1/2 (DELHI)

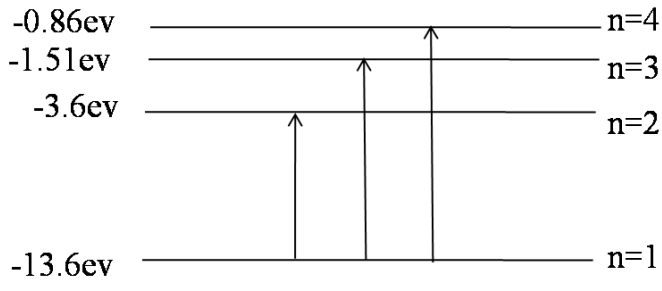
| Q.No. | Expected Answer/Value Points  | Marks                          | Total Marks |
|-------|---|--------------------------------|-------------|
| 1.    | Electrical conductivity is defined as current density per unit electric field<br>( <b>Alternatively</b> , Reciprocal of resistivity)<br>SI Unit : $\text{ohm}^{-1}\text{m}^{-1}$ ( any other correct SI unit)   | $\frac{1}{2}$<br>$\frac{1}{2}$ | 1           |
| 2.    | Modulation index $= \frac{a_m}{a_c}$<br>$= \frac{2}{5} = 0.4$   | $\frac{1}{2}$<br>$\frac{1}{2}$ | 1           |
| 3.    |    | 1                              | 1           |
| 4.    | 20cm  | 1                              | 1           |
| 5.    | If Electric field is not normal, it will have non-zero component along the surface. In that case, work would be done in moving a charge on an equipotential surface.  | 1                              | 1           |
| 6.    | $\vec{F} = q(\vec{v} \times \vec{B})$<br>Perpendicular to the plane formed by $\vec{v}$ and $\vec{B}$ / $\vec{F} \perp \vec{v}$ and $\vec{F} \perp \vec{B}$<br>[ <b>Note:</b> Give full credit for writing the expression.]   | $\frac{1}{2}$<br>$\frac{1}{2}$ | 1           |
| 7.    | X: Channel<br>It connects the Transmitter to the Receiver   | $\frac{1}{2}$<br>$\frac{1}{2}$ | 1           |
| 8.    | Glass.<br>In glass there is no effect of electromagnetic induction, due to presence of Earth's magnetic field, unlike in the case of metallic ball.   | $\frac{1}{2}$<br>$\frac{1}{2}$ | 1           |
| 9.    | <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> Effect on glow of bulb in      Part (i)                      1<br/>    Part (ii)                      1 </div> <div> (i)      Reactance of the capacitor will decrease, resulting in increase of the current in the circuit. Therefore the bulb will glow brighter.      1<br/> (ii)      Increased resistance will decrease the current in the circuit, which will decrease glow of the bulb.      1<br/> [<b>Note :</b> Do not deduct any mark for not giving the reasons] </div> | 1<br>1                         | 2           |



|                     | <p>(<b>Alternatively</b>, if a student writes the conditions given below, give full credit.)</p> <p>Condition for first minimum in single slit diffraction is , <math>\theta \approx \lambda / a</math>,<br/>Whereas in case of two narrow slits separated by distance a, first maximum occurs at angle <math>\theta \approx \lambda / a</math><br/>[<b>Note:</b> Award 1 mark even if the candidate attempts this question partly.]</p>  |             | 2 |                     |                             |       |  |        |  |   |   |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                |   |             |   |       |  |        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                   |
|---------------------|---|-------------|---|---------------------|-----------------------------|-------|--|--------|--|---|---|----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----------------|---|-------------|---|-------|--|--------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-------------------|
| 14.                 | <table><tr><td>Truth Table</td><td>1</td></tr><tr><td>Names of gates used</td><td><math>\frac{1}{2} + \frac{1}{2}</math></td></tr></table> <p><b>Truth Table</b></p> <table><tr><th colspan="2">Input</th><th colspan="2">Output</th></tr><tr><td>A</td><td>B</td><td>Y'</td><td>Y</td></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>1</td><td>1</td><td>1</td></tr></table> <p>Gate R: OR Gate<br/>S: AND Gate</p> <p style="text-align: center;"><b>OR</b></p> <table><tr><td>Identification</td><td>1</td></tr><tr><td>Truth Table</td><td>1</td></tr></table> <p>P: NAND Gate<br/>Q: OR Gate</p> <p><b>Truth Table</b></p> <table><tr><th colspan="2">Input</th><th>Output</th></tr><tr><td>A</td><td>B</td><td>X</td></tr><tr><td>0</td><td>0</td><td>1</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table> | Truth Table | 1 | Names of gates used | $\frac{1}{2} + \frac{1}{2}$ | Input |  | Output |  | A | B | Y' | Y | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | Identification | 1 | Truth Table | 1 | Input |  | Output | A | B | X | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | <p>1</p> <p><math>\frac{1}{2}</math><br/><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math><br/><math>\frac{1}{2}</math></p> <p>1</p> | <p>2</p> <p>2</p> |
| Truth Table         | 1   |             |   |                     |                             |       |  |        |  |   |   |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                |   |             |   |       |  |        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                   |
| Names of gates used | $\frac{1}{2} + \frac{1}{2}$   |             |   |                     |                             |       |  |        |  |   |   |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                |   |             |   |       |  |        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                   |
| Input               |   | Output      |   |                     |                             |       |  |        |  |   |   |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                |   |             |   |       |  |        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                   |
| A                   | B   | Y'          | Y |                     |                             |       |  |        |  |   |   |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                |   |             |   |       |  |        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                   |
| 0                   | 0   | 0           | 0 |                     |                             |       |  |        |  |   |   |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                |   |             |   |       |  |        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                   |
| 0                   | 1   | 1           | 0 |                     |                             |       |  |        |  |   |   |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                |   |             |   |       |  |        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                   |
| 1                   | 0   | 1           | 1 |                     |                             |       |  |        |  |   |   |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                |   |             |   |       |  |        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                   |
| 1                   | 1   | 1           | 1 |                     |                             |       |  |        |  |   |   |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                |   |             |   |       |  |        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                   |
| Identification      | 1   |             |   |                     |                             |       |  |        |  |   |   |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                |   |             |   |       |  |        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                   |
| Truth Table         | 1   |             |   |                     |                             |       |  |        |  |   |   |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                |   |             |   |       |  |        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                   |
| Input               |   | Output      |   |                     |                             |       |  |        |  |   |   |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                |   |             |   |       |  |        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                   |
| A                   | B   | X           |   |                     |                             |       |  |        |  |   |   |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                |   |             |   |       |  |        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                   |
| 0                   | 0   | 1           |   |                     |                             |       |  |        |  |   |   |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                |   |             |   |       |  |        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                   |
| 1                   | 0   | 1           |   |                     |                             |       |  |        |  |   |   |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                |   |             |   |       |  |        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                   |
| 0                   | 1   | 1           |   |                     |                             |       |  |        |  |   |   |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                |   |             |   |       |  |        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                   |
| 1                   | 1   | 1           |   |                     |                             |       |  |        |  |   |   |    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                |   |             |   |       |  |        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |                   |

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|-----|--|---------------|---|
| 15. | <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> Part (a) and its reason <span style="float: right;"><math>\frac{1}{2} + \frac{1}{2}</math></span><br/> Part (b) and its reason <span style="float: right;"><math>\frac{1}{2} + \frac{1}{2}</math></span> </div> <p>(a) Proton</p> $\lambda = \frac{h}{\sqrt{2mqV}}$ <p>as mass of proton &lt; mass of <math>\alpha</math> particle and <math>q_\alpha = 2q_p</math></p> <p><math>\Rightarrow \lambda_p &gt; \lambda_\alpha</math> for the same accelerating potential.</p> <p>(b) Alpha particle</p> <p>K.E. = qV</p> <p>We have <math>q_p &lt; q_\alpha</math></p> <p><math>\therefore</math> (For same accelerating potential) Kinetic energy of proton &lt; KE of <math>\alpha</math> particle</p>  | $\frac{1}{2}$ |   |
| 16. | <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> Finding flux in the two cases <span style="float: right;">1+1</span> </div> <p><math>\phi = EA \cos \theta</math></p> <p><math>= 2 \times 10^3 \times 4 \times 10^{-2} \cos 0^\circ</math></p> <p><math>= 80 \text{ NC}^{-1} \text{ m}^2</math></p> <p><math>\phi = 2 \times 10^3 \times 4 \times 10^{-2} \cos 60^\circ</math></p> <p><math>= 40 \text{ NC}^{-1} \text{ m}^2</math></p>  | $\frac{1}{2}$ | 2 |
| 17. | <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> Statements of two Laws <span style="float: right;"><math>\frac{1}{2} + \frac{1}{2}</math></span><br/> Justification <span style="float: right;"><math>\frac{1}{2} + \frac{1}{2}</math></span> </div> <p><b>Junction rule:</b> At any junction, the sum of the currents entering the junction is equal to the sum of currents leaving the junction.</p> <p><b>Alternatively,</b> <math>\sum i = 0</math></p> <p><b>Justification :</b> Conservation of charge</p> <p><b>Loop rule:</b> The Algebraic sum of changes in the potential around any closed loop involving resistors and cells in the loop is zero.</p> <p><b>Alternatively,</b> <math>\sum \Delta V = 0</math> , where <math>\Delta V</math> is the changes in potential</p> <p><b>Justification :</b> Conservation of energy</p> | $\frac{1}{2}$ | 2 |

|     |  |  |  |
|-----|--|--|--|
| 18. | <div data-bbox="240 199 1075 331" style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">           (a) Estimation of no. of photons per second <span style="float: right;">1</span><br/>           (b) Plot showing the variation <span style="float: right;">1</span> </div> <p>(a) Power = <math>n h \nu</math>, where n = no. of photons per second</p> $2.0 \times 10^{-3} = n \times 6.6 \times 10^{-34} \times 6 \times 10^{14}$ $n = \frac{2.0 \times 10^{-3}}{6.6 \times 10^{-34} \times 6 \times 10^{14}}$ $= 0.050 \times 10^{17} = 5 \times 10^{15} \text{ photons / second}$ <p>[<b>Note:</b> Even if the student doesn't write the formula but calculates correctly, give full credit to this part]</p> <p>(b)</p>  | <div style="text-align: center;">1/2</div> <div style="text-align: center;">1/2</div> <div style="text-align: center;">1</div> |  |
| 19. | <div data-bbox="240 1381 1221 1522" style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">           (a) Statement of Ampere's circuital Law <span style="float: right;">1 1/2</span><br/>           (b) Calculation of net magnetic field<br/>               (i) inside and (ii) outside <span style="float: right;">1 1/2</span> </div> <p>(a) Statement of law<br/>           Expression of the law in integral form:<br/> <math display="block">\oint \vec{B} \cdot d\vec{l} = \mu_0 i</math></p> <p>(Award 1 mark if the student just writes the integral form of Ampere's circuital law)</p> <p>(b) <math>B = \mu_0 n I</math></p>   | <div style="text-align: center;">1</div> <div style="text-align: center;">1/2</div> <div style="text-align: center;">1/2</div> |  |

|     |  |     |   |
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|     | <p>Magnitude of net magnetic field inside the combined system on the axis ,<br/> <math>B = B_1 - B_2</math><br/> <math>\Rightarrow B = \mu_0(n_1 - n_2) I</math></p> <p>Also accept if the student writes <math>B = \mu_0(n_2 - n_1) I</math></p>  | 1/2 |   |
|     | (iii) Outside the combined system, the net magnetic field is zero.   | 1/2 | 3 |
| 20. | <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>Finding maximum energy level of hydrogen atoms 1/2</p> <p>Calculation of wavelengths 2 1/2</p> </div> $\therefore E_n = \frac{-13.6}{n^2} \text{ eV}$ <p>Energy required to excite hydrogen atoms from ground state to excited states = <math>E_{\text{final}} - E_{\text{initial}}</math><br/> <math>= -0.85 - (-13.6) \text{ eV}</math><br/> <math>= +12.75 \text{ eV}</math></p> <p>hydrogen atoms would be excited upto energy level <math>n=4</math></p> <p>[Note : If the student writes gaseous hydrogen is made up of the molecule, or formula award this 1/2 mark.]</p> <p><b>Alternatively</b></p>  <p>For Paschen series</p> $\frac{1}{\lambda} = R \left[ \frac{1}{n_f^2} - \frac{1}{n_i^2} \right]$ $\frac{1}{\lambda} = 1.097 \times 10^7 \left[ \frac{1}{9} - \frac{1}{16} \right]$ $\frac{1}{\lambda} = 1.097 \times 10^7 \times \frac{7}{144}$ $\lambda = \frac{144}{7 \times 1.097 \times 10^7} = 1875 \text{ nm}$ <p>For Balmer series</p> | 1/2 |   |
|     |  | 1/2 |   |
|     |  | 1/2 |   |

$$\frac{1}{\lambda} = 1.097 \times 10^7 \left[ \frac{1}{4} - \frac{1}{9} \right]$$

$$\lambda = \frac{36}{5 \times 1.097 \times 10^7} = 656 \text{ nm}$$

**[Note : Also accept the answers given in terms of R only]**

 $\frac{1}{2}$  $\frac{1}{2}$ 

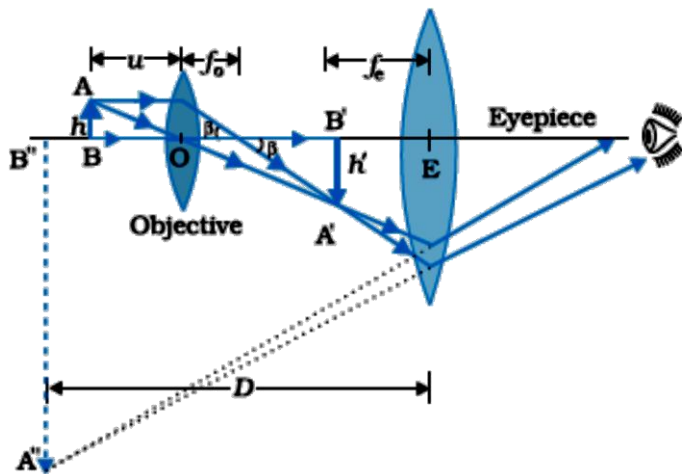
3

21.

### Ray diagram of compound microscope

 $1\frac{1}{2}$ 

### Calculation of focal length of objective and eyepiece

 $1\frac{1}{2}$ 

For eyepiece  $m_e = \frac{v_e}{u_e}$

$$u_e = \frac{v_e}{m_e} = \frac{-20}{5} \text{ cm} = -4 \text{ cm}$$

 $1\frac{1}{2}$  $\frac{1}{2}$ 

$$\text{Also, } \frac{1}{f_e} = \frac{1}{v_e} - \frac{1}{u_e}$$

$$\frac{1}{f_e} = \frac{-1}{20} + \frac{1}{4}$$

$$f_e = 5cm$$

 $\frac{1}{2}$ 

$$m = m_e \times m_0$$

$$-20 = 5 \times m_0 \Rightarrow m_0 = -4$$

Also  $|v_o| + |u_e| = 14$

$$\Rightarrow v_o = (14 - 4) \text{ cm} = 10 \text{ cm}$$

$$m_0 = 1 - \frac{v_o}{f_0} \Rightarrow -4 = 1 - \frac{10}{f_0}$$

|                                      |   |                                   |                              |                                      |      |                  |   |  |                         |   |  |   |
|--------------------------------------|---|-----------------------------------|------------------------------|--------------------------------------|------|------------------|---|--|-------------------------|---|--|---|
|                                      | $\Rightarrow f_o = 2\text{cm}$<br>where subscripts e and o are used for eyepiece and objective respectively.  | $\frac{1}{2}$                     | 3                            |                                      |      |                  |   |  |                         |   |  |   |
| 22.                                  | <table><tr><td>Part (a)</td><td>1</td></tr><tr><td>Part (b)</td><td>1</td></tr><tr><td>Part (c)</td><td>1</td></tr></table> <p>(a) X rays / <math>\gamma</math> rays<br/>Range: <math>10^{18}</math> to <math>10^{22}</math> Hz<br/>[<b>Note:</b> If the student correctly identifies the name of the em wave award full marks.]</p> <p>(b) It absorbs the ultraviolet radiations from the sun and prevents it from reaching the earth's surface.</p> <p>(c) Due to the large value of speed of light ; momentum transferred <math>p = \frac{u}{c}</math><br/>where u is the energy transferred and c is the speed of light.</p>  | Part (a)                          | 1                            | Part (b)                             | 1    | Part (c)         | 1 | $\frac{1}{2}$<br>$\frac{1}{2}$<br><br>1<br><br>1 | 3                       |   |  |   |
| Part (a)                             | 1   |                                   |                              |                                      |      |                  |   |  |                         |   |  |   |
| Part (b)                             | 1   |                                   |                              |                                      |      |                  |   |  |                         |   |  |   |
| Part (c)                             | 1   |                                   |                              |                                      |      |                  |   |  |                         |   |  |   |
| 23.                                  | <table><tr><td>(i)</td><td>Effect of em waves on health</td><td>1</td></tr><tr><td>(ii)</td><td>Values displayed</td><td>1</td></tr><tr><td>(iii)</td><td>Estimation of the range</td><td>1</td></tr></table> <p>(i) Electromagnetic radiations emitted by an antenna can cause<br/>(a) Cardiac problem<br/>(b) Cancer<br/>(c) Giddiness and headache<br/><b>( any one of the above / or any other effect on health)</b></p> <p>(ii) Scientific temperament, awareness (<b>any one / any other correct value</b>)</p> <p>(iii) Range = <math>\sqrt{2h_T R}</math><br/><math>= \sqrt{2 \times 20 \times 6.4 \times 10^6} \text{ km}</math><br/><math>= \sqrt{4 \times 64 \times 10^6} = 16 \text{ km}</math></p> | (i)                               | Effect of em waves on health | 1                                    | (ii) | Values displayed | 1 | (iii)  | Estimation of the range | 1 | 1<br>1<br><br>$\frac{1}{2}$<br><br>$\frac{1}{2}$ | 3 |
| (i)                                  | Effect of em waves on health  | 1                                 |                              |                                      |      |                  |   |  |                         |   |  |   |
| (ii)                                 | Values displayed  | 1                                 |                              |                                      |      |                  |   |  |                         |   |  |   |
| (iii)                                | Estimation of the range   | 1                                 |                              |                                      |      |                  |   |  |                         |   |  |   |
| 24.                                  | <table><tr><td>Calculation of potential gradient</td><td>2</td></tr><tr><td>Determination of emf of primary cell</td><td>1</td></tr></table> $I = \frac{V}{R+R'}$   | Calculation of potential gradient | 2                            | Determination of emf of primary cell | 1    | $\frac{1}{2}$    |   |  |                         |   |  |   |
| Calculation of potential gradient    | 2   |                                   |                              |                                      |      |                  |   |  |                         |   |  |   |
| Determination of emf of primary cell | 1   |                                   |                              |                                      |      |                  |   |  |                         |   |  |   |







$$W = \frac{1}{C} \left( \frac{q^2}{2} \right)_0^Q = \frac{Q^2}{2C}$$

This work is stored as electrostatic energy in the capacitor.

$$\because Q = CV, \quad \therefore U = \frac{1}{2} CV^2$$

$$\text{Energy stored per unit volume} = \frac{\frac{1}{2} CV^2}{Ad} = \frac{\frac{1}{2} \left( \frac{\epsilon_0 A}{d} \right) (Ed)^2}{Ad}$$

$$= \frac{1}{2} \epsilon_0 E^2$$

(b) Work done in moving the charge  $q$  from  $a$  to  $b$ , and from  $c$  to  $d$  is zero because Electric field is perpendicular to the displacement.

Work done from  $b$  to  $c$  = - Workdone from  $d$  to  $a$

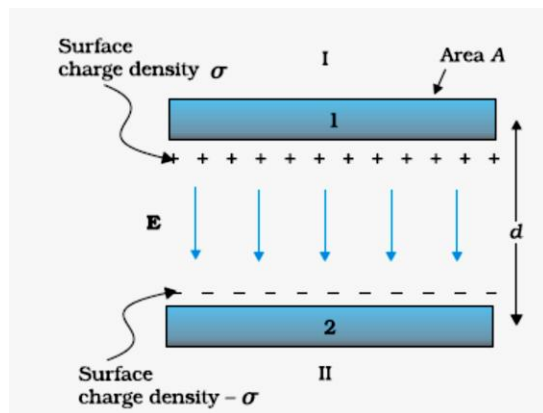
$\therefore$  Total work done in moving a charge  $q$  over a closed loop = 0

(Award this one mark if a student writes correct answer directly)

**OR**

- |   |   |
|---|---|
| (a) Derivation of capacitance of parallel plate capacitor | 2 |
| (b) Finding the Ratio of surface charge densities         | 1 |

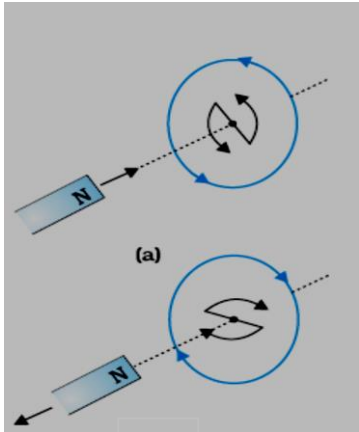
(a)



$$\text{Electric field between the plates of capacitor } E = \frac{\sigma}{\epsilon_0} = \frac{Q}{A\epsilon_0}$$

$\therefore$  potential difference

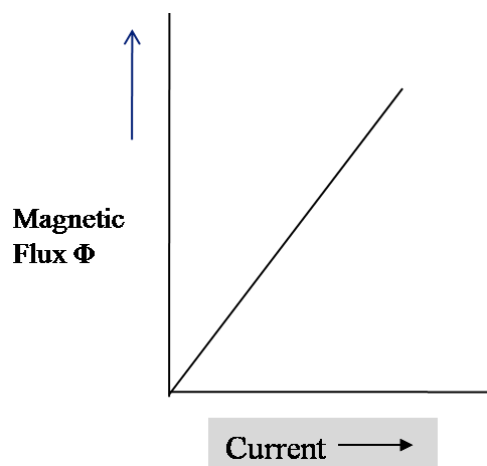
3

|     |   |   |   |
|-----|---|---|---|
|     | $V = Ed = \frac{Qd}{A\epsilon_0}$ <p>Capacitance</p> $C = \frac{Q}{V} = \frac{\epsilon_0 A}{d}$ <p>(b) When the two charged spherical conductors are connected by a conducting wire, they acquire the same potential<br/> i.e <math>\frac{Kq_1}{R_1} = \frac{Kq_2}{R_2} \Rightarrow \frac{q_1}{q_2} = \frac{R_1}{R_2}</math></p> <p>Hence, ratio of surface charge densities</p> $\frac{\sigma_1}{\sigma_2} = \frac{q_1/4\pi R_1^2}{q_2/4\pi R_2^2} = \frac{q_1 R_2^2}{q_2 R_1^2} = \frac{R_1}{R_2} \times \frac{R_2^2}{R_1^2} = \frac{R_2}{R_1}$ | <p>1/2</p> <p>1</p> <p>1/2</p> <p>1/2</p> | 3 |
| 28. | <div style="border: 1px solid black; padding: 5px;"> <p>(a) Description of an experiment/activity showing the polarity of emf induced 2</p> <p>(b) Plots showing variation of</p> <p>(i) Magnetic flux vs current 1</p> <p>(ii) Induced emf vs dI/dt 1</p> <p>(iii) Magnetic Potential energy vs current 1</p> </div> <p>(a)</p>  <p>(b)</p> <p>When a bar magnet is brought close to the coil (fig a), the approaching North Pole</p>                         | 1   |   |

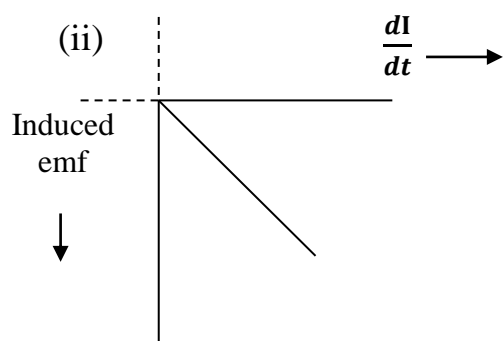
of the bar magnet increases the magnetic flux linked to it. This produces an induced emf which produces (or tends to produce, if the coil is open) an induced current in the anti-clockwise sense. The face of the coil, facing the approaching magnet, then has the same polarity as that of the approaching pole of the magnet. The induced current, therefore, is seen to oppose the change of magnetic flux that produces it. [Note: Give full credit to the candidate who explains this activity by considering the motion of the magnet away from the coil(Fig b) and says that the induced current is in clockwise sense.]

1

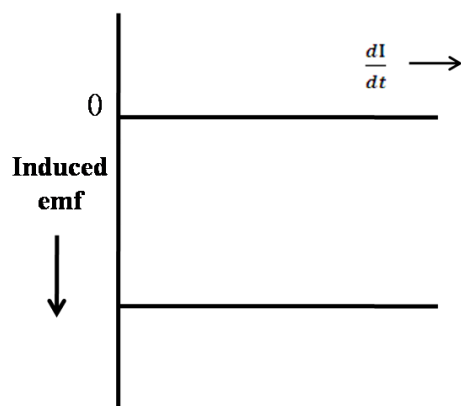
(b) (i) Magnetic flux versus current



1



Alternatively ,

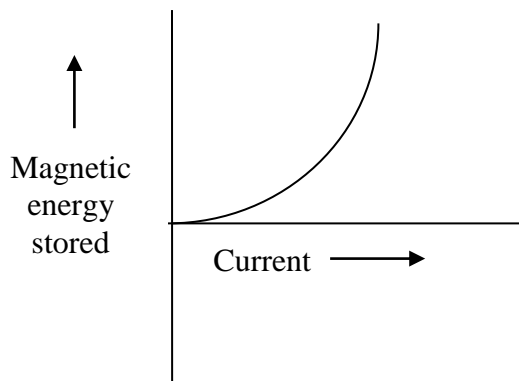


1

when I is increasing at constant value.

[**Note :** If the student draws induced emf vs  $\frac{dI}{dt}$  graph of any shape, while keeping induced emf -ve , award this 1 mark.]

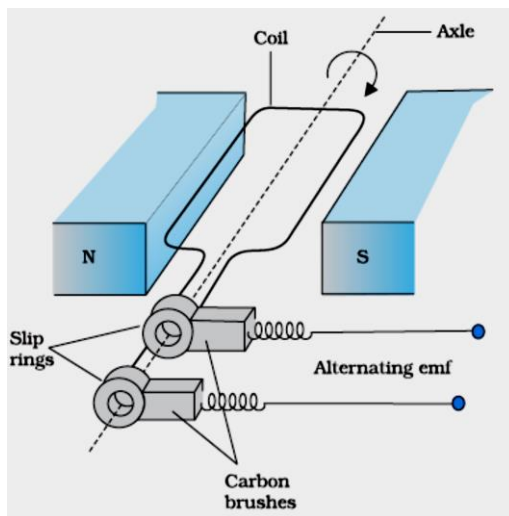
(iii) Magnetic energy stored



[**Note:** If a student writes only the mathematical formulae for these cases, award  $\frac{1}{2}$  mark for each case]

**OR**

|  |     |
|--|-----|
| (a) Schematic sketch of ac generator       | 1½  |
| Working principle                          | 1   |
| Plot of variation of (i) Magnetic flux and |     |
| (ii) alternating emf vs time               | 1+1 |
| (b) Need of choke coil                     | ½   |

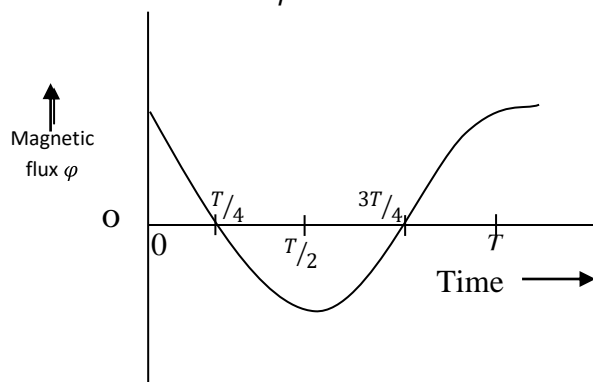


It works on the process of electromagnetic induction, i.e. when a coil rotates continuously in a magnetic field, the effective area of the coil, linked (normally)

with the magnetic field lines, changes continuously with time. This variation of magnetic flux with time results in the production of an (alternating) emf in the coil.

(1) Magnetic flux versus time

$$\phi = NBA \cos \omega t$$

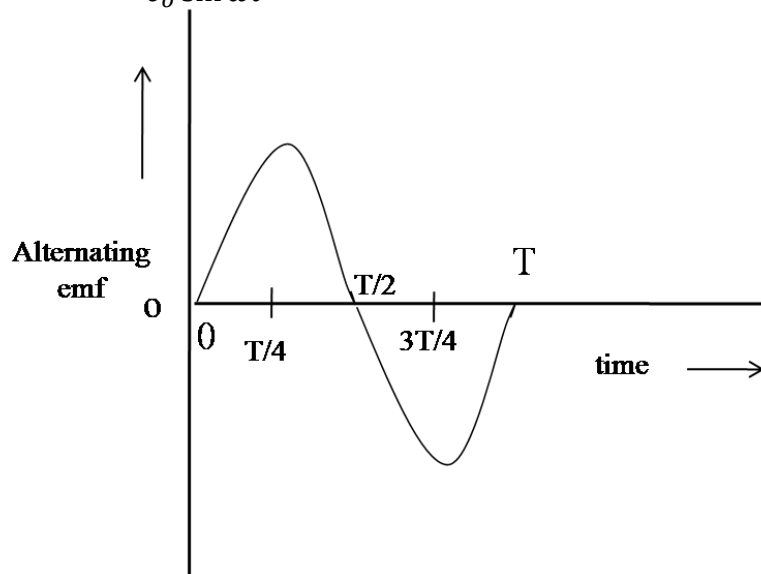


1

(2) Alternating emf versus time

$$e = NAB\omega \sin \omega t$$

$$= e_o \sin \omega t$$



1

[Note : Give credit of ½ mark for each case for writing the mathematical expressions without plotting the graphs.]

(b) A choke coil reduces the voltage across the fluorescent tube without wastage of power.

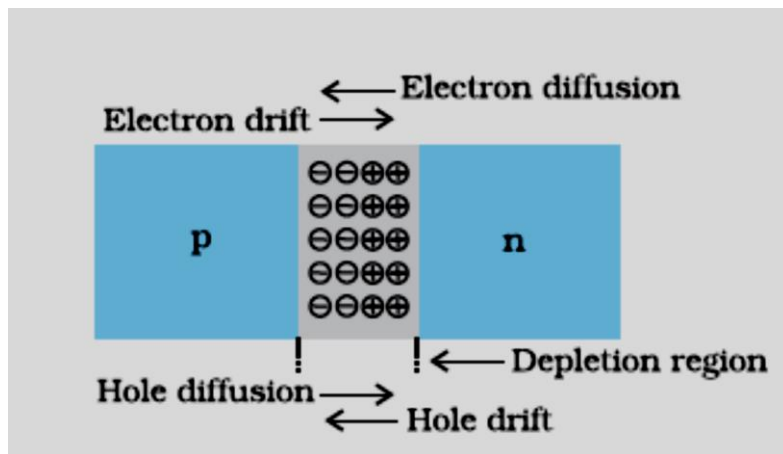
[Note : Award these ½ marks if the student gives any other significant reason.]

½

5

29.

- (a) Processes involved in the formation of depletion region 2  
 (b) Circuit diagrams  $\frac{1}{2} + \frac{1}{2}$   
 V-I characteristics in forward biasing and reverse biasing  $\frac{1}{2} + \frac{1}{2}$   
 Use of the characteristics in rectification 1

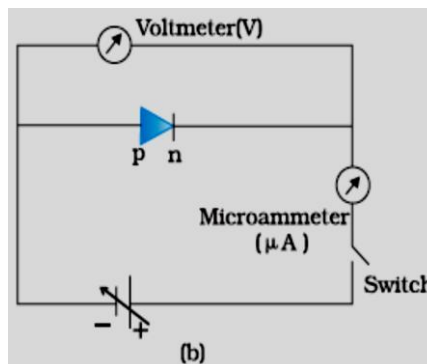
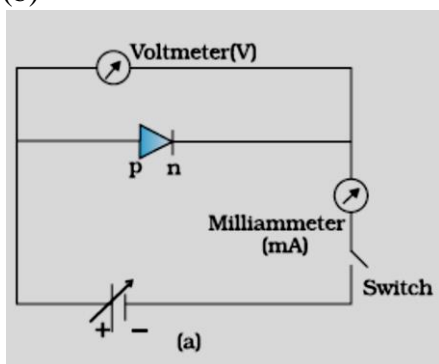


1

Two processes involved during the formation of p-n junction are diffusion and drift . Due to the concentration gradient, across p and n sides of the junction , holes diffuse from p  $\rightarrow$  n , and electrons from n  $\rightarrow$  p . This movement of charge carriers leaves behind ionised acceptors on the p-side and donors on the n- side of the junction . This space charge region on either side of the junction , together , is known as depletion region.

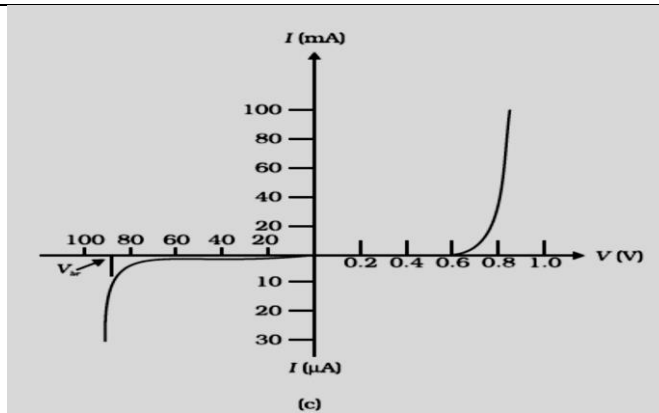
1

(b)

 $\frac{1}{2} + \frac{1}{2}$ 

Using the circuit arrangements shown in fig (a) and fig (b) , we study the variation of current with applied voltage to obtain the V-I characteristics shown below.





From the V-I characteristics of a junction diode . it is clear that it allows the current to pass only when it is forward biased. So when an alternatively voltage is applied across the diode , current flows only during that part of the cycle when it is forward biased.

**OR**

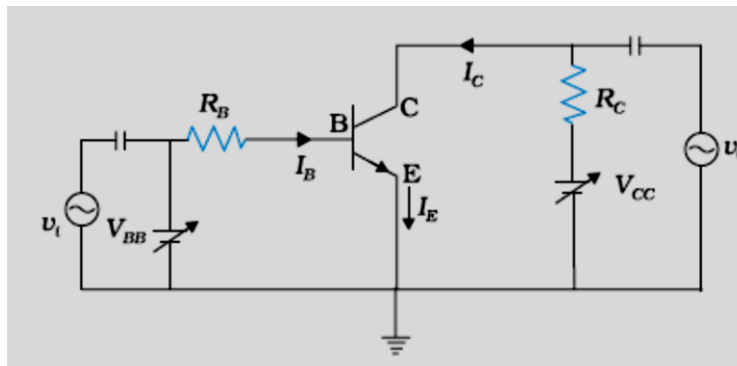
- |  |   |
|--|---|
| (a) Differences between three segments of a transistor   | $\frac{1}{2} + \frac{1}{2} + \frac{1}{2}$ |
| (b) Transistor biasing in active state   | $\frac{1}{2}$                             |
| (c) Circuit diagram of npn transistor in CE configuration for an amplifier and its brief description | $1\frac{1}{2} + 1$                        |
| Expression for the ac current gain   | $\frac{1}{2}$                             |

- (a) Emitter : It is of moderate size and heavily doped  
 Base : It is very thin and lightly doped  
 Collector : It is moderately doped and larger in size

- (b) Transistor is said to be in active state when its emitter-base junction is (suitably) forward biased and base-collector junction is (suitably ) reverse biased.

[**Note** : In the active region, the emitter-base voltage lies between nearly 0.6 volt and 1.0 volt.]

(c)

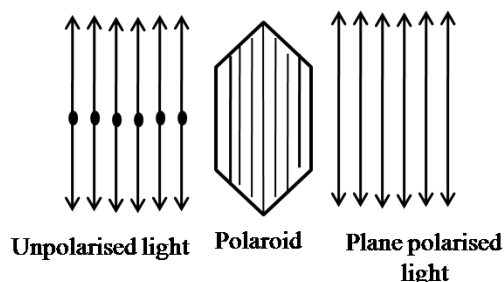


When a small sinusoidal voltage is superposed on the dc base bias , the base current will have sinusoidal variation superimposed on the value of  $I_B$

|    |   |  |   |
|----|---|--|---|
|    | As a consequence , the collector current also will have sinusoidal variations , superimposed on the value of $I_C$ , producing corresponding (amplified ) changes in the value of $V_0$ .<br>ac current gain $\beta_{ac} = \left( \frac{\Delta I_c}{\Delta I_b} \right)_{V_{CE}}$   | $\frac{1}{2}$  | 5 |
| 30 | <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>(a) (i) Reason 1</p> <p>(ii) Obtaining expression for the resultant intensity 2</p> <p>(b) Finding the intensity of light at a required point 2</p> </div> <p>(a) Light waves, originating from two independent monochromatic sources, will not have a constant phase difference. Therefore, these sources will not be coherent and, therefore, would not produce a sustained interference pattern.</p> <p>(b) (i) <math>y = y_1 + y_2</math><br/> <math>= a \cos \omega t + a \cos(\omega t + \phi)</math><br/> <math>= 2a \cos \frac{\phi}{2} \cdot \cos(\omega t + \frac{\phi}{2})</math><br/> Amplitude of resultant displacement is <math>2a \cos \frac{\phi}{2}</math><br/> <math>\therefore</math> Intensity ,<br/> <math>I = 4 a^2 \cos^2 \frac{\phi}{2}</math></p> <p><b>Note :</b> Accept , if a student derives the expression<br/> <math>I = C [a_1^2 + a_2^2 + 2a_1 a_2 \cos \phi]</math> where ‘a’ is the amplitude of the monochromatic light.</p> <p>(ii) A path difference of <math>\lambda</math> , corresponds to a phase difference of <math>2\pi</math><br/> <math>\therefore</math> The intensity, <math>K = 4a^2 \Rightarrow a^2 = \frac{K}{4}</math><br/> A path difference of <math>\frac{\lambda}{3}</math> , corresponds to a phase difference of <math>\frac{2\pi}{3}</math><br/> <math>\therefore</math> Intensity = <math>4 \times \frac{K}{4} \cdot \cos^2 \frac{2\pi}{3} = \frac{K}{4}</math></p> <p style="text-align: center;"><b>OR</b></p> | <p>1</p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> <p><math>\frac{1}{2}</math></p> | 5 |

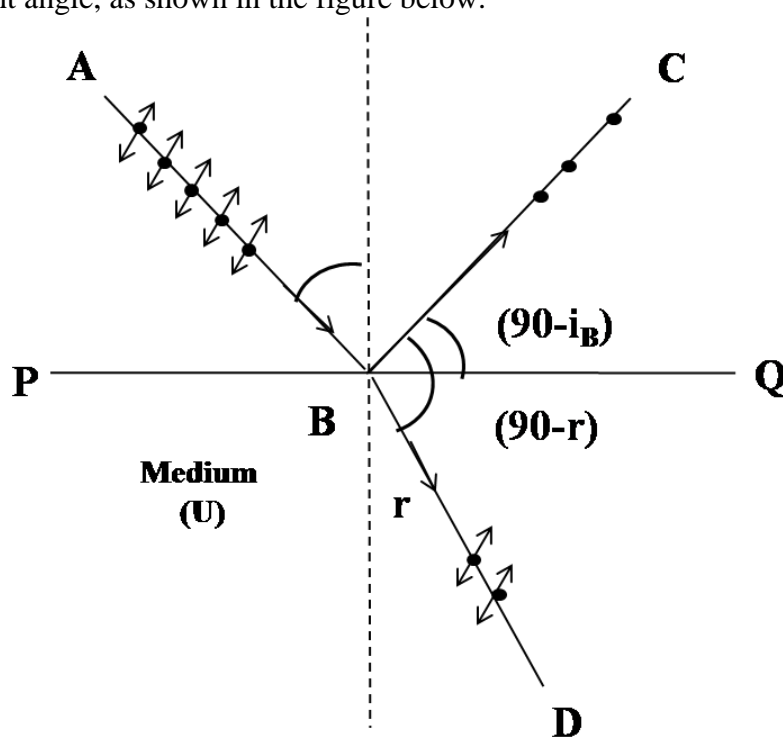
- |  |   |
|--|---|
| (a) Demonstration of polarisation by a polaroid            | 2 |
| (b) Showing polarisation by reflection at $\mu = \tan i_B$ | 3 |

(a)



The components of electric vector associated with light wave, along the direction of aligned molecules of a polaroid, get absorbed. As a result after passing through it, the components perpendicular to the direction of aligned molecules will be obtained in the form of plane polarised light.

- (b) When unpolarised light is incident on the boundary between two transparent media, the reflected light is polarised, with electric vector perpendicular to the plane of incidence when the reflected and refracted light rays make a right angle, as shown in the figure below.



Since ,  $\angle CBQ + \angle QBD = 90^\circ$

|  |   |   |   |
|--|---|---|---|
|  | $(90 - \iota_B) + (90 - r) = 90^0$ $\iota_B + r = 90^0$ $r = 90 - \iota_B$ <p>Using Snell's law,</p> $\mu = \frac{\sin \iota_B}{\sin r}$ $= \frac{\sin \iota_B}{\sin(90 - \iota_B)}$ $= \frac{\sin \iota_B}{\cos \iota_B}$ $\mu = \tan \iota_B$ | $\frac{1}{2}$<br><br>$\frac{1}{2}$<br><br>$\frac{1}{2}$ | 5 |
|--|---|---|---|