Series A1BAB/2

SET-1

प्रश्न-पत्र कोड
Q.P. Code **55/2/1**

रोल नं.
Roll No.

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

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

नोट

(I) कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ **11** हैं ।

(II) प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को परीक्षार्थी उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें ।

(III) कृपया जाँच कर लें कि इस प्रश्न-पत्र में **12** प्रश्न हैं ।

(IV) **कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, उत्तर-पुस्तिका में प्रश्न का क्रमांक अवश्य लिखें ।**

(V) 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 ।

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NOTE

(I) Please check that this question paper contains **11** printed pages.

(II) Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.

(III) Please check that this question paper contains **12** questions.

(IV) **Please write down the serial number of the question in the answer-book before attempting it.**

(V) 15 minute 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 : 2 घण्टे *अधिकतम अंक : 35*

Time allowed : 2 hours *Maximum Marks : 35*

सामान्य निर्देश :

निम्नलिखित निर्देशों को बहुत सावधानी से पढ़िए और उनका सख़्ती से पालन कीजिए :

(i) *इस प्रश्न-पत्र में कुल* ***12*** *प्रश्न हैं । **सभी** प्रश्न अनिवार्य हैं ।*

(ii) *यह प्रश्न-पत्र* ***तीन*** *खण्डों में विभाजित है – **खण्ड क, ख** और **ग** ।*

(iii) ***खण्ड क*** *– प्रश्न संख्या* ***1*** *से* ***3*** *तक प्रत्येक प्रश्न* ***2*** *अंक का है ।*

(iv) ***खण्ड ख*** *– प्रश्न संख्या* ***4*** *से* ***11*** *तक प्रत्येक प्रश्न* ***3*** *अंक का है ।*

(v) ***खण्ड ग*** *– प्रश्न संख्या* ***12*** *प्रकरण अध्ययन-आधारित प्रश्न है । यह प्रश्न* ***5*** *अंक का है ।*

(vi) *प्रश्न-पत्र में कोई समग्र विकल्प नहीं है । हालाँकि कुछ प्रश्नों में आंतरिक विकल्प प्रदान किए गए हैं । इनमें से केवल एक ही प्रश्न का उत्तर लिखिए ।*

(vii) *यदि आवश्यक हो, तो लॉग टेबल का उपयोग कर सकते हैं लेकिन कैल्कुलेटर के उपयोग की अनुमति **नहीं** है ।*

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

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

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

$\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}

$\varepsilon_0 = 8{\cdot}854 \times 10^{-12}$ C^2 N^{-1} m^{-2}

$\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$ N m^2 C^{-2}

इलेक्ट्रॉन का द्रव्यमान $(m_e) = 9{\cdot}1 \times 10^{-31}$ kg

न्यूट्रॉन का द्रव्यमान = $1{\cdot}675 \times 10^{-27}$ kg

प्रोटॉन का द्रव्यमान = $1{\cdot}673 \times 10^{-27}$ kg

आवोगाद्रो संख्या = $6{\cdot}023 \times 10^{23}$ प्रति ग्राम मोल (per gram mole)

बोल्ट्ज़मान नियतांक = $1{\cdot}38 \times 10^{-23}$ JK^{-1}

General Instructions :

Read the following instructions very carefully and strictly follow them :

(i) *This question paper contains **12** questions. **All** questions are compulsory.*

(ii) *This question paper is divided into **three** sections – **Section A**, **B**, and **C**.*

(iii) ***Section A** – Questions no. **1** to **3** are of **2** marks each.*

(iv) ***Section B** – Questions no. **4** to **11** are of **3** marks each.*

(v) ***Section C** – Question no. **12** is a Case Study-Based Question of **5** marks.*

(vi) *There is no overall choice in the question paper. However, internal choice has been provided is some of the questions. Attempt any one of the alternatives in such questions.*

(vii) *Use of log tables is permitted, if necessary, but use of calculator is **not** permitted.*

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

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

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

$\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}

$\varepsilon_0 = 8{\cdot}854 \times 10^{-12}$ C^2 N^{-1} m^{-2}

$\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$ N m^2 C^{-2}

Mass of electron $(m_e) = 9{\cdot}1 \times 10^{-31}$ kg

Mass of neutron $= 1{\cdot}675 \times 10^{-27}$ kg

Mass of proton $= 1{\cdot}673 \times 10^{-27}$ kg

Avogadro's number $= 6{\cdot}023 \times 10^{23}$ per gram mole

Boltzmann constant $= 1{\cdot}38 \times 10^{-23}$ JK^{-1}

खण्ड क

1. किसी p-n संधि में ह्रासी क्षेत्र बनने की व्याख्या कीजिए । *2*

2. (क) (i) गाइगर-मार्सडेन प्रकीर्णन प्रयोग में किसी α-कण के लिए 'संघट्ट प्राचल' और 'उपगमन की समीपस्थ दूरी' की परिभाषा लिखिए ।

(ii) प्रकीर्णन कोण (I) $\theta = 0°$ और (II) $\theta = 180°$ के लिए संघट्ट प्राचल का मान क्या होगा ? *2*

अथवा

(ख) जब किसी पृष्ठ को (i) ν_1, और (ii) ν_2 आवृत्ति के विकिरणों द्वारा किरणित किया जाता है, तो प्रकाश-विद्युत उत्सर्जन होता है । इन दोनों प्रकरणों में उत्सर्जित इलेक्ट्रॉनों की अधिकतम गतिज ऊर्जा क्रमश: K और 2K है । इस पृष्ठ की देहली आवृत्ति के लिए व्यंजक प्राप्त कीजिए । *2*

3. किसी सौर सेल द्वारा तीन मूलभूत प्रक्रियाओं को सम्मिलित करके वि.वा. बल (emf) किस प्रकार जनित किया जाता है ? व्याख्या कीजिए । *2*

खण्ड ख

4. (क) (i) x-अक्ष के अनुदिश संचरण करती किसी समतल विद्युत-चुम्बकीय तरंग का चित्रण कीजिए । इसके दोलीयमान विद्युत और चुम्बकीय क्षेत्रों के लिए व्यंजक लिखिए ।

(ii) विद्युत-चुम्बकीय तरंगों के तीन अभिलक्षण लिखिए । *3*

अथवा

(ख) निम्नलिखित द्वारा उत्पन्न विद्युत-चुम्बकीय तरंगों के नाम लिखिए :

(i) नाभिकों के रेडियोऐक्टिव क्षय

(ii) वेल्डिंग आर्क

(iii) तप्त पिण्ड

इनमें प्रत्येक तरंग का एक-एक उपयोग लिखिए । *3*

SECTION A

1. Explain the formation of depletion region in a p-n junction. *2*

2. (a) (i) Define the terms : 'impact parameter' and 'distance of closest approach' for an α-particle in Geiger-Marsden scattering experiment.

(ii) What will be the value of the impact parameter for scattering angle (I) $\theta = 0°$ and (II) $\theta = 180°$? *2*

OR

(b) Photoelectric emission occurs when a surface is irradiated with the radiation of frequency (i) v_1, and (ii) v_2. The maximum kinetic energy of the electrons emitted in the two cases are K and 2K respectively. Obtain the expression for the threshold frequency for the surface. *2*

3. How is an emf generated by a solar cell due to the three basic processes involved ? Explain. *2*

SECTION B

4. (a) (i) Depict a plane electromagnetic wave propagating along the x-axis. Write the expressions for its oscillating electric and magnetic fields.

(ii) Write three characteristics of electromagnetic waves. *3*

OR

(b) Name the electromagnetic waves which are produced by the following :

(i) Radioactive decays of nucleus

(ii) Welding arcs

(iii) Hot bodies

Write one use each of these waves. *3*

5. (क) पूर्ण आन्तरिक परावर्तन के लिए आवश्यक शर्तें लिखिए ।

(ख) कोई टंकी किसी पारदर्शी द्रव से 'H' ऊँचाई तक भरी है । किसी सिक्के को डोरी से बाँधकर इस टंकी में लटकाया गया है तथा सिक्के को धीरे-धीरे द्रव के भीतर टंकी की सतह को छूने तक डुबोया गया है । सिक्के की विभिन्न गहराइयों की स्थितियों के तदनुरूप उसकी आभासी गहराई निर्धारित की गई है ।

(i) सिक्के की वास्तविक गहराई के साथ उसकी आभासी गहराई के विचरण को ग्राफ खींचकर दर्शाइए ।

(ii) इस ग्राफ के प्रावण्य (ढाल) का भौतिक महत्त्व क्या है ? *3*

6. (क) सामान्य समायोजन में किसी खगोलीय अपवर्ती दूरदर्शी द्वारा प्रतिबिम्ब बनना दर्शाने के लिए नामांकित किरण आरेख खींचिए । इस प्रकार इस दूरदर्शक की आवर्धन क्षमता के लिए व्यंजक प्राप्त कीजिए । *3*

अथवा

(ख) तरंगदैर्घ्य 'λ' के प्रकाश का कोई समतल तरंगाग्र किसी चौड़ाई 'a' की संकीर्ण झिरी पर अभिलंबवत आपतन करता है और इसके विवर्तन पैटर्न का प्रेक्षण झिरी से दूरी 'D' पर स्थित किसी पर्दे पर किया गया है ।

(i) प्रेक्षित पैटर्न में तीव्रता वितरण चित्रित कीजिए ।

(ii) केन्द्रीय उच्चिष्ठ से प्रथम उच्चिष्ठ की दूरी के लिए व्यंजक प्राप्त कीजिए । *3*

7. काँच ($\mu = 1{\cdot}5$) के बने किसी अभिसारी लेंस के गोलीय फलकों की वक्रता त्रिज्याएँ 10 cm और 20 cm हैं ।

(क) वायु में इस लेंस की फोकस दूरी ज्ञात कीजिए ।

(ख) जब यह लेंस अपवर्तनांक 1·25 के किसी द्रव में डूबा है तो इसकी फोकस दूरी ज्ञात कीजिए । *3*

8. किसी हाइड्रोजन परमाणु की प्रथम उत्तेजित अवस्था में ऊर्जा $-3{\cdot}4$ eV है । ज्ञात कीजिए :

(क) कक्षा की त्रिज्या । (बोर त्रिज्या = 0·53 Å लीजिए)

(ख) इस कक्षा में इलेक्ट्रॉन का कोणीय संवेग ।

(ग) इस कक्षा में इलेक्ट्रॉन की गतिज और स्थितिज ऊर्जाएँ । *3*

5. (a) State the conditions for total internal reflection to take place.

(b) A tank is filled with a transparent liquid to height 'H'. A coin suspended by a thread in the liquid is gradually lowered till it touches the bottom. The apparent depth is determined corresponding to different positions of the coin.

(i) Plot a graph showing variation of the apparent depth with the real depth of the coin.

(ii) What is the physical significance of the slope of the graph ? *3*

6. (a) Draw a labelled ray diagram showing the formation of an image by an astronomical refracting telescope in normal adjustment. Hence, obtain the expression for its magnifying power. *3*

OR

(b) A plane wavefront of light of wavelength 'λ' is incident normally on a narrow slit of width 'a' and a diffraction pattern is observed on a screen at a distance 'D' from the slit.

(i) Depict the intensity distribution in the pattern observed.

(ii) Obtain the expression for the first maximum from the central maximum. *3*

7. A converging lens made of glass ($\mu = 1{\cdot}5$) has its spherical faces of radii of curvature 10 cm and 20 cm. Find its focal length

(a) in air, and

(b) when it is immersed in a liquid of refractive index 1·25. *3*

8. The energy of a hydrogen atom in the first excited state is – 3·4 eV. Find :

(a) the radius of this orbit. (Take Bohr radius = 0·53 Å)

(b) the angular momentum of the electron in the orbit.

(c) the kinetic and potential energy of the electron in the orbit. *3*

9. (क) न्यूक्लिऑनों के किसी युगल की स्थितिज ऊर्जा का न्यूक्लिऑनों के बीच दूरी के साथ विचरण चित्रित कीजिए ।

(ख) ${}^{56}_{26}\mathrm{Fe}$ के विखण्डन द्वारा बनने वाले दो समान खण्डों के नाभिकों ${}^{28}_{13}\mathrm{Al}$ की कल्पना कीजिए । क्या यह विखण्डन ऊर्जात्मक दृष्टि से संभव है ? इस प्रक्रिया का Q मान ज्ञात करके अपने उत्तर की पुष्टि कीजिए । *3*

दिया गया है : $m\left({}^{56}_{26}\mathrm{Fe}\right) = 55{\cdot}93494\ \mathrm{u},\ m\left({}^{28}_{13}\mathrm{Al}\right) = 27{\cdot}98191\ \mathrm{u}.$

10. किसी α-कण और किसी प्रोटॉन से संबद्ध दे ब्रॉग्ली तरंगदैर्घ्यों का अनुपात ज्ञात कीजिए, यदि

(क) दोनों की चाल समान है,

(ख) दोनों की गतिज ऊर्जा समान है,

(ग) दोनों को समान विभवान्तर से त्वरित किया गया है । *3*

11. परिपथ आरेख की सहायता से किसी p-n संधि डायोड का पूर्ण तरंग दिष्टकारक के रूप में कार्य करने की व्याख्या कीजिए । इसके निवेशी और निर्गत तरंगरूप भी खींचिए । *3*

खण्ड ग

12. अंग्रेज भौतिकशास्त्री टॉमस यंग ने तरंगों के अध्यारोपण के सिद्धांत का उपयोग करके प्रकाश के व्यतिकरण की व्याख्या की । उन्होंने अपनी प्रायोगिक व्यवस्था, जिसे अब यंग का द्विझिरी प्रयोग कहते हैं, द्वारा पर्दे पर व्यतिकरण पैटर्न का प्रेक्षण किया । उन्होंने किसी झिरी S से आने वाले प्रकाश से दो झिरियों S_1 और S_2 को प्रदीप्त किया । यह व्यतिकरण पैटर्न प्रकाश के चमकीले और काले बैण्डों से मिलकर बनता है । इस प्रकार के बैण्डों को फ्रिंज कहते हैं । दो क्रमागत चमकीली और काली फ्रिंजों के बीच की दूरी को फ्रिंज चौड़ाई कहते हैं ।

(क) यदि पर्दे को झिरियों S_1 और S_2 के तल की ओर ले जाएँ, तो फ्रिंज चौड़ाई :

(i) घट जाएगी, परन्तु चमकीली फ्रिंज की तीव्रता समान रहती है ।

(ii) बढ़ जाएगी, परन्तु चमकीली फ्रिंज की तीव्रता घट जाती है ।

(iii) घट जाएगी, परन्तु चमकीली फ्रिंज की तीव्रता बढ़ जाती है ।

(iv) और तीव्रता दोनों समान रहते हैं ।

9. (a) Depict the variation of the potential energy of a pair of nucleons with the separation between them.

(b) Imagine the fission of a $^{56}_{26}Fe$ into two equal fragments of $^{28}_{13}Al$ nucleus. Is the fission energetically possible ? Justify your answer by working out Q value of the process. *3*

Given : m $\left(^{56}_{26}Fe\right)$ = 55·93494 u, m $\left(^{28}_{13}Al\right)$ = 27·98191 u.

10. Find the ratio of the de Broglie wavelengths associated with an alpha particle and a proton, if both

(a) have the same speeds,

(b) have the same kinetic energy,

(c) are accelerated through the same potential difference. *3*

11. With the help of a circuit diagram, explain the working of a p-n junction diode as a full-wave rectifier. Also draw its input and output waveforms. *3*

SECTION C

12. The British physicist Thomas Young explained the interference of light using the principle of superposition of waves. He observed the interference pattern on the screen, in his experimental set-up, known now as Young's double slit experiment. The two slits S_1 and S_2 were illuminated by light from a slit S. The interference pattern consists of dark and bright bands of light. Such bands are called fringes. The distance between two consecutive bright and dark fringes is called fringe width.

(a) If the screen is moved closer to the plane of slits S_1 and S_2, then the fringe width :

(i) will decrease, but the intensity of bright fringe remains the same.

(ii) will increase, but the intensity of bright fringe decreases.

(iii) will decrease, but the intensity of bright fringe increases.

(iv) and the intensity both remain the same.

(ख) पर्दे पर पैटर्न का क्या होगा, जब दोनों झिरियों S_1 और S_2 को दो स्वतंत्र लेकिन सर्वसम स्रोतों द्वारा प्रतिस्थापित कर दिया जाता है ?

(i) पैटर्न की तीव्रता बढ़ जाएगी

(ii) पैटर्न की तीव्रता घट जाएगी

(iii) फ्रिंजों की संख्या दुगुनी हो जाएगी

(iv) पर्दे पर कोई भी पैटर्न दिखाई नहीं देगा

(ग) दो प्रकाश स्रोतों को कलासंबद्ध कहा जाता है, जब दोनों प्रकाश स्रोत ऐसी प्रकाश तरंग उत्सर्जित करते हैं, जिनके होते हैं :

(i) समान आयाम और विचरण करते कलान्तर ।

(ii) समान तरंगदैर्घ्य और कोई नियत कलान्तर ।

(iii) विभिन्न तरंगदैर्घ्य और समान तीव्रता ।

(iv) विभिन्न तरंगदैर्घ्य और कोई नियत कलान्तर ।

(घ) किसी यंग के द्विझिरी प्रयोग में फ्रिंज चौड़ाई β है । यदि समस्त प्रायोगिक व्यवस्था को किसी द्रव, जिसका अपवर्तनांक 'μ' है, में डुबो दिया जाए, तो नई फ्रिंज चौड़ाई हो जाएगी :

(i) β

(ii) $\beta\mu$

(iii) $\frac{\beta}{\mu}$

(iv) $\frac{\beta}{\mu^2}$

(ङ) पर्दे के बिन्दुओं P_1 और P_2 पर दो तरंगों के मिलने पर उनके बीच कुल पथान्तर क्रमश: $\left(\frac{3\lambda}{2}\right)$ और 2λ हैं तो :

(i) दोनों बिन्दुओं पर चमकीली फ्रिंज बनती हैं ।

(ii) दोनों बिन्दुओं पर काली फ्रिंज बनती हैं ।

(iii) P_1 पर चमकीली फ्रिंज और P_2 पर काली फ्रिंज बनती है ।

(iv) P_2 पर चमकीली फ्रिंज और P_1 पर काली फ्रिंज बनती है । *5×1=5*

(b) What will happen to the pattern on the screen, when the two slits S_1 and S_2 are replaced by two independent but identical sources ?

(i) The intensity of pattern will increase

(ii) The intensity of pattern will decrease

(iii) The number of fringes will become double

(iv) No pattern will be observed on the screen

(c) Two sources of light are said to be coherent, when both emit light waves of :

(i) same amplitude and have a varying phase difference.

(ii) same wavelength and a constant phase difference.

(iii) different wavelengths and same intensity.

(iv) different wavelengths and a constant phase difference.

(d) The fringe width in a Young's double slit experiment is β. If the whole set-up is immersed in a liquid of refractive index 'μ', then the new fringe width will be :

(i) β

(ii) $\beta\mu$

(iii) $\frac{\beta}{\mu}$

(iv) $\frac{\beta}{\mu^2}$

(e) The total path difference between two waves meeting at points P_1 and P_2 on the screen are $\left(\frac{3\lambda}{2}\right)$ and 2λ respectively. Then :

(i) bright fringes are formed at both points.

(ii) dark fringes are formed at both points.

(iii) a bright fringe is formed at P_1 and a dark fringe is formed at P_2.

(iv) a bright fringe is formed at P_2 and a dark fringe is formed at P_1. *5×1=5*

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Senior Secondary School Term II Examination, 2022

Marking Scheme – PHYSICS (SUBJECT CODE — 042)

(PAPER CODE — 55/2/1)

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9. No marks to be deducted for the cumulative effect of an error. It should be penalized only once.

10. A full scale of marks _35_(example 0-40 marks as given in Question Paper) has to be used. Please do not hesitate to award full marks if the answer deserves it.

11. Every examiner has to necessarily do evaluation work for full working hours i.e. 8 hours every day and evaluate 30 answer books per day in main subjects and 35 answer books per day in other subjects (Details are given in Spot Guidelines). This is in view of the reduced syllabus and number of questions in question paper.

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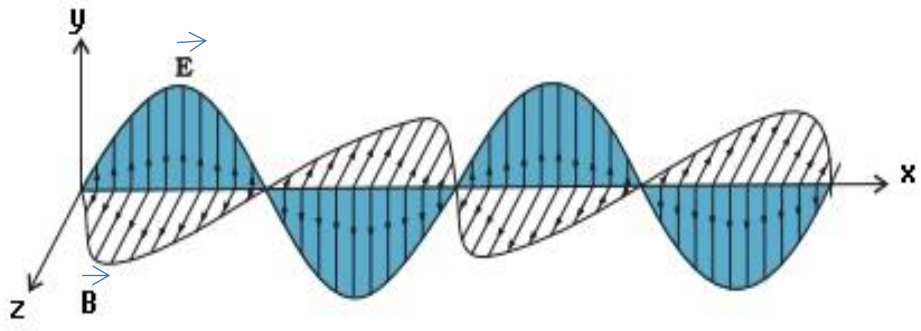
MARKING SCHEME

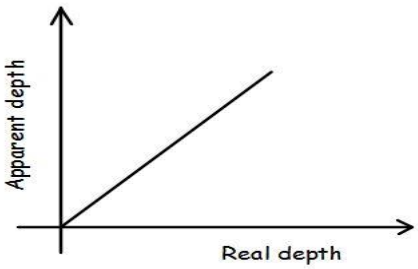
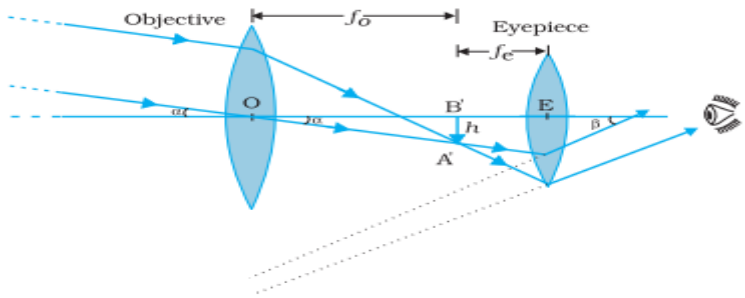
Senior Secondary School Examination TERM–II, 2022

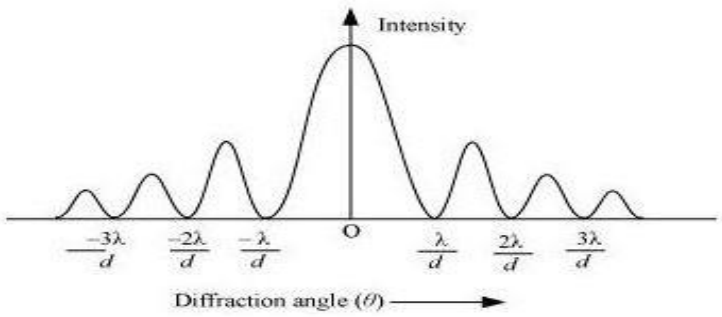
PHYSICS (Subject Code — 042)

[Paper Code — 55/2/1]

Q. No.	EXPECTED ANSWER / VALUE POINTS	Marks	Total Marks
	SECTION—A		
1.	Explanation of Formation of Depletion region 2 When p-type semiconductor is chipped with n-type semiconductor, e^- from the n-side diffuse towards p-side and holes from p-side diffuse towards n-side leaving behind a layer of immobile +ve ions on n-side and immobile –ve ions on p-side leading to formation of depletion layer. **(Note : Award 1 mark, if a student draws a diagram showing depletion region)**	2	2
2.	**a)** Definition of impact parameter & distance of closest approach Values ½ + ½ Value of Impact parameter for (I) & (II) ½ + ½ i. **Impact Parameter** : It is the perpendicular distance of the initial velocity vector of the approaching α-particle from the centre of the nucleus. **Distance of closest approach** : It is the minimum distance of the approaching α-particle and the target gold nucleus $d = \frac{2Ze^2}{4\pi\varepsilon_0 K}$; Where K is the kinetic energy **Alternatively** : Distance of closest approach is the distance of the alpha particle from the centre of gold nucleus where its whole kinetic energy is converted into potential energy ii. $\theta = 0°$; b = maximum / almost of atomic size $\theta = 180°$; b = minimum = zero **(Note: Allot ½ Mark for only formula.)**	½ ½ ½ ½	
	OR		
2.	**b)** Expressions for kinetic energy ½ + ½ Expression for threshold Frequency 1 $K = h\nu_1 - \phi_0$ and $2K = h\nu_2 - \phi_0$ $\Rightarrow 2(h\nu_1 - \phi_0) = h\nu_2 - \phi_0$	½+½	

	$\Rightarrow 2h\nu_1 - 2\phi_0 = h\nu_2 - \phi_0$ $\Rightarrow h(2\nu_1 - \nu_2) = \phi_0 = h\nu_0$ $\Rightarrow (2\nu_1 - \nu_2) = \phi_0 = \nu_0$ $\Rightarrow \nu_0 = 2\nu_1 - \nu_2$	½ ½	2
3.	Processes ½ + ½ + ½ Generation of e.m.f. ½ The three basic processes for generation of e.m.f. by a solar cell are: (i) Generation of e-h pairs due to light (with $h\nu > E_g$) close to the junction. (ii) Separation of e^-s and holes due to electric field of the depletion region. (iii) Collection : e^- reaching the n-side are collected by the front contact & holes reaching p-side are collected by back contact. Thus, p-side becomes positive and n-side becomes negative giving rise to photo voltage.	 ½ ½ ½ ½	2
4.	**SECTION—B** **a)** (i) Depiction of plane EM wave ½ Expression for electric field ½ Expression for magnetic field ½ (ii) Characteristics of EM waves ½ + ½ + ½ (i)  $E_y = E_0 \sin(kx - \omega t)$ $B_z = B_0 \sin(kx - \omega t)$ (ii) The three characteristics are: a) They travel with velocity of light. b) They carry energy and momentum. c) They are transverse in nature. **(Or any other characteristic given)**	 ½ ½ ½ ½ ½ ½ ½	

4.	**OR** **b)** Naming of EM waves ½ + ½ + ½ Uses of EM waves ½ + ½ + ½ (a) Gamma Rays - Used for cancer treatment (b) Ultraviolet/Visible/Infrared (either) – Use of anyone of these three. (c) Infrared Rays – Used in night vision camera, bolometer & thermopiles **(Note: Give full credit to any other use written.)**	½ + ½ ½ + ½ ½ + ½	3
5.	(a) Conditions of TIR 1 (b) Graph 1 (c) Significance of slope 1 (a) The conditions for total internal reflection to take place are: (i) The light should travel from denser to rarer medium. (ii) The angle of incidence should be greater than the critical angle for a given pair of media. (b) (i)  (ii)The slope will give 1/μ where μ is refractive index as per the graph above.	½ ½ 1 1	3
6.	**a)** Labelled Ray Diagram of refracting telescope for normal arrangement 1½ Derivation of Expression of magnifying power 1½  	1½	

	$m = \frac{\tan\beta}{\tan\alpha} \approx \frac{\beta}{\alpha}$ (as α, β are small angles)	½	
	$\approx \frac{h}{f_e} x \frac{f_0}{h}$	½	
	$= \frac{f_0}{f_e}$	½	
6.	**(Note: ½ mark to be deducted if arrows not shown or labelling is not done)**		
	OR		
	b)		
	(i) Intensity distribution curve for diffraction 1½ (ii) Expression of first maximum from the central maximum 1½		
	(i) Intensity distribution curve		
		1½	
	For maximum $a\sin\theta = (n + \frac{1}{2})\lambda$	½	
	For first Maximum ; n = 1 For small θ; $a\theta = \frac{3\lambda}{2}$ => $\theta = \frac{3\lambda}{2a}$	½	
	$\therefore \frac{x}{D} = \frac{3}{2}\frac{\lambda}{a}$ $\therefore x = \frac{3}{2}\frac{\lambda D}{a}$	½	3

7.

Finding the focal length

(a) In Air 1½

(b) In Liquid 1½

(a)

$$\frac{1}{f_a} = ({}_a\mu^g - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$ ½

$R_1 = 10$ cm & $R_2 = -20$ cm , ${}_a\mu^g = 1.5$ ½

$$\frac{1}{f_a} = (1.5-1)\left(\frac{1}{10} - \frac{1}{-20}\right)$$

$f_a = \frac{40}{3} = 13.3$ cm ½

b) $\frac{1}{f_l} = ({}_l\mu^g - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ ½

$= \left(\frac{1.5}{1.25} - 1\right)\left(\frac{1}{10} - \frac{1}{-20}\right)$ ½

$f_l = \frac{100}{3} = 33.3$ cm ½

3

8.

Finding the

a) Radius of orbit 1

b) Angular Momentum 1

c) Kinetic & Potential Energy 1

a) $r = n^2 r_0 = (2)^2 \times 0.53 = 2.12$ Å 1

b) $L = \frac{nh}{2\pi} = \frac{2 \times 6.63 \times 10^{-34}}{2 \times 3.14} = 2 \times 10^{-34}$ kg m/s 1

c) K.E = + 3.4 eV & P.E = - 6.8eV 1

3

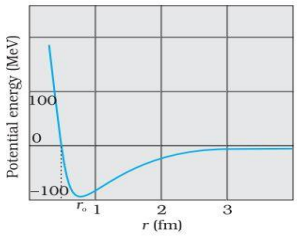
9.

(a) Graph 1½

(b) Mass Difference 1

Conclusion ½

(a)



1½

(b)Mass Difference = 55.93494 – 2 × 27.98191

= - 0.02442 u

1

Fission not possible.

½

3

10.

Finding the ratio when	
a) Speed is same	1
b) K.E. is same	1
c) Potential difference is same	1

(a) $\lambda = \frac{h}{p}$ ½

$$\frac{\lambda_\alpha}{\lambda_p} = \frac{h}{m_\alpha v_\alpha} \times \frac{m_p v_p}{h} = \frac{1}{4}$$ ½

(b)

$$p = \sqrt{2m(K.E)}$$ ½

$$\frac{\lambda_\alpha}{\lambda_p} = \frac{h}{\sqrt{2m_\alpha (\mathrm{K.E.})_\alpha}} \times \frac{\sqrt{2m_p (K.\mathrm{E.})_p}}{h} = \sqrt{\frac{m_p}{m_\alpha}} = \frac{1}{2}$$ ½

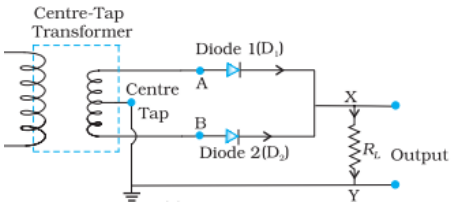
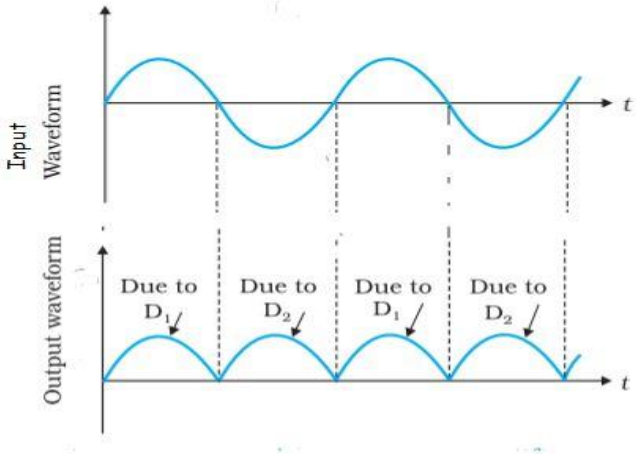
(c)

$$v = \sqrt{\frac{2qV}{m}}$$ ½

$$\frac{\lambda_\alpha}{\lambda_p} = \frac{h}{m_\alpha v_\alpha} \times \frac{m_p v_p}{h} = \frac{m_p}{m_\alpha}\sqrt{\frac{2q_p V}{m_p}} \times \sqrt{\frac{m_\alpha}{2q_\alpha V}}$$

$$= \frac{m_p}{m_\alpha} \times \sqrt{\frac{m_\alpha}{m_p}} \times \sqrt{\frac{q_p}{q_\alpha}} = \frac{1}{2\sqrt{2}}$$ ½

3

11.	Explanation of working 1 Circuit Diagram of full wave rectifier 1 Input & Output Waveform ½ + ½  Let input voltage at A w.r.t. the centre tap at any instant is positive, then voltage at B will be negative. So, diode D_1 gets forwarded biased & D_2 gets reverse biased. Hence output current is obtained. When voltage at A becomes –ve ; then voltage at B would be + ve , hence D_1, gets reverse biased & D_2 gets forwarded biased . So output current is again obtained as shown in the figure.  **(Note: If the student takes inverted input waveform full credit to be given.)**	1 1 ½ ½	3
12.	a) (iii) b) (iv) c) (ii) d) (iii) e) (iv)	1 1 1 1 1	5

* * *

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Senior Secondary School Term II Examination, 2022

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(PAPER CODE — 55/2/2)

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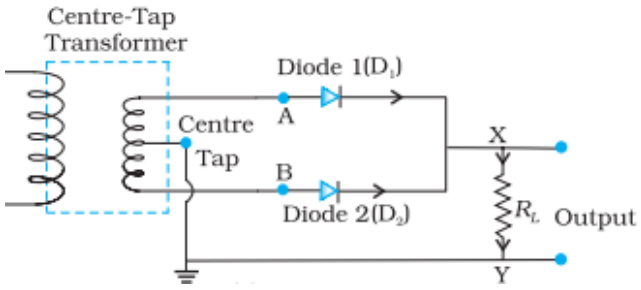
MARKING SCHEME

Senior Secondary School Examination TERM–II, 2022

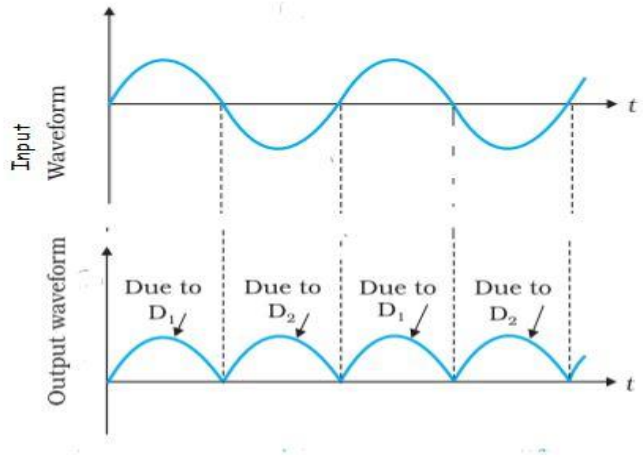
PHYSICS (Subject Code — 042)

[Paper Code — 55/2/2]

Q. No.	EXPECTED ANSWER / VALUE POINTS	Marks	Total Marks
	SECTION—A		
1.	**a)**		
	Definition of impact parameter and distance of closest approach ½ + ½ Values of impact parameter for (I) & (II) ½ + ½		
	Definitions of		
	i. **Impact Parameter** : It is the perpendicular distance of the initial velocity vector of the approaching α-particle from the centre of the nucleus.	½	
	Distance of closest approach : It is the minimum distance of the approaching α-particle and the target gold nucleus.	½	
	Alternatively:- It is the distance of the α-particle from the centre of gold nucleus where its whole kinetic energy is converted into potential energy.		
	$d = \frac{2Ze^2}{4\pi\varepsilon_0 K}$; Where K is the kinetic energy		
	ii. $\theta = 0°$; b = maximum / almost of atomic size	½	
	$\theta = 180°$; b = minimum = zero	½	
	(Note: Allot ½ Mark for only formula.)		
	OR		
1.	**b)**		
	Expression for threshold Frequency 2		
	$K = h\nu_1 - \phi_0$ and $2K = h\nu_2 - \phi_0$	½+½	
	$\Rightarrow 2(h\nu_1 - \phi_0) = h\nu_2 - \phi_0$		
	$\Rightarrow 2h\nu_1 - 2\phi_0 = h\nu_2 - \phi_0$	½	
	$\Rightarrow h(2\nu_1 - \nu_2) = \phi_0 = h\nu_0$		
	$\Rightarrow (2\nu_1 - \nu_2) = \phi_0 = \nu_0$		
	$\nu_0 = 2\nu_1 - \nu_2$	½	2

2.	Working of LED 1 Uses of LED ½ + ½ When the diode is forward biased, electrons are sent from n-side to p-side and holes are sent from p-side to n-side. At the junction the concentration of minority carriers increases. Thus, at the junction, the excess minority carriers recombine with majority carriers and energy is released in the form of photons. Uses:- 1) Remote controls 2) Burglar Alarm System 3) Optical Communication **(Any two of the above or any two other uses)**	1 ½ + ½	2
3.	Explanation of Formation of Depletion region 2 When p-type semiconductor is chipped with n-type semiconductor, e^- from the n-side diffuse towards p-side and holes from p-side diffuse towards n-side leaving behind a layer of immobile +ve ions on n-side and immobile –ve ions on p-side leading to formation of depletion layer. **(Note : Award 1 mark, if a student draws a diagram showing depletion region)**	2	2
	SECTION—B		
4.	Explanation of working 1 Circuit Diagram of full wave rectifier 1 Input & Output Waveform ½ + ½  Let input voltage at A w.r.t. the centre tap at any instant is positive, then voltage at B will be negative. So, diode D_1 gets forwarded biased & D_2 gets reverse biased. Hence output current is obtained. When voltage at A becomes –ve ; then voltage at B would be + ve , hence D_1, gets reverse biased & D_2	1 1	

gets forwarded biased . So output current is again obtained as shown in the figure.



½

½

(Note: If the student takes inverted input waveform full credit to be given.)

3

5.

Finding the ratio when

(a) Speed is same 1
(b) K.E. is same 1
(c) Potential difference is same 1

(a) $\lambda = \frac{h}{p}$ ½

$$\frac{\lambda_\alpha}{\lambda_p} = \frac{h}{m_\alpha v_\alpha} \times \frac{m_p v_p}{h} = \frac{1}{4}$$ ½

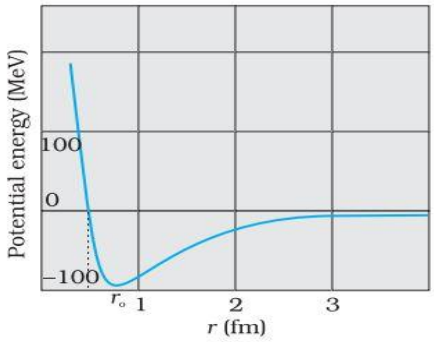
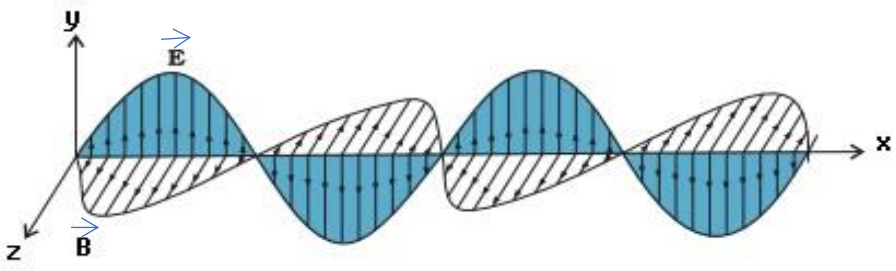
(b) $\lambda = \frac{h}{\sqrt{2m(K.E.)}}$ ½

$$\frac{\lambda_\alpha}{\lambda_p} = \frac{h}{\sqrt{2m_\alpha (K.E)_\alpha}} \times \frac{\sqrt{2m_p (K.E)_p}}{h} = \sqrt{\frac{m_p}{m_\alpha}} = \frac{1}{2}$$ ½

(c)

$v = \sqrt{\frac{2qV}{m}}$ ½

$$\frac{\lambda_\alpha}{\lambda_p} = \frac{h}{m_\alpha v_\alpha} \times \frac{m_p v_p}{h} = \frac{m_p}{m_\alpha} \sqrt{\frac{2q_p V}{m_p}} \times \sqrt{\frac{m_\alpha}{2q_\alpha V}}$$

	$= \frac{m_p}{m_\alpha} \times \sqrt{\frac{m_\alpha}{m_p}} \times \sqrt{\frac{q_p}{q_\alpha}} = \frac{1}{2\sqrt{2}}$	½	3
6.	(a)Graph 1½ (b)Mass Difference 1 Conclusion ½ (a)  (b) Mass Difference = 55.93494 – 2 × 27.98191 = – 0.02442 u Fission not possible	1 ½ 1 ½	3
7.	**a)** (i) Depiction of plane EM wave ½ Expression for electric field ½ Expression for magnetic field ½ (ii) Characteristics of EM waves ½ + ½ + ½ (i)  $E_y = E_0 \sin(kx - \omega t)$ $B_z = B_0 \sin(kx - \omega t)$ (ii) The three characteristics are: a) They travel with velocity of light. b) They carry energy and momentum. c) They are transverse in nature. **(Or Any other)**	½ ½ ½ ½ ½ ½	

OR

7. **b)**

Naming of EM waves	½ + ½ + ½
Uses of EM waves	½ + ½ + ½

(a) Gamma Rays - Used for cancer treatment ½+½

(b) Ultraviolet/Visible/Infrared (either) – Use of anyone of these three. ½ +½

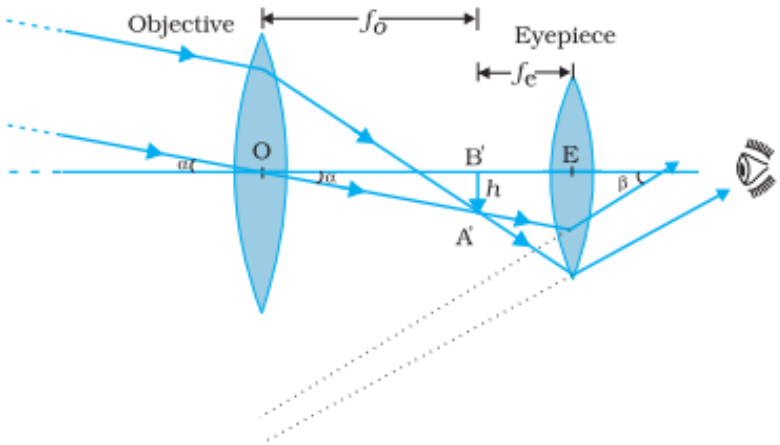
(c) Infrared Rays – Used in night vision camera, bolometer & thermopiles ½ +½

(Note: Give full credit to any other use written.) 3

8. **a)**

Labelled Ray Diagram of refracting telescope for normal adjustment	1 ½
Derivation of Expression of magnifying power	1 ½

Ray Diagram refer to



1½

$m = \frac{\tan\beta}{\tan\alpha} \approx \frac{\beta}{\alpha}$ (as α, β are small angles) ½

$\approx \frac{h}{f_e} \times \frac{f_0}{h}$ ½

$m = \frac{f_o}{f_e}$ ½

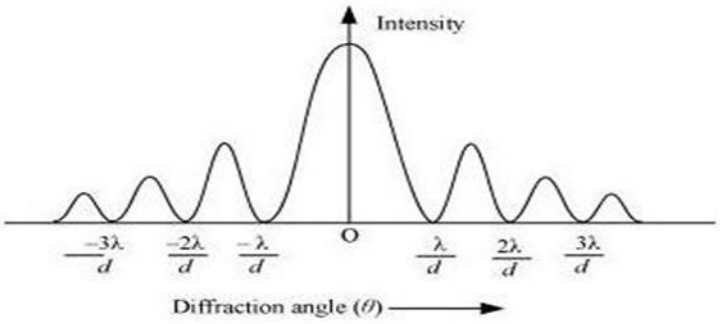
(Note: ½ mark to be deducted if arrows not shown or labelling is not done)

8. **OR**

b)

(i)	Intensity distribution curve for diffraction	1 ½
(ii)	Expression of first maximum from the central maximum	1 ½

(i) Intensity distribution curve



1½

For maximum

(ii) $a\sin\theta = (n+\frac{1}{2})\lambda$ ½

For first Maximum ; n = 1

For small θ; a $\theta = \frac{3\lambda}{2} \Rightarrow \theta = \frac{3\lambda}{2a}$ ½

$\therefore \frac{x}{D} = \frac{3\lambda}{2a}$

$\therefore x = \frac{3\lambda D}{2a}$ ½

3

9.

a) Bohr's Quantization condition for stationary orbit	1
b) Relation between λ_1, λ_2 and λ_3	2

a) Condition for stationary orbits:- The electron revolves around the nucleus only in those orbits for which angular momentum is some integral multiple of $\frac{h}{2\pi}$. 1

mvr = L = $\frac{nh}{2\pi r}$

(b) For transition $C \to A$ $\frac{hc}{\lambda_3} = E_C - E_A$ ½

For transition $C \to B$ $\frac{hc}{\lambda_1} = E_C - E_B$ ½

For transition $B \rightarrow A$ $\quad \frac{hc}{\lambda_2} = E_B - E_A$ ½

$\Rightarrow E_C - E_A = E_C - E_B + E_B - E_A$

$\frac{1}{\lambda_3} = \frac{1}{\lambda_1} + \frac{1}{\lambda_2}$ ½

3

10.

a) Dependence	½
Reason	½
b) Finding the area of surface	2

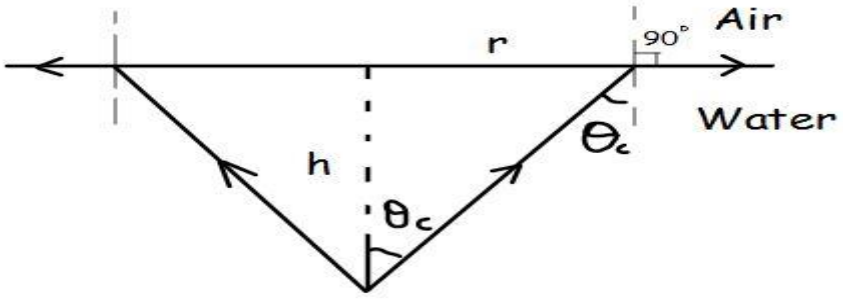
a) No ½

$\mu \alpha \frac{1}{v_m} \alpha \frac{1}{\lambda}$

Where v_m velocity of light in medium ½

$\therefore$ velocity depends on wavelength

b)



½

$\mu \sin\theta_c = 1 \Rightarrow \sin\theta_c = \frac{1}{\mu} = \frac{3}{4}$ ½

$\tan\theta_c = \frac{r}{h} = \frac{1}{\mu} \times \frac{1}{\sqrt{1 - \frac{1}{\mu^2}}} = \frac{1}{\sqrt{\mu^2 - 1}}$

Area $A = \pi r^2 = \pi (h \tan\theta_c)^2$ ½

$A = \frac{\pi h^2}{\mu^2 - 1}$

$A = \frac{\pi \times 70 \times 70}{\left(\frac{4}{3}\right)^2 - 1} = 19800 \text{ cm}^2$ ½

3

11.	a) Calculation of Angle of minimum deviation 2 b) Critical Angle 1 a) $\mu = \frac{\sin(\frac{\delta_m + A)}{2}}{\sin(A/2)}$ $\sqrt{2} = \frac{\sin\left(\frac{\delta_m + 60°}{2}\right)}{\sin 30°} \Rightarrow \sin\left(\frac{\delta_m + 60°}{2}\right) = \sqrt{2} \times \frac{1}{2}$ $\sin\left(\frac{\delta_m + 60°}{2}\right) = \frac{1}{\sqrt{2}} \Rightarrow \left(\frac{\delta_m + 60°}{2}\right) = 45°$ $\delta_m = 90° - 60° \Rightarrow \delta_m = 30°$ b) $\sin\theta_c = \frac{1}{\mu} = \frac{1}{\sqrt{2}}$ $\theta_c = 45°$	½ ½ ½ ½ ½ ½	3
12.	a) (iii) b) (iv) c) (ii) d) (iii) e) (iv)	1 1 1 1 1	5

* * *

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SeniorSecondary School Term II Examination, 2022

Marking Scheme – PHYSICS (SUBJECT CODE — 042)

(PAPER CODE — 55/2/3)

General Instructions: -

1. You are aware that evaluation is the most important process in the actual and correct assessment of the candidates. A small mistake in evaluation may lead to serious problems which may affect the future of the candidates, education system and teaching profession. To avoid mistakes, it is requested that before starting evaluation, you must read and understand the spot evaluation guidelines carefully.

2. **"Evaluation policy is a confidential policy as it is related to the confidentiality of the examinations conducted, Evaluation done and several other aspects. Its' leakage to public in any manner could lead to derailment of the examination system and affect the life and future of millions of candidates. Sharing this policy/document to anyone, publishing in any magazine and printing in News Paper/Website etc may invite action under IPC."**

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 strictly adhered to and religiously followed. **However, while evaluating, answers which are based on latest information or knowledge and/or are innovative, they may be assessed for their correctness otherwise and marks be awarded to them. In class-X, while evaluating two competency based questions, please try to understand given answer and even if reply is not from marking scheme but correct competency is enumerated by the candidate, marks should be awarded.**

4. The Head-Examiner must go through the first five answer books evaluated by each evaluator on the first day, to ensure that evaluation has been carried out as per the instructions given in the Marking Scheme. The remaining answer books meant for evaluation shall be given only after ensuring that there is no significant variation in the marking of individual evaluators.

5. Evaluators will mark(√) wherever answer is correct. For wrong answer 'X' be marked. Evaluators will not put right kind of mark while evaluating which gives an impression that answer is correct and no marks are awarded. **This is most common mistake which evaluators are committing.**

6. If a question has parts, please award marks on the right-hand side for each part. Marks awarded for different parts of the question should then be totaled up and written in the left-hand margin and encircled. This may be followed strictly.

7. If a question does not have any parts, marks must be awarded in the left-hand margin and encircled. This may also be followed strictly.

8. If a student has attempted an extra question, answer of the question deserving more marks should be retained and the other answer scored out.

9. No marks to be deducted for the cumulative effect of an error. It should be penalized only once.

10. A full scale of marks _35_(example 0-40 marks as given in Question Paper) has to be used. Please do not hesitate to award full marks if the answer deserves it.

11. Every examiner has to necessarily do evaluation work for full working hours i.e. 8 hours every day and evaluate 30 answer books per day in main subjects and 35 answer books per day in other subjects (Details are given in Spot Guidelines). This is in view of the reduced syllabus and number of questions in question paper.

12. Ensure that you do not make the following common types of errors committed by the Examiner in the past:-
    - Leaving answer or part thereof unassessed in an answer book.
    - Giving more marks for an answer than assigned to it.
    - Wrong totaling of marks awarded on a reply.
    - Wrong transfer 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 transfer of marks from the answer book to online award list.
    - Answers marked as correct, but marks not awarded. (Ensure that the right tick mark is correctly and clearly indicated. It should merely be a line. Same is with the X for incorrect answer.)
    - Half or a part of answer marked correct and the rest as wrong, but no marks awarded.

13. While evaluating the answer books if the answer is found to be totally incorrect, it should be marked as cross (X) and awarded zero (0)Marks.

14. 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.

15. The Examiners should acquaint themselves with the guidelines given in the Guidelines for spot Evaluation before starting the actual evaluation.

16. Every Examiner shall also ensure that all the answers are evaluated, marks carried over to the title page, correctly totaled and written in figures and words.

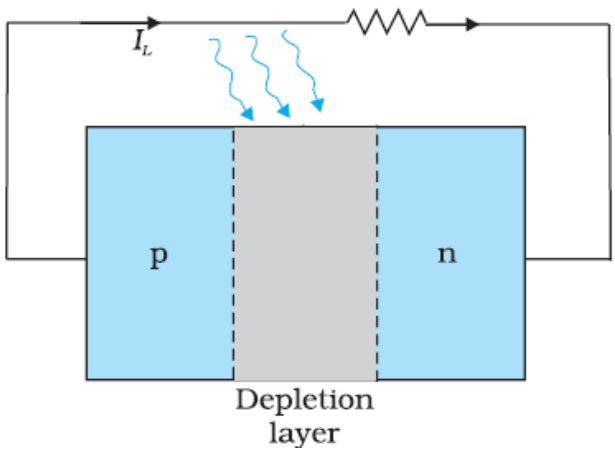
17. The Board permits candidates to obtain photocopy of the Answer Book on request in an RTI application and also separately as a part of the re-evaluation process on payment of the processing charges.

MARKING SCHEME

Senior Secondary School Examination TERM–II, 2022

PHYSICS (Subject Code — 042)

[Paper Code — 55/2/3]

Q. No.	EXPECTED ANSWER / VALUE POINTS	Marks	Total Marks
	SECTION—A		
1.	Significance of P and Q 1 Circuit diagram 1 a) Point P: open circuit Potential difference or emf Point Q : short circuit current b)  	½ ½ 1	2
2.	Explanation of Formation of Depletion region 2 When p-type semiconductor is chipped with n-type semiconductor, e^- from the n-side diffuse towards p-side and holes from p-side diffuse towards n-side leaving behind a layer of immobile +ve ions on n-side and immobile –ve ions on p-side leading to formation of depletion layer. **(Note : Award 1 mark, if a student draws a diagram showing depletion region)**	2	2
3.	(a) Definition of impact parameter & distance of closest approach Values ½ + ½ Value of Impact parameter for (I) & (II) ½ + ½		

i. **Impact Parameter** : It is the perpendicular distance of the initial velocity vector of the approaching α-particle from the centre of the nucleus. ½

Distance of closest approach : It is the minimum distance of the approaching α-particle and the target gold nucleus ½

$d = \frac{2Ze^2}{4\pi\varepsilon_0 K}$; Where K is the kinetic energy

Alternatively : Distance of closest approach is the distance of the alpha particle from the centre of gold nucleus where its whole kinetic energy is converted into potential energy

ii. $\theta = 0°$; b = maximum / almost of atomic size ½

$\theta = 180°$; b = minimum = zero ½

(Note: Allot ½ Mark for only formula.)

3. **OR**

(b)

Expressions for kinetic energy	½ + ½
Expression for threshold Frequency	1

$K = h\nu_1 - \phi_0$ and $2K = h\nu_2 - \phi_0$ ½+½

$\Rightarrow 2(h\nu_1 - \phi_0) = h\nu_2 - \phi_0$

$\Rightarrow 2h\nu_1 - 2\phi_0 = h\nu_2 - \phi_0$ ½

$\Rightarrow h(2\nu_1 - \nu_2) = \phi_0 = h\nu_0$

$\Rightarrow (2\nu_1 - \nu_2) = \phi_0 = \nu_0$

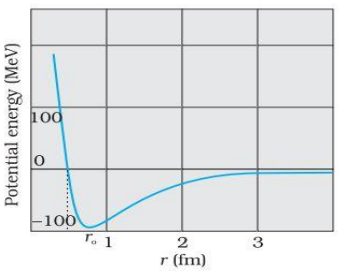
$\Rightarrow \nu_0 = 2\nu_1 - \nu_2$ ½

2

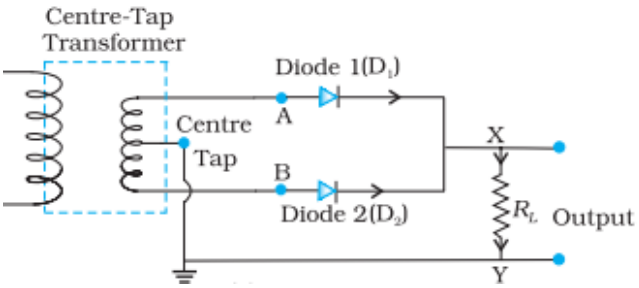
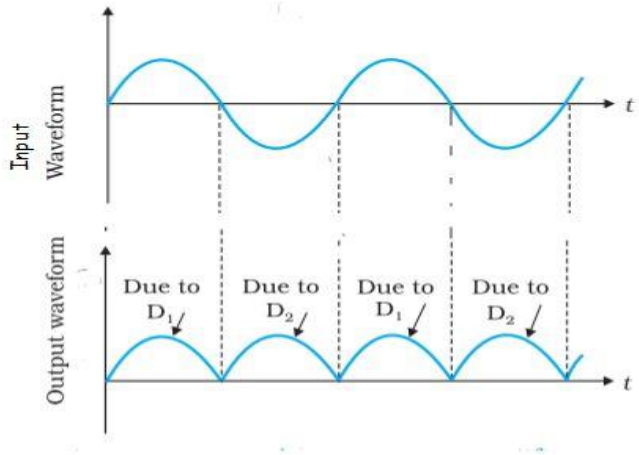
4.

(a) Graph	1½
(b) Mass Difference	1
Conclusion	½

(a)



1 ½

	(b)Mass Difference = 55.93494 – 2 X 27.98191 = - 0.02442 u Fission not possible.	1 ½	2
5.	Explanation of working 1 Circuit Diagram of full wave rectifier 1 Input & Output Waveform ½ + ½  Let input voltage at A w.r.t. the centre tap at any instant is positive, then voltage at B will be negative. So, diode D_1 gets forwarded biased & D_2 gets reverse biased. Hence output current is obtained. When voltage at A becomes –ve ; then voltage at B would be + ve , hence D_1, gets reverse biased & D_2 gets forwarded biased . So output current is again obtained as shown in the figure.  **(Note: If the student takes inverted input waveform full credit to be given.)**	1 1 ½ ½	3

6.

Finding the position of the image	2 ½
Nature	½

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \qquad \text{½}$$

$$\frac{1}{f} = \frac{1}{32} + \frac{1}{16} = \frac{1+2}{32} = \frac{3}{32} \qquad \text{½}$$

$$f = \frac{32}{3} cm \qquad \text{½}$$

When lens is cut into two equal halves the new focal length = $f' = 2f = \frac{64}{3}$ cm

$$\frac{1}{f'} = \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{3}{64} = \frac{1}{v} + \frac{1}{16} \qquad \text{½}$$

$$\frac{1}{v} = \frac{3}{64} - \frac{1}{16} = \frac{3-4}{64} = \frac{-1}{64}$$

v = - 64 cm ½

Image formed is virtual & erect. ½ 3

7.

Critical Angle	1
Angle of Refraction	2

a)

$$\mu = \frac{1}{\sin i_c} \Rightarrow \sqrt{2} = \frac{1}{\sin i_c} \qquad \text{½}$$

$$i_c = 45° \qquad \text{½}$$

b)

$$r_2 = 45° = i_c \qquad \text{½}$$

$$A = r_1 + r_2 \qquad \text{½}$$

$$60 = r_1 + 45° \qquad \text{½}$$

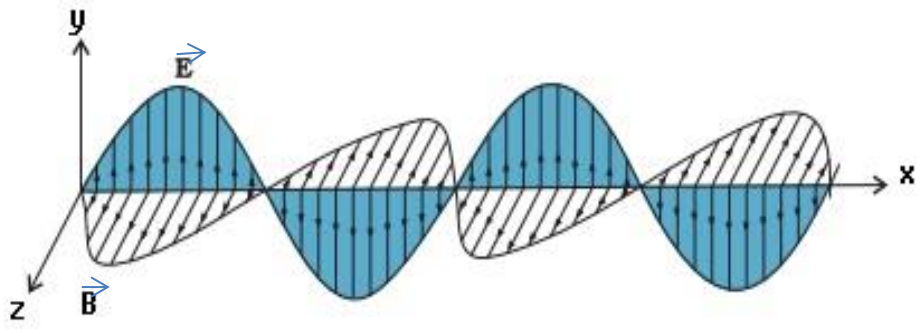
$r_1 = 15°$ ½ 3

8. **SECTION—B**

a)

(i)	Depiction of plane EM wave	½
	Expression for electric field	½
	Expression for magnetic field	½
(ii)	Characteristics of EM waves	½ + ½ + ½

(i)



½

$E_y = E_0 \sin(kx - \omega t)$ ½

$B_z = B_0 \sin(kx - \omega t)$ ½

(ii) The three characteristics are:

a) They travel with velocity of light. ½

b) They carry energy and momentum. ½

c) They are transverse in nature. ½

(Or any other characteristic given)

OR

8. **b)**

Naming of EM waves	½ + ½ + ½
Uses of EM waves	½ + ½ + ½

(a) Gamma Rays - Used for cancer treatment

(b) Ultraviolet/Visible/Infrared (either) – Use of anyone of these three. ½ + ½

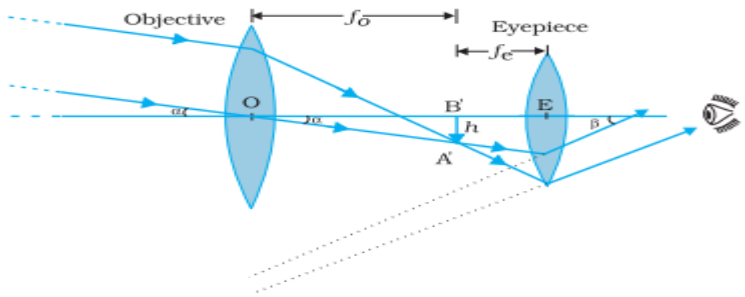
(c) Infrared Rays – Used in night vision camera, bolometer & thermopiles ½ + ½

(Note: Give full credit to any other use written.) ½ + ½

3

9. **a)**

Labelled Ray Diagram of refracting telescope for normal arrangement	1 ½
Derivation of Expression of magnifying power	1 ½



1½

$$m = \frac{\tan\beta}{\tan\alpha} \approx \frac{\beta}{\alpha} \text{ (as } \alpha, \beta \text{ are small angles)}$$ ½

$$\approx \frac{h}{f_e} x \frac{f_0}{h}$$ ½

$$= \frac{f_0}{f_e}$$ ½

(Note: ½ mark to be deducted if arrows not shown or labelling is not done)

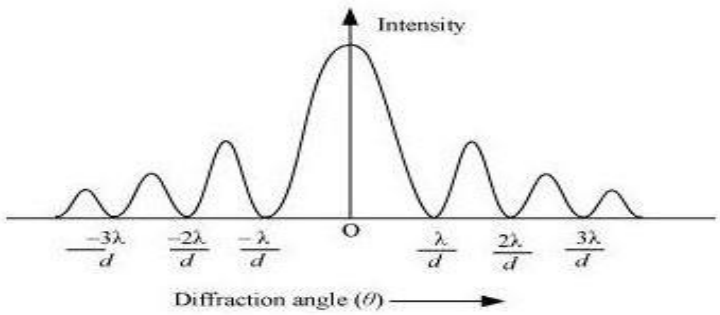
9.

OR

b)

(i)Intensity distribution curve for diffraction	1½
(ii)Expression of first maximum from the central maximum	1½

(i) Intensity distribution curve



1½

For maximum ½

$$a\sin\theta = (n + \frac{1}{2})\lambda$$

For first Maximum ; n = 1 ½

For small θ; a $\theta = \frac{3\lambda}{2}$ => $\theta = \frac{3\lambda}{2a}$

$\therefore \frac{x}{D} = \frac{3}{2}\frac{\lambda}{a}$ ½

$\therefore x = \frac{3}{2}\frac{\lambda D}{a}$ 3

10.

Finding the ratio when	
a) Speed is same	1
b) K.E. is same	1
c) Potential difference is same	1

(a) $\lambda = \frac{h}{p}$ ½

$\frac{\lambda_\alpha}{\lambda_p} = \frac{h}{m_\alpha v_\alpha} \times \frac{m_p v_p}{h} = \frac{1}{4}$ ½

(b)

$p = \sqrt{2mK.E}$ ½

$\frac{\lambda_\alpha}{\lambda_p} = \frac{h}{\sqrt{2m_\alpha (\mathrm{K.E.})_\alpha}} \times \frac{\sqrt{2m_p (K.\mathrm{E.})_p}}{h} = \sqrt{\frac{m_p}{m_\alpha}} = \frac{1}{2}$ ½

(c)

$v = \sqrt{\frac{2qV}{m}}$ ½

$\frac{\lambda_\alpha}{\lambda_p} = \frac{h}{m_\alpha v_\alpha} \times \frac{m_p v_p}{h} = \frac{m_p}{m_\alpha}\sqrt{\frac{2q_p V}{m_p}} \times \sqrt{\frac{m_\alpha}{2q_\alpha V}}$

$= \frac{m_p}{m_\alpha} \times \sqrt{\frac{m_\alpha}{m_p}} \times \sqrt{\frac{q_p}{q_\alpha}} = \frac{1}{2\sqrt{2}}$ ½ 3

11.

a) Number of spectral lines	1
b) Minimum wavelength	2

(a) 6 1

	(b) $h\nu = \frac{hc}{\lambda} = E_4 - E_1$ $= -0.85 + 13.6$ $= +12.75 ev$ $\frac{hc}{\lambda} = 12.75 \times 1.6 \times 10^{-19}$ $\lambda = \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{12.75 \times 1.6 \times 10^{-19}}$ $\lambda = 975 nm = 9.75 \times 10^{-11} m$	½ ½ ½ ½	3
12.	a) (iii) b) (iv) c) (ii) d) (iii) e) (iv)	1 1 1 1 1	5