QB365 - Question Bank Software

Series OSR/1/C

कोड नं.
Code No. **55/1/2**

रोल नं.
Roll No.

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 **16** 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 जाएगा । 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 **16** 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 घण्टे | *अधिकतम अंक : 70*

Time allowed : 3 hours | *Maximum Marks : 70*

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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 और प्रश्न **28** से **30** में प्रत्येक प्रश्न **पाँच** अंक का है ।

(iv) तीन अंकों वाले प्रश्नों में से एक मूल्यपरक 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 दिए गए चयन 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 :

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

$$h = 6{\cdot}63 \times 10^{-34} \text{ Js}$$

$$e = 1{\cdot}6 \times 10^{-19} \text{ C}$$

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

$$\frac{1}{4\pi\varepsilon_o} = 9 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$$

$$m_e = 9{\cdot}1 \times 10^{-31} \text{ kg}$$

General Instructions :

(i) *All questions are compulsory.*

(ii) *There are **30** questions in total. Questions No. **1** to **8** are very short answer type questions and carry **one** mark each.*

(iii) *Questions No. **9** to **18** carry **two** marks each, questions **19** to **27** carry **three** marks each and questions **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.*

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(vii) *You may use the following values of physical constants wherever necessary :*

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

$h = 6{\cdot}63 \times 10^{-34}$ Js

$e = 1{\cdot}6 \times 10^{-19}$ C

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

$$\frac{1}{4\pi\varepsilon_o} = 9 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$$

$m_e = 9{\cdot}1 \times 10^{-31}$ kg

1. विभवमापी (पोटेन्शियोमीटर) किस सिद्धान्त पर आधारित है ? उल्लेख कीजिए । *1*

State the underlying principle of a potentiometer.

2. उच्च आवृत्ति की प्रत्यावर्ती धारावाही किसी कुंडली से घिरा हुआ धातु का टुकड़ा गर्म क्यों हो जाता है ? *1*

A metallic piece gets hot when surrounded by a coil carrying high frequency alternating current. Why ?

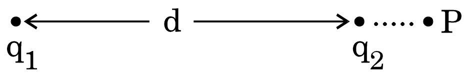
3. किसी रेखीय ऐंटीना से विकिरित प्रभावी शक्ति, प्रेषित किए गए संकेतों (सिग्नलों) की तरंगदैर्घ्य पर किस प्रकार निर्भर करती है ? *1*

How does the effective power radiated from a linear antenna depend on the wavelength of the signal to be transmitted ?

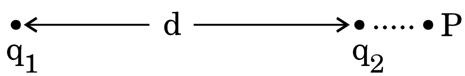
4. संचार व्यवस्था में प्रयुक्त प्रेषित्र (ट्रांसमिटर) का एक ब्लॉक आरेख बनाइए । *1*

Draw a block diagram of a transmitter used in communication system.

5. आरेख में दर्शाए गए अनुसार दो बिन्दु आवेश 'q_1' तथा 'q_2' एक-दूसरे से 'd' दूरी पर स्थित हैं । इनको जोड़ने वाली सरल रेखा पर स्थित एक बिन्दु 'P' पर विद्युत्-क्षेत्र की तीव्रता शून्य है । इससे आप जो दो निष्कर्ष निकाल सकते हैं, उनका उल्लेख कीजिए । *1*



Two point charges 'q_1' and 'q_2' are placed at a distance 'd' apart as shown in the figure. The electric field intensity is zero at a point 'P' on the line joining them as shown. Write two conclusions that you can draw from this.



6. यंग के द्विझिरी प्रयोग में व्यतिकरण पैटर्न उत्पन्न करने के लिए आवश्यक 'कला-संबद्ध स्रोतों' को परिभाषित कीजिए । *1*

Define the term 'coherent sources' which are required to produce interference pattern in Young's double slit experiment.

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7. किसी पदार्थ की आपेक्षिक पारगम्यता (चुम्बकशीलता), μ_r = 400 है । यह किस प्रकृति का चुम्बकीय पदार्थ है ? *1*

Relative permeability of a material, μ_r = 400. Identify the nature of the magnetic material.

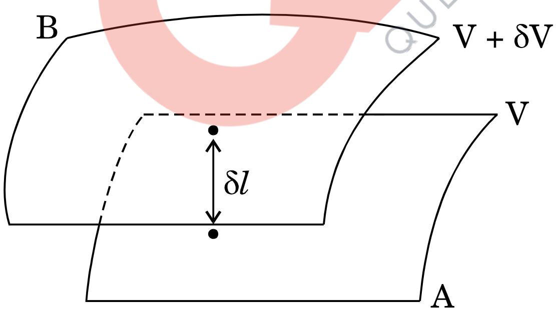
8. किसी चालक के सिरों पर एक विभवान्तर अनुप्रयुक्त किया (लगाया) जाए, तो उसमें मुक्त इलेक्ट्रॉनों की यादृच्छिक गति पर क्या प्रभाव पड़ता है ? *1*

How does the random motion of free electrons in a conductor get affected when a potential difference is applied across its ends ?

9. दो बिन्दु आवेश q_1 तथा q_2 किसी बाह्य विद्युत्-क्षेत्र $\vec{E}$ में क्रमशः $\vec{r}_1$ तथा $\vec{r}_2$ पर स्थित हैं । इस विन्यास को प्राप्त करने के लिए आवश्यक कुल कार्य के लिए एक व्यंजक प्राप्त कीजिए । *2*

अथवा

दो निकटस्थ समविभव पृष्ठों A और B के विभव V तथा V + δV हैं (जहाँ δV, V में परिवर्तन है), इन्हें चित्र में दर्शाए गए अनुसार एक-दूसरे से δl दूरी पर रखा गया है । इनके बीच विद्युत्-क्षेत्र तथा विभव प्रवणता के लिए संबंध व्युत्पन्न कीजिए । विद्युत्-क्षेत्र तथा विद्युत् विभवों के बीच सम्बन्ध के बारे में दो महत्त्वपूर्ण निष्कर्षों का उल्लेख कीजिए । *2*



Two point charges q_1 and q_2 are located at $\vec{r}_1$ and $\vec{r}_2$ respectively in an external electric field $\vec{E}$. Obtain the expression for the total work done in assembling this configuration.

OR

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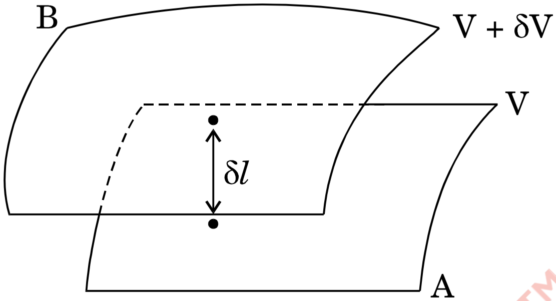
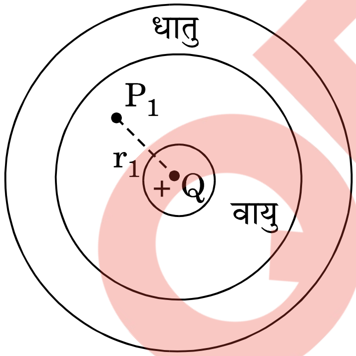
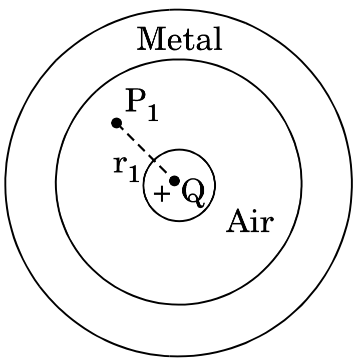
Two closely spaced equipotential surfaces A and B with potentials V and V + δV, (where δV is the change in V), are kept δl distance apart as shown in the figure. Deduce the relation between the electric field and the potential gradient between them. Write the two important conclusions concerning the relation between the electric field and electric potentials.



10. धातु के एक छोटे गोले पर +Q आवेश है । इसे किसी बड़े, धातु के गोलाकार कोश (शैल) की, गोलीय कोटर (कैविटी) के केन्द्र पर रखा गया है । गोलाकार कोश पर कोई आवेश नहीं है । गोलाकार कोश की बाह्य (बाहरी) तथा भीतरी पृष्ठों पर आवेश के बारे में लिखिए । बिन्दु P_1 पर विद्युत्-क्षेत्र के लिए व्यंजक लिखिए । 2



A small metal sphere carrying charge +Q is located at the centre of a spherical cavity in a large uncharged metallic spherical shell. Write the charges on the inner and outer surfaces of the shell. Write the expression for the electric field at the point P_1.



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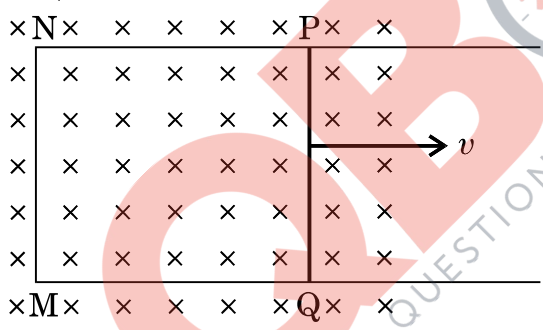
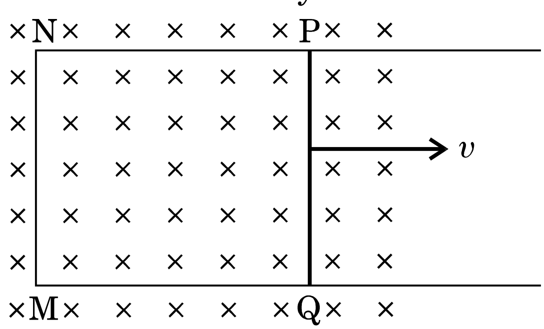
11. एक आयताकार कुण्डली, जिसकी लम्बाई 'l' तथा चौड़ाई 'b' है, से I धारा प्रवाहित हो रही है । इसको एक एकसमान चुम्बकीय क्षेत्र $\vec{B}$ में रखा गया है । चुम्बकीय क्षेत्र की दिशा, कुण्डली के तल के लम्बवत् है । कुण्डली पर लगने वाले बल-आघूर्ण के लिए व्यंजक प्राप्त कीजिए । *2*

A rectangular coil of sides 'l' and 'b' carrying a current I is subjected to a uniform magnetic field $\vec{B}$ acting perpendicular to its plane. Obtain the expression for the torque acting on it.

12. एक आयताकार पाश (लूप) PQMN की भुजा PQ को आगे-पीछे खिसकाया जा सकता है । PQ की लम्बाई 20 cm है तथा इसका प्रतिरोध 5 Ω है । इसको आरेख में दर्शाए गए अनुसार एक एकसमान चुम्बकीय क्षेत्र में रखा गया है । इस चुम्बकीय क्षेत्र की तीव्रता 0·2 T है तथा इसकी दिशा पाश (लूप) के समतल के लम्बवत् है । MN, NP तथा MQ भुजाओं के प्रतिरोध नगण्य हैं । भुजा PQ को 15 m/s के वेग से बाहर निकालने पर (i) भुजा PQ के सिरों के बीच प्रेरित विद्युत्-वाहक बल तथा (ii) पाश में बहने वाली प्रेरित विद्युत् धारा का परिकलन कीजिए । *2*



A rectangular loop PQMN with movable arm PQ of length 20 cm and resistance 5 Ω is placed in a uniform magnetic field of 0·2 T acting perpendicular to the plane of the loop as is shown in the figure. The resistances of the arms MN, NP and MQ are negligible. Calculate the (i) emf induced in the arm PQ and (ii) current induced in the loop when arm PQ is moved with velocity 15 m/s.



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13. एक लम्बी परिनालिका से प्रवाहित विद्युत् धारा के कारण उत्पन्न, चुम्बकीय क्षेत्र रेखाओं को दर्शाइए । यदि इसमें I धारा प्रवाहित हो रही हो और इसकी प्रति इकाई लम्बाई में फेरों की संख्या n हो, तो ऐम्पियर के परिपथीय नियम के उपयोग द्वारा, इस धारा के कारण चुम्बकीय क्षेत्र के लिए एक व्यंजक प्राप्त कीजिए । *2*

Draw the magnetic field lines due to a current passing through a long solenoid. Use Ampere's circuital law, to obtain the expression for the magnetic field due to the current I in a long solenoid having n number of turns per unit length.

14. किसी प्रकाश-संवेदी पृष्ठ पर एक्स-किरणों के आपतन से प्रकाश-विद्युत् उत्सर्जन हो रहा है । इस पृष्ठ के कार्य-फलन को नगण्य मानते हुए, आपतित फोटॉनों की ऊर्जा (E_v) तथा उत्सर्जित इलेक्ट्रॉनों की दे-ब्रॉग्ली तरंगदैर्ध्य (λ) के बीच संबंध ज्ञात कीजिए । E_v के फलन के रूप में λ के लिए ग्राफ (आलेख) की प्रकृति को दर्शाइए । *2*

X-rays fall on a photosensitive surface to cause photoelectric emission. Assuming that the work function of the surface can be neglected, find the relation between the de-Broglie wavelength (λ) of the electrons emitted to the energy (E_v) of the incident photons. Draw the nature of the graph for λ as a function of E_v.

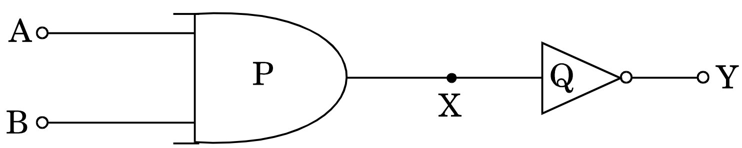
15. ताप में वृद्धि के साथ (i) किसी चालक तथा (ii) किसी अर्धचालक की प्रतिरोधकता में परिवर्तन को दर्शाने के लिए एक ग्राफ (आलेख) बनाइए ।

इनके इस व्यवहार को आवेश वाहकों के संख्या घनत्व तथा विश्रांति काल के पदों में कैसे स्पष्ट किया जाता है ? *2*

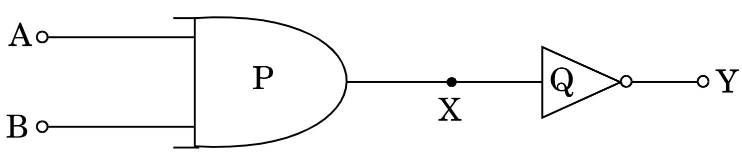
Draw a plot showing the variation of resistivity of a (i) conductor and (ii) semiconductor, with the increase in temperature.

How does one explain this behaviour in terms of number density of charge carriers and the relaxation time ?

16. यहाँ दिए गए तर्क परिपथ आरेख में 'P' तथा 'Q' गेटों के नाम लिखिए । इनके संयोजन के तुल्य गेट को पहचान कर उसका नाम लिखिए और संयोजन गेट की सत्यमान सारणी बनाइए । *2*



Name the gates 'P' and 'Q' shown in the figure of logic circuit given below. Write the truth table for the combination of the gates and identify the equivalent gate.



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17. अपवर्ती दूरदर्शक का एक व्यवस्था आरेख बनाइए । इसकी दो मुख्य कमियाँ (सीमाएँ) लिखिए । *2*

Draw a schematic diagram of a refracting telescope. Write its two important limitations.

18. दो एकवर्णी विकिरणों की आवृत्तियाँ क्रमशः ν_1 तथा ν_2 ($\nu_1 > \nu_2$) हैं । इनकी तीव्रताएँ आपस में समान हैं । ये विकिरण किसी प्रकाश-संवेदी पृष्ठ पर बारी-बारी से आपतित होकर प्रकाश-विद्युत् उत्सर्जन करते हैं । कारण सहित स्पष्ट कीजिए कि, किस दशा में (i) अधिक संख्या में इलेक्ट्रॉनों का उत्सर्जन होगा तथा (ii) उत्सर्जित प्रकाश-इलेक्ट्रॉनों की अधिकतम गतिज ऊर्जा अधिक होगी । *2*

Two monochromatic radiations of frequencies ν_1 and ν_2 ($\nu_1 > \nu_2$) and having the same intensity are, in turn, incident on a photosensitive surface to cause photoelectric emission. Explain, giving reason, in which case (i) more number of electrons will be emitted and (ii) maximum kinetic energy of the emitted photoelectrons will be more.

19. एक आवेशित कण जिसका द्रव्यमान 'm' है और जिस पर 'q' आवेश है, किसी चुम्बकीय क्षेत्र $\vec{B}$ में $\vec{v}$ वेग से गति कर रहा है ।

(a) यदि $\vec{v}$ चुम्बकीय क्षेत्र $\vec{B}$ के लम्बवत् है, तो दर्शाइए कि यह कण एक वृत्ताकार पथ पर गति करेगा, जिसकी कोणीय आवृत्ति, $\omega = qB/m$ होगी ।

(b) यदि वेग $\vec{v}$ का चुम्बकीय क्षेत्र $\vec{B}$ की दिशा के समान्तर कोई घटक हो, तो कण द्वारा चलित पथ का अनुरेखण कीजिए । अपने उत्तर की पुष्टि कीजिए । *3*

अथवा

चल कुंडली धारामापी का एक व्यवस्था आरेख बनाइए और इसकी कार्यविधि का संक्षिप्त वर्णन कीजिए ।

"गैल्वैनोमीटर (धारामापी) की धारा सुग्राहिता में वृद्धि से उसकी वोल्टता सुग्राहिता में भी वृद्धि का होना आवश्यक नहीं है ।" इस कथन की पुष्टि में कारण लिखिए । *3*

Consider the motion of a charged particle of mass 'm' and charge 'q' moving with velocity $\vec{v}$ in a magnetic field $\vec{B}$.

(a) If $\vec{v}$ is perpendicular to $\vec{B}$, show that its describes a circular path having angular frequency $\omega = qB/m$.

(b) If the velocity $\vec{v}$ has a component parallel to the magnetic field $\vec{B}$, trace the path described by the particle. Justify your answer.

OR

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Draw a schematic sketch of a moving coil galvanometer and describe briefly its working.

"Increasing the current sensitivity of a galvanometer does not necessarily increase the voltage sensitivity." Justify this statement.

20. अनुज की माताजी के सिर में लगातार दर्द (पीड़ा) हो रहा था । डॉक्टरी परीक्षण से उनके सिर में ट्यूमर होने का पता चला । अनुज ने देखा कि उनके घर के पास ही एक दूरसंचार टावर है । उसने डॉक्टर से पूछा कि क्या टावर से निकले विकिरण इस ट्यूमर का कारण हो सकते हैं ? डॉक्टर द्वारा सहमति के पश्चात्, उसने पुलिस से शिकायत की और वह टावर को आवासीय कॉलोनी से दूर हटवाने में सफल हो गया ।

निम्नांकित प्रश्नों के उत्तर दीजिए :

(i) अनुज ने किन मूल्यों का प्रदर्शन किया ?

(ii) अनुज ने अंदाज लगाया कि ऐंटीना की भू-तल से ऊँचाई लगभग 20 m थी । परिकलन कीजिए कि इस टावर से विकिरण अधिकतम कितनी दूरी तक पहुँच सकते हैं । पृथ्वी की त्रिज्या का मान 6400×10^3 m प्रयोग कीजिए । *3*

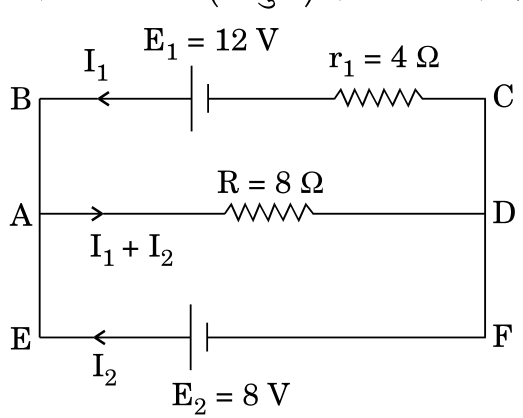
Anuj's mother was having constant headaches. After a medical check-up, she was diagnosed with tumour. Anuj realized there was a telecommunication tower very close to their house. He enquired from the doctor if the radiation from the tower could have caused the tumour. As the doctor supported his anxiety, he lodged a complaint with the police and ultimately succeeded in getting the tower removed to a distant place away from the residential colony.

Answer the following :

(i) What values were displayed by Anuj ?

(ii) Anuj made a rough estimate about the height of the antenna to be about 20 m from the ground. Calculate the maximum distance upto which radiations from the tower are likely to reach. Use the value of radius of the Earth = 6400×10^3 m.

21. आरेख में दर्शाए गए विद्युत् नेटवर्क (परिपथ जाल) में किरखोफ़ के नियमों के उपयोग द्वारा $R = 8\ \Omega$ प्रतिरोध में व्ययित (उपभुक्त) शक्ति का परिकलन कीजिए । *3*



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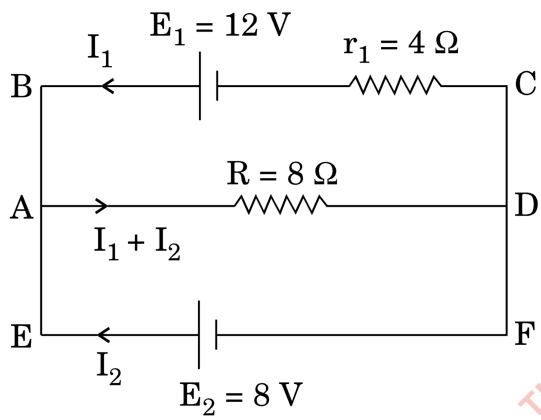
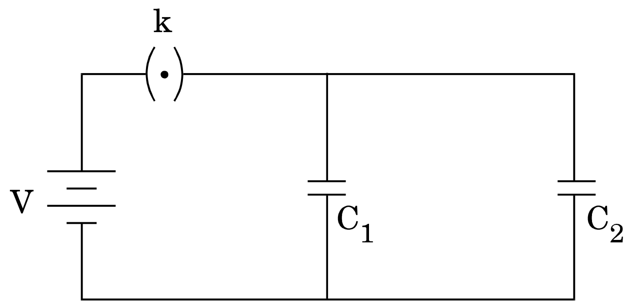
In the electric network shown in the figure use Kirchhoff's rules to calculate the power consumed by the resistance R = 8 Ω.



22. दो समान्तर प्लेट (पट्टिका) संधारित्रों की धारिताएँ C_1 तथा C_2 हैं, जहाँ $C_1 = (C_2)/2$ । इनको आरेख में दर्शाए गए अनुसार एक V वोल्ट की बैटरी से जोड़ा गया है । प्रारंभ में कुंजी (की) k, को बन्द किया जाता है, ताकि दोनों संधारित्र पूर्णतः आवेशित हो सकें । फिर, कुंजी (k) को खोल दिया जाता है और दोनों संधारित्रों की पट्टिकाओं के बीच के स्थान को एक परावैद्युत पदार्थ की पट्टी से पूरा भर दिया जाता है । यदि इस पट्टी का परावैद्युतांक 'K' हो, तो कुंजी खोलने से पहले और खोलने के बाद संयोजन की (i) प्रभावी धारिता और (ii) प्रभावी संचित ऊर्जाओं का अनुपात ज्ञात कीजिए । *3*



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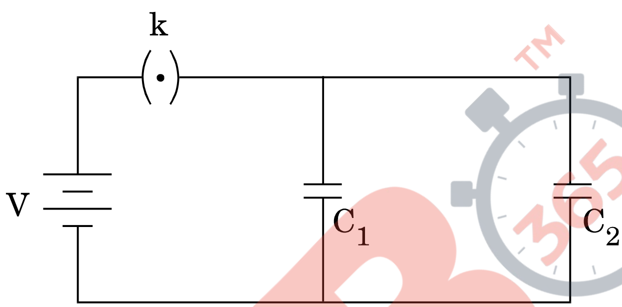
Two parallel plate capacitors of capacitances C_1 and C_2 such that $C_1 = (C_2)/2$ are connected across a battery of V volts as shown in the figure. Initially the key (k) is kept closed to fully charge the capacitors. The key is now thrown open and a dielectric slab of dielectric constant 'K' is inserted in the two capacitors to completely fill the gap between the plates. Find the ratio of (i) the net capacitance and (ii) the energies stored in the combination, before and after the introduction of the dielectric slab.



23. (a) हाइड्रोजन परमाणु में अन्तरतम इलेक्ट्रॉन कक्षा की त्रिज्या $5{\cdot}3 \times 10^{-11}$ m है । n = 2 कक्षा में इसकी त्रिज्या का परिकलन कीजिए ।

(b) हाइड्रोजन परमाणु की द्वितीय उत्तेजित अवस्था में, इलेक्ट्रॉन की कुल ऊर्जा $-1{\cdot}51$ eV है । ज्ञात कीजिए इसकी – इसी अवस्था में, (i) गतिज ऊर्जा तथा (ii) स्थितिज ऊर्जा । *3*

(a) The radius of the innermost electron orbit of a hydrogen atom is $5{\cdot}3 \times 10^{-11}$ m. Calculate its radius in n = 2 orbit.

(b) The total energy of an electron in the second excited state of the hydrogen atom is $-1{\cdot}51$ eV. Find out its (i) kinetic energy and (ii) potential energy in this state.

24. (a) ${}^{A}_{Z}M$ द्रव्यमान, परमाणु क्रमांक (Z) तथा द्रव्यमान संख्या (A), के एक नाभिक की बंधन ऊर्जा (MeV में) के लिए एक संबंध (व्यंजक) उसके घटकों — न्यूट्रॉन तथा प्रोटॉन के द्रव्यमानों के पदों में लिखिए ।

(b) BE/A तथा द्रव्यमान संख्या A के बीच एक ग्राफ़ (आलेख), $2 \le A \le 170$, सीमा के लिए बनाइए । इस ग्राफ का उपयोग, दो हल्के नाभिकों के नाभिकीय संलयन के प्रक्रम में, ऊर्जा के विमोचन की व्याख्या करने में कीजिए । *3*

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(a) Write the relation for binding energy (BE) (in MeV) of a nucleus of mass ${}^{A}_{Z}M$, atomic number (Z) and mass number (A) in terms of the masses of its constituents — neutrons and protons.

(b) Draw a plot of BE/A versus mass number A for $2 \le A \le 170$. Use this graph to explain the release of energy in the process of nuclear fusion of two light nuclei.

25. एकवर्णी प्रकाश की एक समान्तर किरण पुंज, 'a' चौड़ाई की पतली झिरी (स्लिट) पर लम्बवत् टकराकर, झिरी के समतल के समान्तर रखे एक पर्दे पर, विवर्तन पैटर्न बनाती है । हाइगेन्स के सिद्धान्त के उपयोग द्वारा स्पष्ट कीजिए कि

(i) केन्द्रीय दीप्त उच्चिष्ठ की चौड़ाई, अन्य उच्चिष्ठों से दुगुनी होती है ।

(ii) केन्द्र से दूर दोनों ओर के उच्चिष्ठों की तीव्रता में निरन्तर कमी होती जाती है । *3*

A parallel beam of monochromatic light falls normally on a narrow slit of width 'a' to produce a diffraction pattern on the screen placed parallel to the plane of the slit. Use Huygens' principle to explain that

(i) the central bright maxima is twice as wide as the other maxima.

(ii) the intensity falls as we move to successive maxima away from the centre on either side.

26. निम्नांकित प्रश्नों के उत्तर दीजिए : *3*

(i) एक सरल उदाहरण द्वारा दर्शाइए कि विद्युत्-चुम्बकीय तरंगें ऊर्जा तथा संवेग की वाहक कैसे होती हैं ।

(ii) सूक्ष्मतरंगें कैसे उत्पन्न होती हैं ? माइक्रोवेव चूल्हों (ऑवन) में आवृत्तियों का चयन इस प्रकार करना आवश्यक क्यों है कि वह जल के अणुओं की अनुनाद-आवृत्ति से मेल (सुमेलित हो) खा जाएँ ?

(iii) अवरक्त किरणों के दो प्रमुख उपयोग क्या हैं ?

Answer the following questions :

(i) Show, by giving a simple example, how em waves carry energy and momentum.

(ii) How are microwaves produced ? Why is it necessary in microwave ovens to select the frequency of microwaves to match the resonant frequency of water molecules ?

(iii) Write two important uses of infra-red waves.

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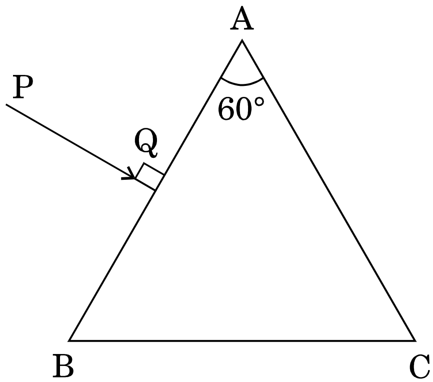
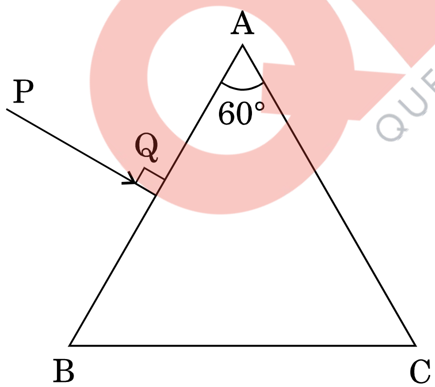
27. प्रकाश की एक किरण PQ, किसी पारदर्शी पदार्थ के बने त्रिभुजाकार प्रिज़्म के फलक AB पर आरेख में दर्शाए गए अनुसार आपतित होती है । प्रिज़्म का अपवर्तक कोण 60° है और इसके पदार्थ का अपवर्तनांक $2/\sqrt{3}$ है । प्रिज़्म से गुज़रते हुए इस किरण के पथ का अनुरेखण कीजिए । निर्गत कोण तथा विचलन कोण के मान का भी परिकलन कीजिए । *3*



A ray PQ is incident normally on the face AB of a triangular prism of refracting angle of 60°, made of a transparent material of refractive index $2/\sqrt{3}$, as shown in the figure. Trace the path of the ray as it passes through the prism. Also calculate the angle of emergence and angle of deviation.



28. (a) एक आरेख की सहायता से दर्शाइए कि संधि-डायोड में ह्रासी परत तथा रोधिका विभव कैसे बनते हैं ।

(b) पूर्ण-तरंग दिष्टकारी का परिपथ आरेख बनाइए । इसकी कार्यविधि का वर्णन कीजिए तथा निवेशी और निर्गत तरंगरूपों को दर्शाइए । *5*

अथवा

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(a) एक परिपथ आरेख द्वारा संक्षेप में स्पष्ट कीजिए कि निवेशी तथा निर्गत अभिलक्षणों का अध्ययन करने के लिए C.E. विन्यास में किसी n-p-n ट्रांज़िस्टर का उपयोग कैसे किया जाता है ।

(b) किसी ट्रांज़िस्टर प्रवर्धक का दोलित्र के रूप में क्रिया करने के सिद्धान्त का संक्षेप में वर्णन कीजिए । इससे, आवश्यक परिपथ आरेख के उपयोग द्वारा स्पष्ट कीजिए कि दोलित्र में स्वतः परिपालित दोलन कैसे प्राप्त होते हैं । *5*

(a) Explain with the help of a diagram, how a depletion layer and barrier potential are formed in a junction diode.

(b) Draw a circuit diagram of a full wave rectifier. Explain its working and draw input and output waveforms.

OR

(a) Explain briefly, with the help of a circuit diagram how an n-p-n transistor in C.E. configuration is used to study input and output characteristics.

(b) Describe briefly the underlying principle of a transistor amplifier working as an oscillator. Hence, use the necessary circuit diagram to explain how self sustained oscillations are achieved in the oscillator.

29. (a) एक श्रेणी LCR परिपथ, परिवर्ती आवृत्ति के किसी ए.सी. (a.c.) स्रोत से जुड़ा है । उपयुक्त फेज़र आरेख बनाइए और इससे धारा के आयाम तथा कला कोण (फेज़ एंगल) के लिए एक व्यंजक व्युत्पन्न कीजिए ।

(b) अनुनाद के लिए प्रतिबन्ध (शर्त) प्राप्त कीजिए । दो प्रतिरोधों, R_1 तथा R_2 ($R_1 > R_2$) के लिए ए.सी. (a.c.) स्रोत की आवृत्ति के साथ विद्युत् धारा के परिवर्तन को दर्शाने के लिए एक ग्राफ (आलेख) बनाइए । इससे गुणवत्ता गुणांक Q को परिभाषित कीजिए तथा लिखिए कि इसकी परिपथ की ट्यूनिंग (समस्वरण) में क्या भूमिका होती है । *5*

अथवा

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(a) ए.सी. (a.c.) जनित्र का एक नामांकित आरेख बनाइए तथा इसकी कार्यविधि का सिद्धान्त लिखिए ।

(b) किसी जनित्र में, आर्मेचर कुंडली से सम्बद्ध चुम्बकीय फ्लक्स में किस प्रकार परिवर्तन किया जाता है ?

(c) प्रेरित विद्युत्-वाहक बल (ई.एम.एफ.) के अधिकतम मान के लिए एक व्यंजक व्युत्पन्न कीजिए तथा प्रेरित विद्युत्-वाहक बल की दिशा के लिए नियम लिखिए ।

(d) चुम्बकीय क्षेत्र की दिशा के सापेक्ष आर्मेचर को घुमाने पर, जनित विद्युत्-वाहक बल (ई.एम.एफ.) के समय के साथ परिवर्तन को दर्शाइए । *5*

(a) A series LCR circuit is connected to an a.c. source of variable frequency. Draw a suitable phasor diagram to deduce the expressions for the amplitude of the current and phase angle.

(b) Obtain the condition at resonance. Draw a plot showing the variation of current with the frequency of a.c. source for two resistances R_1 and R_2 ($R_1 > R_2$). Hence define the quality factor, Q and write its role in the tuning of the circuit.

OR

(a) Draw a labelled diagram of a.c. generator and state its working principle.

(b) How is magnetic flux linked with the armature coil changed in a generator ?

(c) Derive the expression for maximum value of the induced emf and state the rule that gives the direction of the induced emf.

(d) Show the variation of the emf generated versus time as the armature is rotated with respect to the direction of the magnetic field.

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30. किसी गोलाकार उत्तल पृष्ठ के एक ओर n_1 अपवर्तनांक का माध्यम है और दूसरी ओर n_2 अपवर्तनांक का माध्यम है । उत्तल पृष्ठ की मुख्य अक्ष पर एक बिन्दु वस्तु स्थित है, n_1 अपवर्तनांक वाले अधिक विरल माध्यम में । इसके प्रतिबिम्ब का बनना दर्शाने के लिए एक किरण आरेख बनाइए । इससे, माध्यम के अपवर्तनांक तथा उत्तल पृष्ठ की वक्रता त्रिज्या के पदों में वस्तु की दूरी तथा प्रतिबिम्ब की दूरी के बीच सम्बन्ध व्युत्पन्न कीजिए ।
इस संबंध से पतले उत्तल लेंस के लिए लेंस-मेकर सूत्र का व्यंजक प्राप्त कीजिए । *5*

अथवा

(a) रैखिकतः ध्रुवित प्रकाश तथा अध्रुवित प्रकाश में अन्तर (भेद) लिखिए ।

(b) दर्शाइए कि प्रकाश तरंगों की प्रकृति अनुप्रस्थ होती है ।

(c) आकाश के किसी स्वच्छ नीले भाग से आते हुए प्रकाश को यदि किसी पोलेरॉइड से देखें, तो पोलेरॉइड को घुमाने पर प्रकाश की तीव्रता में वृद्धि और कमी होती रहती है । इसकी आवश्यक आरेख के द्वारा व्याख्या कीजिए । *5*

Draw a ray diagram showing the formation of the image by a point object on the principal axis of a spherical convex surface separating two media of refractive indices n_1 and n_2, when a point source is kept in rarer medium of refractive index n_1. Derive the relation between object and image distance in terms of refractive index of the medium and radius of curvature of the surface.
Hence obtain the expression for lens-maker's formula in the case of thin convex lens.

OR

(a) Distinguish between linearly polarised and unpolarised light.

(b) Show that the light waves are transverse in nature.

(c) Why does light from a clear blue portion of the sky show a rise and fall of intensity when viewed through a polaroid which is rotated ? Explain by drawing the necessary diagram.

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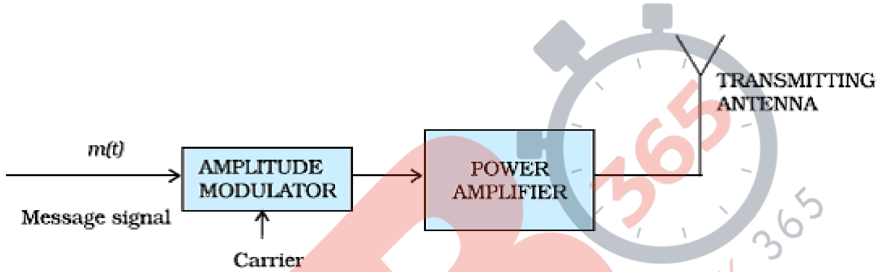
MARKING SCHEME
SET 55/1/2 (Compartment)

Q.No.	Expected Answer/Value Points	Marks	Total Marks
1.	When a constant current flows through a wire, the Potential difference, between any two points on the wire of uniform cross section, is directly proportional to the length of the wire between these points. **Alternatively:** $V \alpha \ell$ or $dV/d\ell$ = constant	1	1
2.	Due to the heating effect of eddy currents set up in the metallic piece.	1	1
3.	Effective power $\alpha \frac{1}{\lambda^2}$ **(Alternatively:** Effective power radiated decreases with an increase in wavelength.)	1	1
4.		1	1
5.	i. The two point charges(q_1 and q_2) should be of opposite nature. ii. Magnitude of charge q_1 must be greater than that of charge q_2	½ ½	1
6.	Two monochromatic sources, which produce light waves, having a constant phase difference, are known as coherent sources.	1	1
7.	Ferromagnetic material	1	1
8.	Random motion of free electrons gets directed towards the point at a higher potential. **Alternatively:** Random motion becomes a (partially) directed motion.	1	1
9	Obtaining the expression for total work done 2 Work done in bringing the charge q_1 from infinity to position r_1 $W_1 = q_1 V(r_1)$ work done in bringing charge q_2 to the position r_2 $W_2 = q_2 V(r_2) + \frac{q_1 q_2}{4\pi\varepsilon_o r_{12}}$ Hence, total work done in assembling the two charges $W = W_1 + W_2$ $= q_1 V(r_1) + q_2 V(r_2) + \frac{q_1 q_2}{4\pi\varepsilon_o r_{12}}$ **OR**	½ ½ +½ ½	2

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<table>
<tr><td></td><td>Derivation of relation between Electric field and potential gradient 1
Two important conclusions ½ + ½

Work done in moving a unit positive charge along distance $\delta\ell$
$|E_l|\ \delta\ell = V_A - V_B$
$= V - (V + \delta V)$
$= -\ \delta V$
$E = -\frac{\delta V}{\delta \ell}$
(i) Electric field is in the direction in which the potential decreases steepest.
(ii) Magnitude of Electric field is given by the change in the magnitude of potential per unit displacement, normal to the equipotential surface at the point.</td><td>½

½
½
½</td><td>2</td></tr>
<tr><td>10.</td><td>Charges on the inner and outer surfaces ½ + ½
Expression for electric field 1

Charge on inner surface : - Q
Charge on outer surface : + Q

Electric field at point P_1
$E = \frac{1}{4\pi\varepsilon_o}\frac{Q}{r_1^2}$</td><td>½
½

1</td><td>2</td></tr>
<tr><td>11.</td><td>Obtaining the expression for the torque 2

Equivalent magnetic moment of the coil
$\vec{m} = IA\hat{n}$
$\therefore \vec{m} = I\ell b\hat{n}$
($\hat{n}$= unit vector ⊥ to the plane of the coil)
$\therefore$Torque $= \vec{m} \times \vec{B}$
$= I\ell b\hat{n} \times \vec{B}$
$= 0$
(as $\hat{n}$ *and* $\vec{B}$ are parallel or antiparallel, to each other)
[Note: Also give credit, when student obtains the relation $\tau = mBsin\theta$, and substitutes $\theta = 0$ or 180^o and writes $\tau = 0$]</td><td>½

½
½
½</td><td>2</td></tr>
<tr><td>12.</td><td>Calculation of
i. emf induced in the arm PQ 1
ii. Current induced in the loop 1

i. emf induced
$e = B\ell v$
$= 0.2 \times 20 \times 10^{-2} \times 15$
$= 0.6$ volt
ii. Current in the loop
$i = \frac{e}{R}$
$= \frac{0.6}{5} = 0.12$ A</td><td>½

½

½

½</td><td>2</td></tr>
</table>

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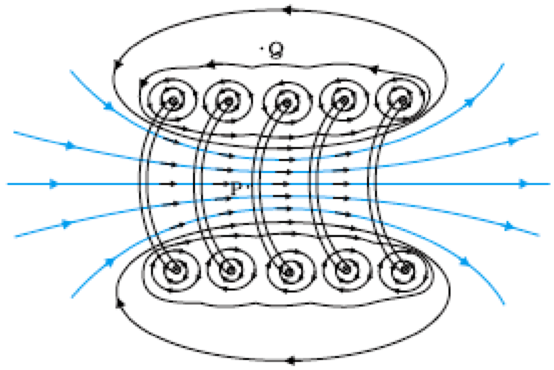
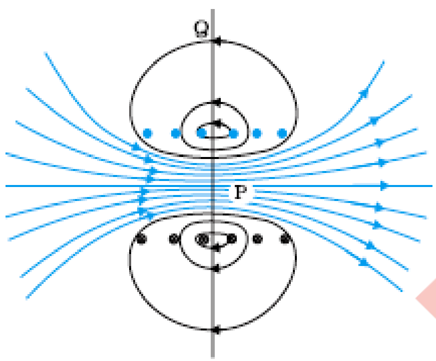
13.

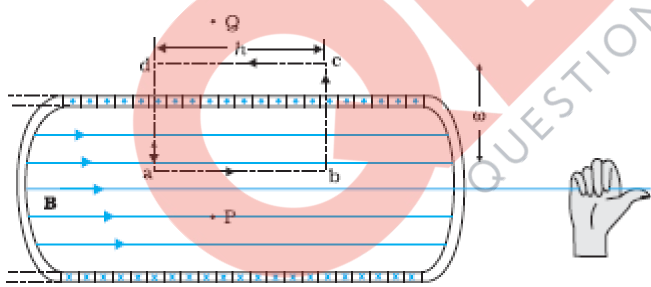
Drawing of magnetic field lines	½
Obtaining the expression for magnetic field	1 ½



½

Alternatively:





½

Applying Ampere circuital law for the rectangular loop abcd

$\oint \vec{B} \cdot \vec{d\ell} = \mu_o I$ ½

$\text{Bh} = \mu_o I(\text{nh})$

$\text{B} = \mu_o nI$ ½ 2

14.

Finding the relation	1 ½
Drawing the graph	½

$E_v = \phi_o + K_{max}$ ½

As $\phi_o = 0$

⇨ $E_v = K_{max}$

⇨ $K_{max} = \frac{p^2}{2m} = E_v$ ½

⇨ $p = \sqrt{2mE_v}$

∴ wavelength (λ)of emitted electrons, $\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mE_v}}$ ½

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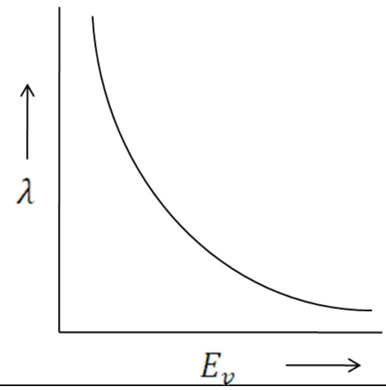
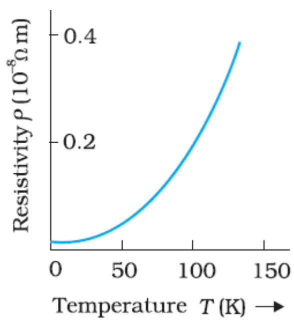


½ | 2

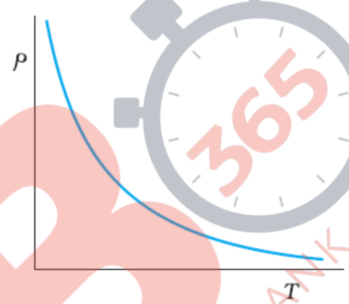
15.

Drawing the two plots	½ + ½
Explanation of Behaviour	½ + ½

(i) Conductor



(ii) Semiconductor



½ + ½

$$\rho = \frac{m}{ne^2\tau}$$

In conductors, average relaxation time decreases with increase in temperature, resulting in an increase in resistivity. ½

In semiconductors, the increase in number density (with increase in temperature) is more than the decrease in relaxation time; the net result is, therefore, a decrease in resistivity. ½ | 2

16.

Naming of gates P and Q	½ + ½
Truth table & Identification	½ + ½

P: OR Gate ½

Q: NOT Gate ½

Inputs		Output
A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

½

NOR Gate ½ | 2

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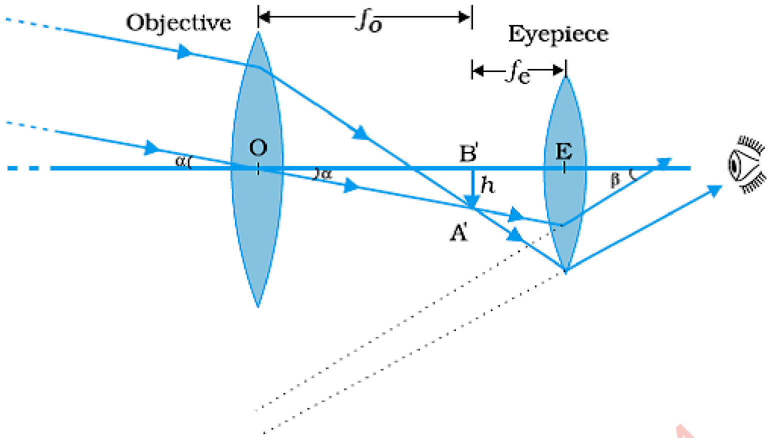
17.	Schematic diagram 1 Two important limitations ½ + ½		
		1	
	i. It suffers chromatic aberration ii. It has spherical aberration iii. Magnifying power small. iv. Small resolving power **(Any two)**	½ + ½	2
18.	Explanation of parts (i) and (ii) 1+1		
	(i) Intensity of incident radiation I = nh$v$, where n is number of photons incident per unit time per unit area. For same intensity of two monochromatic radiations of frequency v_1 and v_2	½	
	$n_1 h v_1 = n_2 h v_2$ As $v_1 > v_2$ ⇨ $n_2 > n_1$ Therefore the number of electrons emitted for monochromatic radiation of frequency v_2, will be more than that for radiation of frequency v_1	½	
	[Alternatively: Also accept if the student says that, for same intensity of incident radiation, the number of emitted electrons is same for each of the two frequencies of incident radiation.]		
	(ii) hv = $\phi_o + K_{max}$ ∴ For given ϕ_o (work function of metal)	½	
	K_{max} increases with v ∴ Maximum Kinetic energy of emitted photoelectrons will be more for monochromatic light of frequency v_1 (as $v_1 > v_2$)	½	2
19.	a) Circular path + angular frequency expression 1 + ½ b) Trace of path; justification ½+ 1		
	a) Force acting on the charged particle, moving with a velocity $\vec{v}$, in a magnetic field $\vec{B}$: $\vec{F} = q(\vec{v} \times \vec{B})$	½	

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As, $\vec{v} \perp \vec{B}$, $|Force| = qvB$

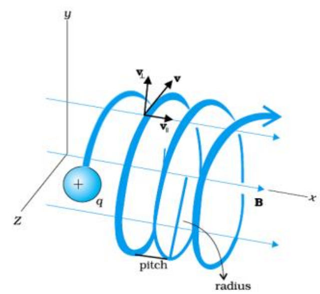
Since, $\vec{F} \perp \vec{v}$, it acts as a centripetal force and makes the particle move in a circular path, in the plane, perpendicular to the magnetic field. — ½

$\therefore qvB = \frac{mv^2}{r}$

$\therefore r = \frac{mv}{qB}$ — ½

Now $\omega = \frac{v}{r}$ $\therefore \omega = \frac{qB}{m}$

b)



— ½

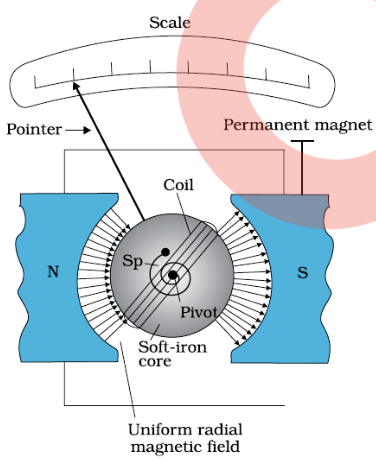
Component of velocity $\vec{v}$ parallel to magnetic field, will make the particle move along the field.

Perpendicular component of velocity $\vec{v}$ will cause the particle to move along a circular path in the plane perpendicular to the magnetic field.

Hence, the particle will follow a helical path, as shown — 1 — 3

OR

Schematic sketch and brief description of working	1+1
Justification	1



— 1

When a current, I, flows through the coil, a torque $\tau = NIAB$ acts on it. — ½

A spring provides a counter torque ($K\varphi$)which balances the deflecting torque

$\therefore K\varphi = NIAB$

$\varphi = \left(\frac{NAB}{K}\right) I$; or $\varphi \propto I$ — ½

Current sensitivity = $\frac{NAB}{K}$

Voltage sensitivity = $\frac{NAB}{KR}$ — ½

On increasing number of turns, the resistance of the coil increases proportionally.

$\therefore$ Increase in current sensitivity does not necessarily increase voltage sensitivity. — ½ — 3

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20.	(i) Values displayed 1+1 (ii) Calculation of maximum distance 1 (i) a. Concern b. Scientific temperament c. Keen observer d. Alertness (or any other two correct values.) (ii) d $=\sqrt{2hR}$ $= \sqrt{2 \times 20 \times 6.4 \times 10^6}$ m $= 2 \times 8 \times 10^3$m = 16 km	1+1 ½ ½	3
21.	Calculation of power consumed by the resistance R 3 For loop ABCDA $-12 + 4I_1 + 8(I_1 + I_2) = 0$ $12 I_1 + 8I_2 = 12$ $3 I_1 + 2I_2 = 3$ ------------------------(i) For loop ADFEA $-8(I_1 + I_2) + 8 = 0$ $I_1 + I_2 = 1$ -----------------------(ii) Simplifying (i) and (ii) For loop ABCDA $I_1 = 1$A $I_2 = 0$A Hence, power consumed by the resistor = $(I_1)^2R$ = 9 watt	½ ½ ½ ½ ½ ½	3
22.	Finding the rate of i. Net capacitance 1 ½ ii. Energy stored 1 ½ i. Net capacitance before filling the gap with dielectric $C_{initial} = C_1 + C_2 = \frac{C_2}{2} + C_2 = \frac{3}{2}C_2$ Net capacitance after filling the gap with dielectric slab of dielectric constant 'K' $C_{final} = KC_1 + KC_2 = \frac{KC_2}{2} + KC_2 = \frac{3}{2}KC_2$ Ratio of net capacitance : Hence, $\frac{C_{initial}}{C_{final}} = \frac{1}{K}$ ii. Energy stored in the combination before introduction of dielectric slab $U_{initial} = \frac{2Q^2}{3C_2}$	½ ½ ½ ½	

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Energy stored in the combination after introduction of dielectric slab

$$U_{final} = \frac{2Q^2}{3KC_2}$$ ½

$$\frac{U_{initial}}{U_{final}} = \frac{K}{1}$$ ½

[Note: Accept any other alternative correct method.] 3

23.

a. Calculation of radius in n = 2 orbit	1
b. Finding of	
i. Kinetic energy	1
ii. Potential energy	1

a. Radius of nth orbit = $n^2 r_o$ ½

∴ radius of n=2 orbit

$r_2 = (2)^2 \times 5.3 \times 10^{-11}$

$= 21.2 \times 10^{-11}$m ½

b. As kinetic energy = - Total energy ½

= - (- 1.51)eV

= 1.51eV ½

Potential energy = 2 x Total energy ½

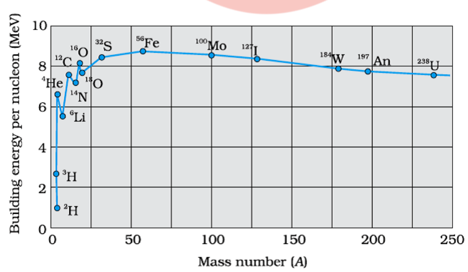
= -2 x 1.51 = -3.02 eV ½ 3

24.

a) Relation for binding energy	1
b) Plot of BE/A versus mass number A	1
Explanation of release of energy	1

a) B.E = $[ZM_P + (A - Z)M_n - {}^{A}_{Z}M \ ]$ x c^2 1

b)



1

From the binding energy per nucleon curve, it is clear that binding energy per nucleon , of the fused nuclei is more than those of the light nuclei taking part in nuclear fusion. Hence energy gets released in the process. 1 3

25.

Explanation of part (i) and (ii)	1 ½ + 1 ½

(i) In diffraction pattern, intensity will be minimum at an angle $\theta = n\lambda/a$ ½

∴ There will be a first minimum at an angle $\theta = \lambda/a$, on either side of central maximum

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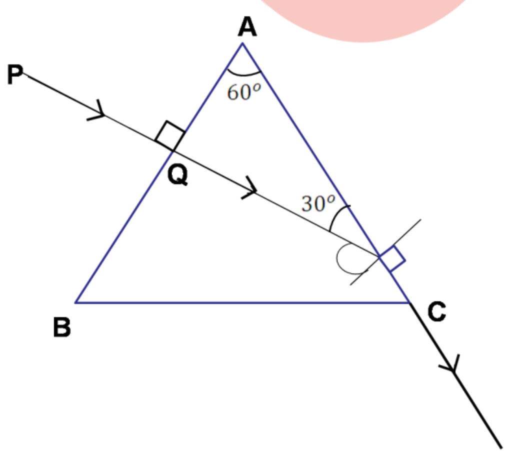
	$\therefore$ width of central maxima = $2\lambda/a$, whereas the width of other minimum/ maximum $\approx \lambda/a$ (ii) The intensity of maxima decreases as the order (n) or diffraction maxima increases. This is because, on dividing the slit into odd number of parts, the contributions of the corresponding (outermost) pairs cancel each other, leaving behind the contribution of only the innermost segment. For example, for first maximum, dividing slit into three parts out of these three parts of the slit, the contributions from first two parts cancel each other; only $\frac{1}{3}$rd portion of the slit contributes to the maxima of intensity. Similarly for, second maxima, dividing slit into five parts, contribution of first four parts will be zero(as they cancel each other). The remaining $\frac{1}{5}$th portion, only, will contribute for maxima; and so on.	½ ½ ½ ½ ½	3
26.	Answers of part (i), (ii) and (iii) 1+1+1 (i) Consider a plane perpendicular to the direction of propagation of the wave. An electric charge, on the plane, will be set in motion by the electric and magnetic fields of em wave, incident on this plane. This illustrates that em waves carry energy and momentum. (ii) Microwaves are produced by special vacuum tubes like the klystron,/ Magnetron/ Gunn diode. The frequency of microwaves is selected to match the resonant frequency of water molecules, so that energy is transferred efficiently to the kinetic energy of the molecules. (iii) a. Associated with the green house effect. b. In remote switches of household electrical appliances. ***(or any other two uses.)***	1 ½ ½ ½ ½	3
27.	Tracing of the path of the ray 1 Calculation of angle of emergence and angle of deviation 1 + 1  If i_c is the critical angle for the prism/material, $\mu = \frac{1}{\text{Sin}i_c}$ $\therefore \sin i_c = \frac{1}{\mu} = \frac{\sqrt{3}}{2}$ $\Rightarrow i_c = 60^o$ Angle of incidence at face AC of the prism = 60^o	1 ½	

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Hence, refracted ray grazes the surface AC. ½

⇨ Angle of emergence = 90^o

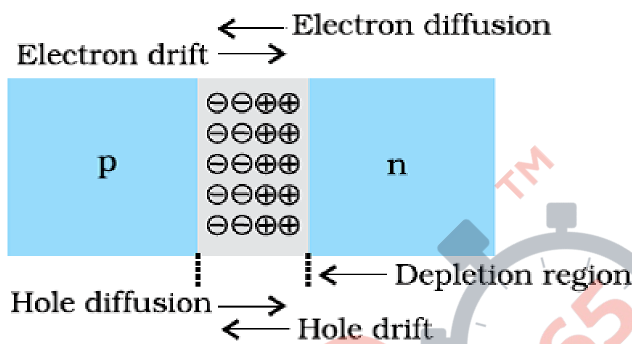
⇨ Angle of deviation = 30^o ½

[Note: Accept other correct alternative method.] ½ 3

28.

a) Explanation of Depletion Layer and barrier potential.	1+1
b) Circuit diagram of full wave rectifier	1
Explanation of working and drawing of input and output Waveforms	1+ ½ + ½

a)

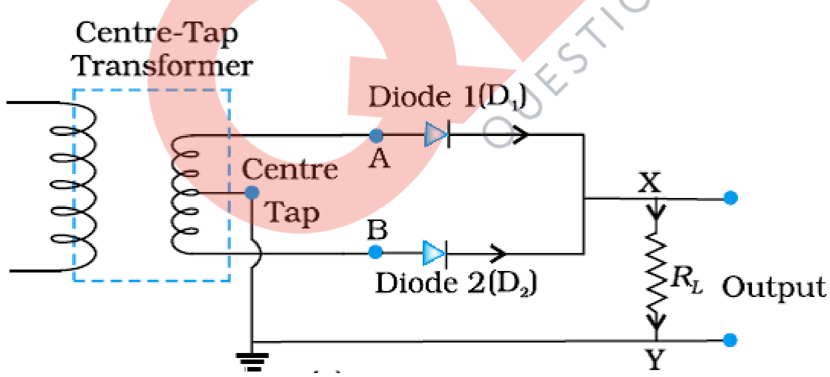


½

Due to the diffusion of electrons and the holes, from their majority zone to minority zone, a layer of positive and negative space charge region on either side of the junction is formed. This is called the depletion region. ½

The loss of electrons, from n-region and gain of electrons by the p-region, causes a difference of potential across the junction. This tends to prevent the movement of charge carriers across the junction and is, therefore, termed as barrier potential. 1

b)



1

For positive half cycle of input ac, one of the two diodes gets forward biased and conducts and output is obtained across the load R_L

For negative half cycle of input ac, the other diode gets forward biased and thus output is obtained due to it. Therefore, output is obtained for both the cycles of input ac. 1

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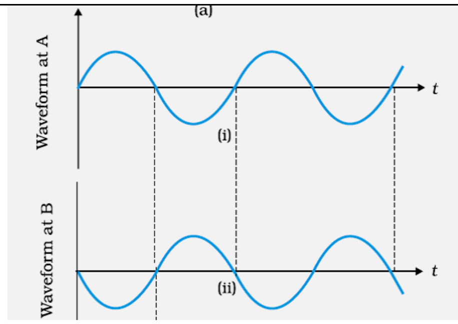
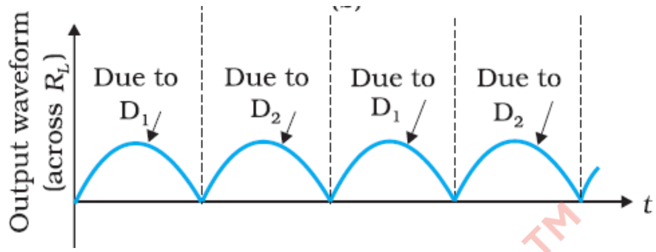


½

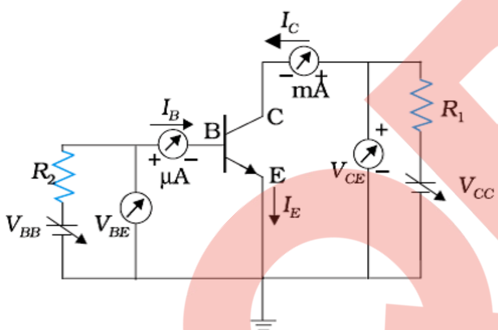


½ 5

OR

a) Labelled circuit diagram and explanation	1 ½ + 1
b) Underlying principle and working	1 + 1 ½

a)



1 ½

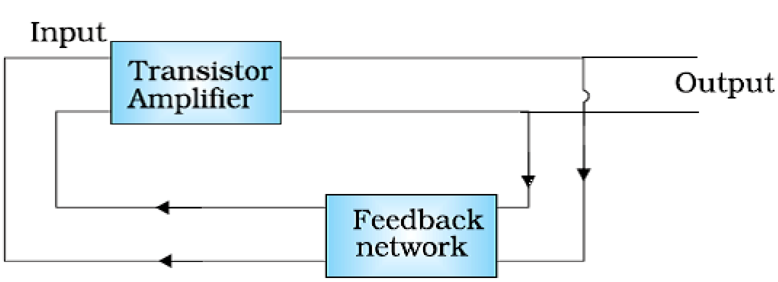
For input characteristics

At constant V_{CE} , for different values of V_{BE}, different values of I_b are obtained. ½

For output characteristics

At constant I_b, for different values of V_{CE}, different values of I_c are obtained. ½

b) A portion of output power is returned at the input in same phase as that of starting power; hence the output in the oscillator gets self sustained. This is termed as positive feedback.



1

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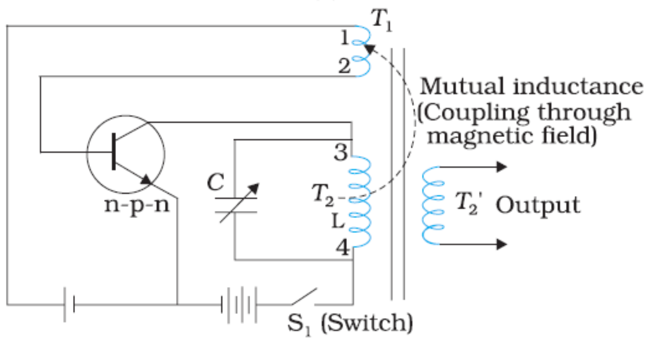


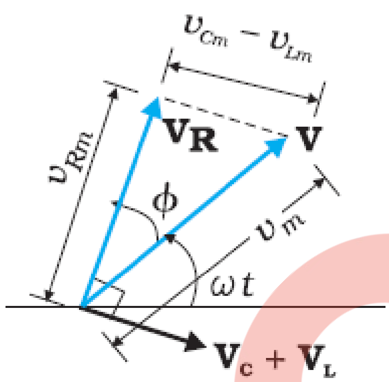
1

As the switch S_1 is closed, a surge of collector current flows through coil T_2, which causes a changing magnetic flux around it. Hence a portion of the output is fedback to the coil T_1, as a result of the positive feedback. The emitter current, therefore, also starts oscillating. ½ | 5

29.

a) Derivation of expression for amplitude of current and phase angle	1+1
b) Condition at resonance	½
c) Drawing of plot	1
d) Definition of Q factor and its role in tuning	1 +½

a)



½

From the phasor diagram

$\vec{V} = \vec{V_L} + \vec{V_R} + \vec{V_C}$

Magnitude of net voltage

$V_m = \sqrt{(V_{RM})^2 + (V_{Cm} - V_{Lm})^2}$

$V_m = I_m\sqrt{[R^2 + (X_C - X_L)^2]}$ ½

$I_m = \dfrac{V_m}{\sqrt{[R^2 + (X_C - X_L)^2]}}$ ½

From the figure

$\tan\phi = \dfrac{V_{Cm} - V_{Lm}}{V_{Rm}}$

$= \dfrac{I_m(X_C - X_L)}{I_m R}$

$\therefore \phi = \tan^{-1}\left(\dfrac{X_C - X_L}{R}\right)$ ½

b) At resonance, I_m *is maximum*

⇨ $X_L = X_c,$

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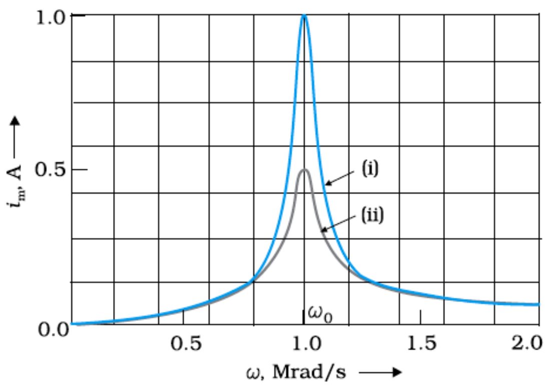
[Alternatively: $\omega_o = \frac{1}{\sqrt{LC}}$] ½



(ii) plot is for R_1
(i) plot is for R_2 ½ + ½

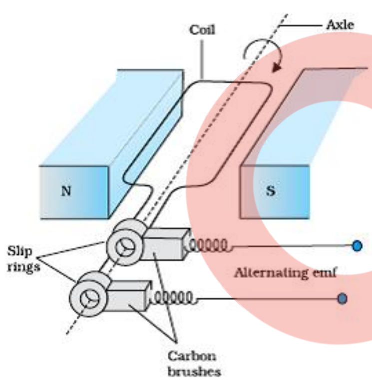
Quality factor of LCR circuit is defined as $\frac{\omega_o}{2\Delta\omega} = \frac{\omega_o L}{R}$ 1

A larger value of quality factor corresponds to a sharper resonance. ½ 5

OR

a)	Labelled diagram & working principle	1+1
b)	Explanation of change in magnetic flux	½
c)	Derivation of expression of maximum value of induced emf and statement of the rule	1 + ½
d)	Showing the variation of emf	1

a)



1

It works on the principle of electromagnetic induction, i.e. when a coil continuously rotates in a magnetic field, the magnetic flux associated with it keeps on changing; thus an induced emf is produced in it. 1

b) When the coil rotates in a magnetic field, its effective area i.e. A cosθ, (i.e. area normal to the magnetic field) keeps on changing. Hence magnetic flux ϕ= NBAcosθ, keeps on changing. ½

c) Let the coil be rotating with angular velocity 'ω', at any instant 't' when the normal to the plane of the coil makes an angle θ with the magnetic field. Hence magnetic flux ½

ϕ =NBAcos ωt, Therefore induced emf(e) = - $\frac{d\phi}{dt}$ ½

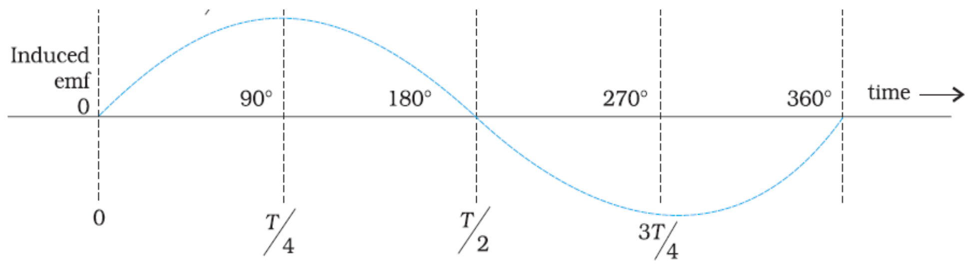
⇨ e = NBAωsin ωt

Induced emf will be maximum when $\omega t = 90^0$ ½

Hence, e_{max} = NBAω

Direction of induced emf can be determined using Flemming's Right hand rule. ***Alternatively:*** Statement of the above rule.

d)

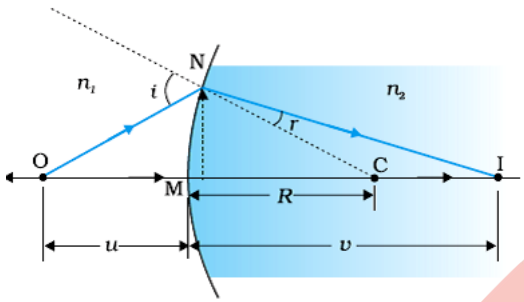


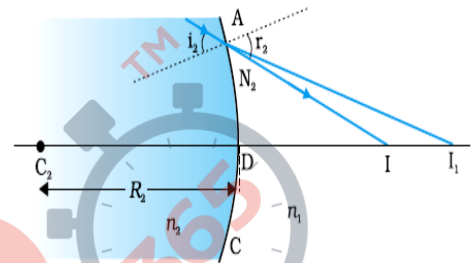
1

5

30.

Ray diagram	1
Derivation of relation $\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$	2
Obtaining the expression $\frac{1}{f} = \left(\frac{n_2}{n_1} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$	2





1

The incident rays coming from the object 'O' kept in the rarer medium of refractive index n_1, incident on the refracting surface NM, produce the real image at I.

From the diagram

$\angle i = \angle NOM + \angle NCM$

$= \frac{NM}{OM} + \frac{NM}{MC}$ ½

$\angle r = \angle NCM - \angle NIM$

$= \frac{NM}{MC} - \frac{NM}{MI}$ ½

From Snell's law

$\therefore \frac{n_2}{n_1} = \frac{\sin i}{\sin r} \sim \frac{i}{r}$ (for small angles $\sin\theta \sim \theta$)

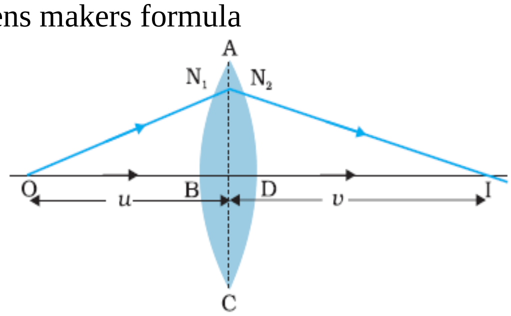
$\therefore n_2 r = n_1 i$ ½

$or\ n_2\left(\frac{NM}{MC} - \frac{NM}{MI}\right) = n_1\left(\frac{NM}{OM} + \frac{NM}{MC}\right)$

$or\ n_2\left(\frac{1}{+R} - \frac{1}{+v}\right) = n_1\left(\frac{1}{-u} + \frac{1}{R}\right)$ ½

$or\ \frac{n_2 - n_1}{R} = \frac{n_2}{v} - \frac{n_1}{u}$

Lens makers formula ½



The first refracting surface ABC forms the image I_1 of the object O. The image I_1 acts as a virtual object for the second refracting surface ADC which forms the real image I as shown in the diagram

∴ for refraction at ABC

$\frac{n_2}{v_1} - \frac{n_1}{u} = \frac{n_2 - n_1}{R_1}$ ---------------------(i)

For refraction at ADC

$\frac{n_1}{v} - \frac{n_2}{v_1} = \frac{n_1 - n_2}{R_2}$ ---------------------(ii) ½

Adding equation (i) and equation (ii), we get ½

$\frac{n_1}{v} - \frac{n_1}{u} = (n_2 - n_1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$\frac{1}{v} - \frac{1}{u} = (\frac{n_2}{n_1} - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ => $\frac{1}{f} = (\mu_{21} - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ ½ 5

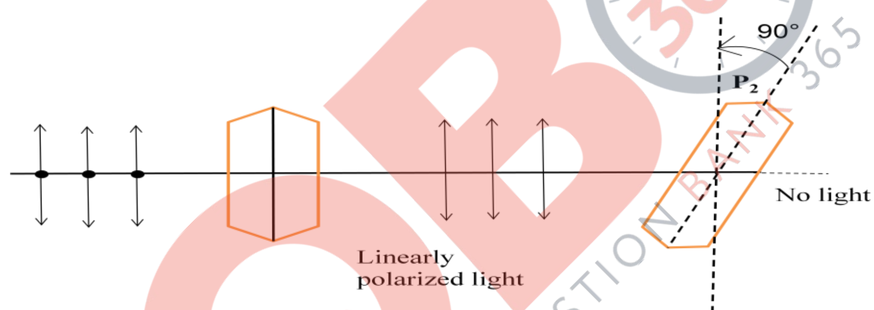
OR

a)	Distinguishing between linearly polarized and unpolarized light	1
b)	Transverse nature	2
c)	Rise or fall of intensity of sunlight	2

a) A light wave, in which the electric vector oscillates in all possible directions in a plane perpendicular to the direction of propagation, is known as unpolarized light. ½

If the oscillations of the electric vectors are restricted to just one direction, in a plane perpendicular to the direction of propagation, the corresponding light is known as linearly polarized light. ½

b)



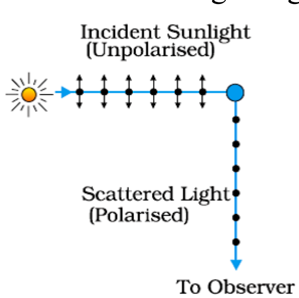
1

Unpolarized light passing through Polaroid P_1 gets linearly polarized. ½

[As the electric field vector components parallel to the pass axis of P_1 are transmitted whereas the others are blocked].

When this polarized light is incident on a Polaroid P_2 , kept crossed with respect to P_1, then these components also gets blocked and no light is transmitted beyond P_2. ½

c) It is due to scattering of light by molecules of earth's atmosphere



1

Under the influence of the electric field of the incident (unpolarized) wave, the electrons in the molecules acquire components of motion in both these directions. Charges, accelerating parallel to the double arrows, do not radiate energy towards the observer since their acceleration has no transverse component.

The radiation scattered by the molecule is therefore represented by dots , i.e. it is polarized perpendicular to plane of figure. 1 5

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