Series A5BAB/5

SET No. 1

प्रश्न पत्र कोड
Q.P. Code 55/5/1

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 :		NOTE :	
(I)	कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ **15** हैं।	(I)	Please check that this question paper contains **15** printed pages.
(II)	प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को छात्र उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें।	(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)	कृपया जाँच कर लें कि इस प्रश्न-पत्र में **12** प्रश्न हैं।	(III)	Please check that this question paper contains **12** questions.
(IV)	कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, उत्तर-पुस्तिका में प्रश्न का क्रमांक अवश्य लिखें।	(IV)	Please write down the Serial Number of the question in the answer-book before attempting it.
(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।	(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
Time allowed : 2 hours

अधिकतम अंक : 35
Maximum Marks : 35

सामान्य निर्देश:

निम्नलिखित निर्देशों को ध्यान से पढ़ें और उनका पालन करें :

1. *इस प्रश्न-पत्र में कुल **12** प्रश्न हैं। **सभी** प्रश्न अनिवार्य हैं।*
2. *यह प्रश्न-पत्र **तीन** खण्डों में विभाजित है, **खण्ड - क, ख** और **ग**।*
3. ***खण्ड क** - प्रश्न संख्या 1 से 3 तक प्रत्येक प्रश्न **2** अंक का है।*
4. ***खण्ड ख** - प्रश्न संख्या 4 से 11 तक प्रत्येक प्रश्न **3** अंक का है।*
5. ***खण्ड ग** - प्रश्न संख्या 12 प्रकरण आधारित प्रश्न है। यह प्रश्न **5** अंक का है।*
6. *प्रश्न-पत्र में कोई समग्र विकल्प नहीं है। हालांकि कुछ प्रश्नों में आंतरिक विकल्प प्रदान किए गए हैं। इनमें से **केवल एक** ही प्रश्न का उत्तर लिखिए।*
7. *लॉग टेबल का उपयोग कर सकते हैं लेकिन कैलकुलेटर के उपयोग की अनुमति नहीं है।*

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

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

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

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

$\varepsilon_0 = 8.854 \times 10^{-12}$ C^2 N^{-1} m^{-2}

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

इलेक्ट्रॉन का द्रव्यमान $(m_e) = 9.1 \times 10^{-31}$ kg

न्यूट्रॉन का द्रव्यमान = 1.675×10^{-27} kg

प्रोटॉन का द्रव्यमान = 1.673×10^{-27} kg

आवोगाद्रो संख्या = 6.023×10^{23} प्रति ग्राम मोल

बोल्ट्ज़मान नियतांक = 1.38×10^{-23} JK^{-1}

General Instructions :

Please read the following instructions carefully and follow them :

1. *This question paper contains* ***12*** *questions.* ***All*** *questions are compulsory.*
2. *This question paper is divided into* ***THREE*** *sections,* ***Section*** **- A, B** *and* **C**.
3. ***Section*** **A** - *Question number 1 to 3 are of* ***2*** *marks each.*
4. ***Section*** **B** - *Question number 4 to 11 are of* ***3*** *marks each.*
5. ***Section*** **C** - *Question number 12 is a case study based question of* ***5*** *marks.*
6. *There is no overall choice in the question paper. However, internal choice has been provided in some of the questions. Attempt* ***any one*** *of the alternatives in such questions.*
7. *Use of log tables is permitted, if necessary, but use of calculator is not permitted.*

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

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

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

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

$\varepsilon_0 = 8.854 \times 10^{-12}$ 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) = 9.1×10^{-31} kg

Mass of neutron = 1.675×10^{-27} kg

Mass of proton = 1.673×10^{-27} kg

Avogadro's number = 6.023×10^{23} per gram mole

Boltzmann constant = 1.38×10^{-23} JK^{-1}

खण्ड क

1. परिपथ आरेख की सहायता से संक्षेप में p-n संधि डायोड की अर्ध तरंग दिष्टकारी के रूप में कार्यविधि की व्याख्या कीजिए। 2

2. (क) यदि α–कण प्रकीर्णन प्रयोग को स्वर्ण पत्र के स्थान पर हाइड्रोजन की एक पतली शीट (हाइड्रोजन 14K से कम ताप पर ठोस अवस्था में होती है) के साथ दोहराया जाए, तो आप किस परिणाम की अपेक्षा करते हैं ? व्याख्या कीजिए। 2

अथवा

(ख) ऐसा क्यों है कि किसी प्रकाश स्रोत की आवृत्ति, न कि तीव्रता, यह निर्धारित करती है कि प्रकाशिक इलेक्ट्रॉनों का उत्सर्जन होगा अथवा नहीं होगा ? व्याख्या कीजिए। 2

3. यद्यपि अग्रदिशिक बायस में पश्चदिशिक बायस की तुलना में विद्युतधारा बहुत अधिक होती है फिर कोई फोटो–डायोड पश्चदिशिक बायस में क्यों प्रचालित होता है ? व्याख्या कीजिए। इसके दो उपयोगों का उल्लेख कीजिए। 2

खण्ड ख

4. गाइगर–मार्सडेन प्रयोग में प्रकीर्णन कोण θ के साथ प्रकीर्णित कणों की संख्या N के विचरण को दर्शाने वाला ग्राफ आरेखित कीजिए। $\theta > 90^\circ$ पर कणों का केवल एक छोटा भाग ही प्रकीर्णित होता है। परमाणु के रदरफोर्ड–मॉडल की दो सीमाओं का उल्लेख कीजिए। 3

SECTION A

1. With the help of a circuit diagram, explain briefly how a p-n junction diode works as a half-wave rectifier. 2

2. (a) What results do you expect if α-particle scattering experiment is repeated using a thin sheet of hydrogen in place of a gold foil ? Explain. (Hydrogen is a solid at temperature below 14K) 2

OR

(b) Why it is the frequency and not the intensity of light source that determines whether emission of photoelectrons will occur or not ? Explain. 2

3. Why a photo-diode is operated in reverse bias whereas current in the forward bias is much larger than that in the reverse bias ? Explain.
Mention its two uses. 2

SECTION B

4. Draw a graph showing the variation of number of particles scattered (N) with the scattering angle θ in Geiger-Marsden experiment. Why only a small fraction of the particles are scattered at $\theta > 90^{\circ}$? Mention two limitations of Rutherford nuclear model of an atom. 3

5. (i) किसी p-n संधि डायोड का V-I अभिलाक्षणिक खींचिए। 3

(ii) किसी डायोड के लिए देहली वोल्टता और भंजन वोल्टता के बीच विभेदन कीजिए।

(iii) संधि डायोड के उस गुण का उल्लेख कीजिए जो उसे ac वोल्टता के दिष्टकरण के लिए उपयुक्त बनाता है।

6. तीव्र गतिशील न्यूट्रॉनों द्वारा $^{238}_{92}U$ के विखण्डन की किसी घटना में न्यूट्रॉनों का कोई उत्सर्जन नहीं होता है तथा प्राथमिक खण्डों के बीटा क्षय के पश्चात् बने अंतिम उत्पाद $^{140}_{58}Ce$ और $^{99}_{44}Ru$ हैं। इस प्रक्रिया के लिए Q परिकलित कीजिए। बीच के चरणों में उत्सर्जित इलेक्ट्रॉनों/पाज़िट्रॉनों के द्रव्यमानों की उपेक्षा कीजिए। 3

दिया है : $m\left(^{238}_{92}U\right) = 238.05079u;\ m\left(^{140}_{58}Ce\right) = 139.90543u$

$m\left(^{99}_{44}Ru\right) = 98.90594u;\ m\left(^{1}_{0}n\right) = 1.008665u$

7. आप यह किस प्रकार विभेदन कर सकते हैं कि कोई पैटर्न एक-झिरी द्वारा उत्पन्न किया गया है अथवा द्वि-झिरी द्वारा उत्पन्न किया गया है ? किसी एकल-झिरी विवर्तन द्वारा उत्पन्न (i) चमकीली फ्रिन्जों, (ii) काली फ्रिन्जों की कोणीय स्थिति के लिए व्यंजक व्युत्पन्न कीजिए। 3

5. (i) Draw V-I characteristics of a p-n Junction diode. 3

(ii) Differentiate between the threshold voltage and the breakdown voltage for a diode.

(iii) Write the property of a junction diode which makes it suitable for rectification of ac voltages.

6. In a fission event of $^{238}_{92}U$ by fast moving neutrons, no neutrons are emitted and final products, after the beta decay of the primary fragments, are $^{140}_{58}Ce$ and $^{99}_{44}Ru$. Calculate Q for this process. Neglect the masses of electrons/ positrons emitted during the intermediate steps. 3

Given : $m\left(^{238}_{92}U\right) = 238.05079u$; $m\left(^{140}_{58}Ce\right) = 139.90543u$

$m\left(^{99}_{44}Ru\right) = 98.90594u$; $m\left(^{1}_{0}n\right) = 1.008665u$

7. How can you differentiate whether a pattern is produced by a single slit or double slits ? Derive the expression for the angular position of (i) bright and (ii) dark fringes produced in a single slit diffraction. 3

8. (क) (i) लेंस की क्षमता के SI मात्रक की परिभाषा लिखिए। 3

(ii) कोई समतल-उत्तल लेंस 1.5 अपवर्तनांक के कांच का बना है। इसके उत्तल पृष्ठ की वक्रता त्रिज्या 25 cm है।

(ii.i) इस लेंस की फोकस दूरी परिकलित कीजिए।

(ii.ii) यदि कोई बिम्ब इस लेंस के सामने 50 cm दूरी पर स्थित है तो बनने वाले प्रतिबिम्ब की स्थिति और प्रकृति ज्ञात कीजिए।

अथवा

(ख) 0.6 mm चौड़ी किसी झिरी को 600 nm और 480 nm तरंगदैर्ध्य के किसी प्रकाश पुन्ज द्वारा प्रकाशित किया गया है। विवर्तन पैटर्न को झिरी से 1 m दूर स्थित पर्दे पर प्रेक्षित किया गया है। 3

(i) 600 nm के प्रकाश के केन्द्रीय उच्चिष्ठ से दूसरी चमकीली फ्रिन्ज की दूरी ज्ञात कीजिए।

(ii) केन्द्रीय उच्चिष्ठ से वह अल्पतम दूरी ज्ञात कीजिए जिस पर दोनों तरंगदैर्ध्यों की चमकीली फ्रिन्जें संपात करेंगी।

9. (क) तरंगदैर्ध्य 331.5 nm के किसी प्रकाश पुन्ज में किसी फोटॉन की ऊर्जा और संवेग परिकलित कीजिए। 3

(ख) भाग (क) के फोटॉन के बराबर संवेग प्राप्त करने के लिए किसी हाइड्रोजन-परमाणु को कितनी तीव्र चाल से गमन करना चाहिए ?

8. (a) (i) Define SI unit of power of a lens. 3

(ii) A plano convex lens is made of glass of refractive index 1.5. The radius of curvature of the convex surface is 25 cm.

(ii.i) Calculate the focal length of the lens.

(ii.ii) If an object is placed 50 cm in front of the lens, find the nature and position of the image formed.

OR

(b) A slit of width 0.6 mm is illuminated by a beam of light consisting of two wavelengths 600 nm and 480 nm. The diffraction pattern is observed on a screen 1.0 m from the slit. Find : 3

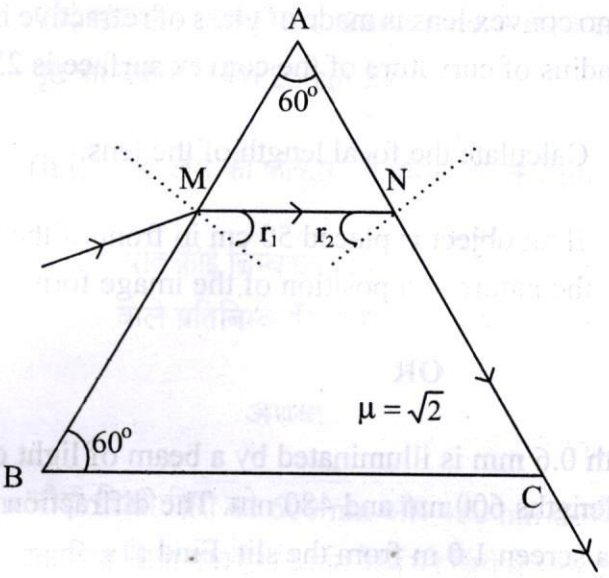
(i) The distance of the second bright fringe from the central maximum pertaining to light of 600 nm.

(ii) The least distance from the central maximum at which bright fringes due to both the wavelengths coincide.

9. (a) Calculate the energy and momentum of a photon in a monochromatic beam of wavelength 331.5 nm. 3

(b) How fast should a hydrogen atom travel in order to have the same momentum as that of the photon in part (a) ?

10. अपवर्तनांक $\sqrt{2}$ के किसी प्रिज़्म से कोई प्रकाश की किरण, आरेख में दर्शाए अनुसार गमन कर रही है। 3



(i) फलक AC पर आपतन कोण ($\angle r_2$) का मान ज्ञात कीजिए।

(ii) प्रिज़्म के लिए न्यूनतम विचलन कोण का मान ज्ञात कीजिए।

11. (क) (i) नीचे दी गई विद्युत-चुम्बकीय विकिरण को उनकी आवृत्तियों के आरोही (बढ़ते) क्रम में व्यवस्थित कीजिए : 3

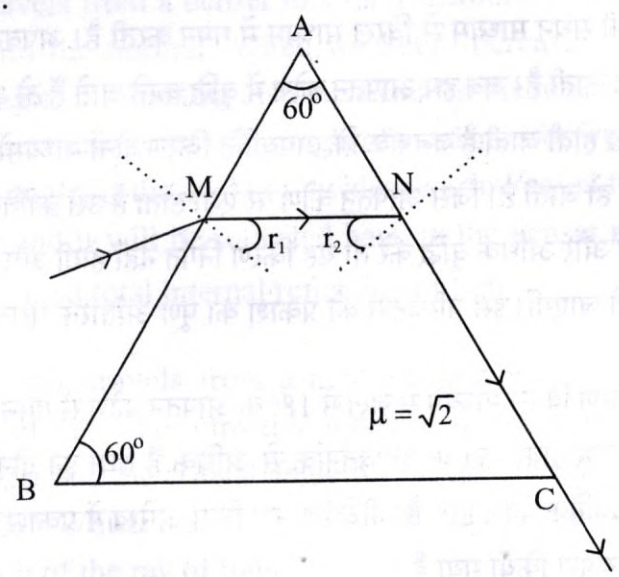
X-किरणें, सूक्ष्म तरंगें, गामा किरणें, रेडियो-तरंगें

(ii) इन विकिरणों में से किन्हीं दो विकिरणों के दो-दो उपयोग लिखिए।

अथवा

(ख) किरण आरेख की सहायता से किसी परावर्ती दूरदर्शक की कार्यविधि की व्याख्या कीजिए। 3
अपवर्ती दूरदर्शक की तुलना में परावर्ती दूरदर्शक की दो विशेषताओं का उल्लेख कीजिए।

10. A ray of light passes through a prism of refractive index $\sqrt{2}$ as shown in the figure. Find : 3



(i) The angle of incidence ($\angle r_2$) at face AC.

(ii) The angle of minimum deviation for this prism.

11. (a) (i) Arrange the following electromagnetic radiation in the ascending order of their frequencies : 3

X-rays, microwaves, gamma rays, radio waves

(ii) Write two uses of any two of these radiation.

OR

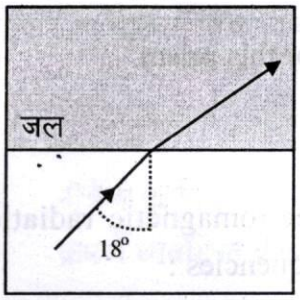
(b) With the help of a ray diagram explain the working of a reflecting telescope. Mention two advantages of a reflecting telescope over a refracting telescope. 3

खण्ड ग

12. कोई प्रकाश किरण किसी सघन माध्यम से विरल माध्यम में गमन करती है। अपवर्तन के पश्चात् यह अभिलम्ब से दूर मुड़ जाती है। जब हम आपतन कोण में वृद्धि करते जाते हैं तो अपवर्तन कोण में भी उस समय तक वृद्धि होती जाती है जब तक कि अपवर्तित किरण दोनों माध्यमों के अन्तरापृष्ठ के अनुदिश पृष्ठसर्पी नहीं हो जाती है। जिस आपतन कोण पर ऐसा होता है उसे क्रांतिक कोण कहते हैं। यदि आपतन कोण में और अधिक वृद्धि करें तो यह किरण निर्गत नहीं होगी और सघन माध्यम में ही वापस परावर्तित हो जाएगी। इस परिघटना को प्रकाश का पूर्ण आंतरिक परावर्तन कहते हैं। 5

(i) कोई प्रकाश किरण किसी माध्यम से जल में 18° के आपतन कोण से गमन करती है। इस माध्यम का अपवर्तनांक जल के अपवर्तनांक से अधिक है तथा इन दोनों माध्यमों के अन्तरापृष्ठ पर क्रांतिक कोण 20° है। नीचे दिए गए किस आरेख में प्रकाश किरण के पथ का सर्वोत्तम निरूपण किया गया है ?

(क)



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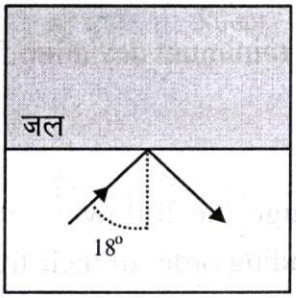
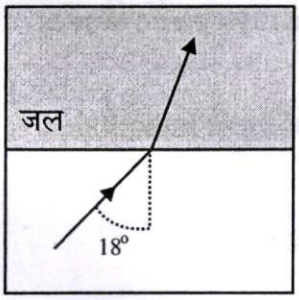
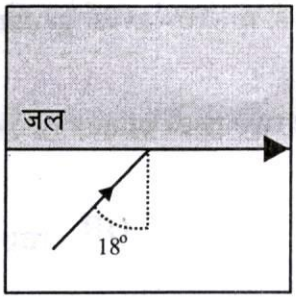


(ग)



(घ)

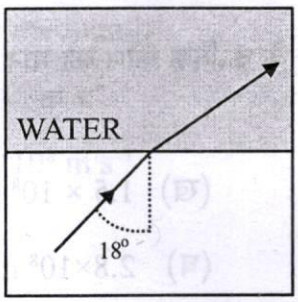


SECTION C

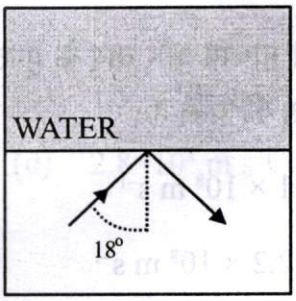
12. A ray of light travels from a denser to a rarer medium. After refraction, it bends away from the normal. When we keep increasing the angle of incidence, the angle of refraction also increases till the refracted ray grazes along the interface of two media. The angle of incidence for which it happens is called critical angle. If the angle of incidence is increased further the ray will not emerge and it will be reflected back in the denser medium. This phenomenon is called total internal reflection of light. 5

(i) A ray of light travels from a medium into water at an angle of incidence of 18°. The refractive index of the medium is more than that of water and the critical angle for the interface between the two media is 20°. Which one of the following figures best represents the correct path of the ray of light ?

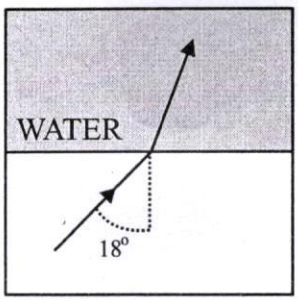
(A)



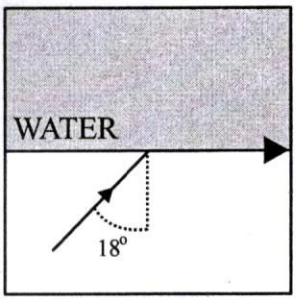
(B)



(C)



(D)



(ii) प्रकाश का कोई बिन्दु स्रोत अपवर्तनांक μ के पानी से भरी किसी टंकी, जिसकी गहराई d है, की तली पर रखा है। जल के पृष्ठ का वह क्षेत्रफल क्या है जिससे होकर स्रोत का प्रकाश निर्गत हो सकता है :

(क) $\frac{\pi d^2}{2(\mu^2-1)}$ (ख) $\frac{\pi d^2}{(\mu^2-1)}$ (ग) $\frac{\pi d^2}{\sqrt{2}\sqrt{\mu^2-1}}$ (घ) $\frac{2\pi d^2}{(\mu^2-1)}$

(iii) निम्नलिखित में से किस माध्यम का, वायु के सापेक्ष, क्रांतिक कोण का मान अधिकतम है ?

(क) क्राउन कांच (ख) फ्लिंट कांच (ग) पानी (घ) हीरा

(iv) दो माध्यमों A (अपवर्तनांक 2.0) और B (अपवर्तनांक 1.0) के किसी युगल के लिए क्रांतिक कोण का मान है :

(क) 0° (ख) 30° (ग) 45° (घ) 60°

(v) किसी माध्यम और वायु के युगल के क्रांतिक कोण का मान 30° है। इस माध्यम में प्रकाश की चाल है :

(क) 1×10^8 m s^{-1} (ख) 1.5×10^8 m s^{-1}

(ग) 2.2×10^8 m s^{-1} (घ) 2.8×10^8 m s^{-1}

(ii) A point source of light is placed at the bottom of a tank filled with water, of refractive index μ, to a depth d. The area of the surface of water through which light from the source can emerge, is :

(a) $\frac{\pi d^2}{2(\mu^2-1)}$ (b) $\frac{\pi d^2}{(\mu^2-1)}$ (c) $\frac{\pi d^2}{\sqrt{2}\sqrt{\mu^2-1}}$ (d) $\frac{2\pi d^2}{(\mu^2-1)}$

(iii) For which of the following media, with respect to air, the value of critical angle is maximum ?

(a) Crown glass (b) Flint glass (c) Water (d) Diamond

(iv) The critical angle for a pair of two media A and B of refractive indices 2.0 and 1.0 respectively is :

(a) 0° (b) 30° (c) 45° (d) 60°

(v) The critical angle of pair of a medium and air is 30°. The speed of light in the medium is :

(a) 1×10^8 m s^{-1} (b) 1.5×10^8 m s^{-1}

(c) 2.2×10^8 m s^{-1} (d) 2.8×10^8 m s^{-1}

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Senior Secondary School Term II Examination, 2022

Marking Scheme – PHYSICS (SUBJECT CODE – 042)

(PAPER CODE – 55/5/1)

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 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.

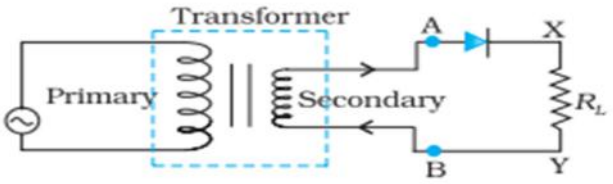
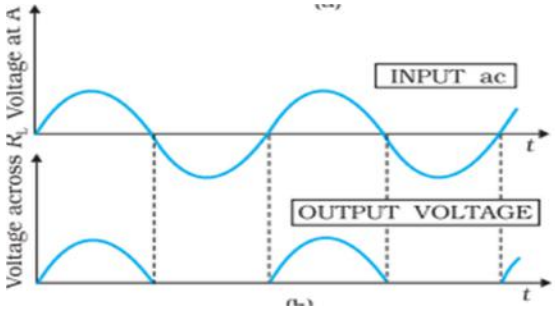
17. The Board permits candidates to obtain photocopy of the Answer Book on request in an RTI application and also separately as a part of the re-evaluation process on payment of the processing charges.

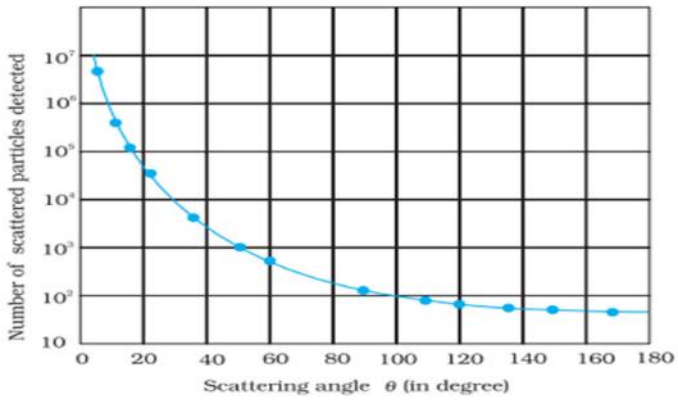
MARKING SCHEME

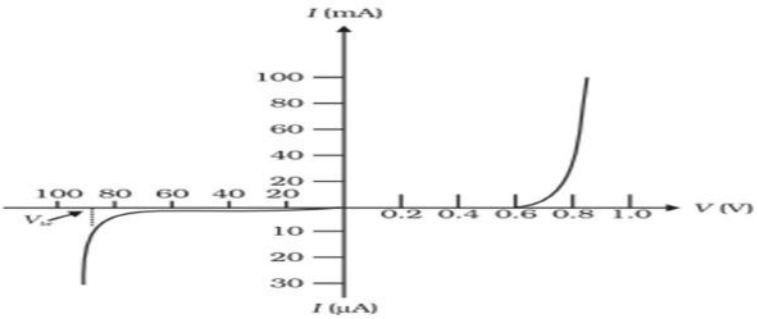
Senior Secondary School Examination TERM–II, 2022

PHYSICS (Subject Code–042)

[Paper Code : 55/5/1]

Q. No.	EXPECTED ANSWER / VALUE POINTS	Marks	Total Marks
	SECTION—A		
1.	Circuit Diagram of p-n junction diode as half wave rectifier 1 Explanation of its Working 1  • When voltage at A is positive, diode is forward biased and it conducts and when voltage at A is negative, diode is reverse biased and it does not conduct, so output is zero. **Alternatively:**  	1 1 1	2
2.	**a)** Writing of the result 1 Explanation 1 There would be no large angle scattering / Size of nucleus can't be determined. As hydrogen atom which is a target nucleus has only one proton whereas approaching α particle is more massive than the target nucleus. **Alternatively**: Repulsive force between target nucleus (Hydrogen) and α–particles will be very less. **(Note: Give full credit for other correct explanations.)**	1 1	

	OR **b)** Explanation 2 According to the photon picture of light the emission of photoelectrons depend on the energy of photon incident on the metal surface which is determined by the frequency not by the intensity.	2	2
3.	Explanation 1 Two uses ½ + ½ It is easier to observe the change in current with change in light intensity if a reverse bias is applied. **Alternatively:** The fractional change due to photo effect on the minority carrier dominated reverse bias current, is more readily measureable than the fractional change in the forward bias current. **Uses:** (Any two uses) • Smoke detector • Remote control • Medical devices • Optical signal detection (Any other uses)	1 ½+½	2
	SECTION—B		
4.	Graph 1 Reason 1 Two Limitations ½ + ½  (**Note :** Full credit if values on the axis are not mentioned)	1	

	Due to the large empty space available in an atom, α particles heading towards the nucleus are less, therefore, small fraction of particles are scattered at $\theta > 90^0$ **Alternatively:** For angle $\theta > 90^0$, the impact parameter is very small. **Limitations** • Could not explain the stability of the atom • Could not explain the existence of line spectra	1 ½ ½	3
5.	 *V-I* characteristics 1 Difference between threshold voltage and breakdown voltage 1 Property of junction diode 1 i)  (**Note :** Full credit if values on the axis are not mentioned) ii) **Threshold Voltage:** Forward bias voltage at which the current increases significantly (exponentially) even for a very small increase in voltage. **Alternatively:** Forward bias voltage at which the width depletion layer and barrier potential decreases significantly. **Alternatively:** The voltage at which resistance of junction decreases significantly. **Break down voltage:** Reverse bias voltage at which current increases suddenly **Alternatively:** Large number of covalent bonds present in the depletion layer break suddenly iii) Junction Diode conducts when it is forward biased and does not conduct when reverse biased.	1 ½ ½ 1	3

6.			
	Calculation of mass defect 2 Calculation of Q value 1		
	Δm = total mass of the reactants – total mass of the products	½	
	$= [m(^{238}_{92}\mathrm{U}) + m_n - m(^{140}_{58}\mathrm{Ce}) - m(^{99}_{44}\mathrm{Ru})]$	½	
	$= [238 \cdot 05079 + 1 \cdot 008665 - 139 \cdot 90543 - 98 \cdot 90594]u$	½	
	$= [239 \cdot 059455 - 238 \cdot 81137]u$		
	$= 0 \cdot 248085\ u$	½	
	Q-value $= 0 \cdot 248085$ x 931.5 MeV		3
	= 231.09 MeV	1	
	(Note: Award this 1 mark even if Q-value is not calculated)		
7.			
	Difference in the pattern of fringes due to single slit and double slits 1 Derivation of angular position of (i) Bright fringe and (ii) Dark fringe 1+1		
	In the pattern of fringes produced by a single slit, the central fringe (band) is brighter as compared to other fringes i.e intensity goes on decreasing as the order (n) of the maxima increases, while in the fringe pattern produced by double slits all bright fringes including central fringe are of same intensity.	1	
	Alternatively: In the fringe pattern produced by single slit, the fringe at the centre is wider as compared to the width of other bright fringes, while in the fringe pattern produced by double slits all bright fringes are of equal width.		
	(**Note :** Give full credit, for the differentiation by drawing intensity distribution curves of the patterns produced by single slit and double slits)		
	Calculation of angular position		
	For the slit of width 'a ' and angle of diffraction 'θ'		
	Path difference (Δp) = a sin θ		
	(i) Condition for Bright Fringe, $\Delta p = (2n+1)\frac{\lambda}{2}$	½	
	$\therefore$ a sin θ = $(2n+1)\frac{\lambda}{2}$		

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

for small angle, $\sin\theta \approx \theta$ ½

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

(ii) Condition for dark fringe , $\Delta p = n\lambda$ ½

$a \sin\theta = n\lambda$ (n = 1, 2…)

$\therefore \sin\theta = \frac{n\lambda}{2a}$

for small angle, $\sin\theta \approx \theta$

$\theta = \frac{n\lambda}{a}$ ½ 3

8. **a)**

Definition	1
Calculation of focal length	1
Nature and position of image	1

(i) Dioptre is the reciprocal of focal length of lens in metre. 1

Alternatively:

$\text{Dioptre} = \frac{1}{\text{focal length (m)}}$

Alternatively:

One dioptre is the power of a lens of focal length of one metre

$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ ½

$R_1 = \infty,\ R_2 = -25\text{ cm},\ \mu = 1{\cdot}5$

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{\infty} + \frac{1}{25}\right)$$

$$or\ \frac{1}{f} = 0{\cdot}5 \times \frac{1}{25}\ or\ f = 50\text{ cm}$$ ½

(ii) $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$$\frac{1}{50} = \frac{1}{v} - \frac{1}{-50}$$

$$\frac{1}{v} = 0$$

$\therefore \quad v = \infty$, ½

Thus the image will be real and inverted ½

(Note: Award only ½ mark if a student draws ray diagram showing correct position of the image.)

OR

b)

Calculation of (i) distance of second bright fringe	1 ½
(ii) least distance	1 ½

(i) $\sin\theta \simeq \theta = \frac{x}{D} = \frac{5\lambda}{2a}$ ½

$$\therefore x = \frac{5\lambda D}{2a} = \frac{5\times 600\times 10^{-9}\times 1}{2\times 0\cdot 6\times 10^{-3}}$$ ½

$= 2.5\text{mm}$ ½

(ii) $(2n+1)\frac{\lambda}{2} = \frac{(2(n+1)+1)\lambda'}{2}$ ½

$(2n+1) \times 600 = (2n+3) \times 480$

$\therefore \; n = 3.5$ ½

$$x_n = \frac{(2n+1)\lambda D}{2d} = \frac{(2\times 3.5+1)\times 600\times 10^{-9}\times 1}{2\times 0\cdot 6\times 10^{-3}}$$ ½

$= 4$ mm

(**Note:** Give full credit for finding the position by taking $n = 3$ or $n = 4$ for $n = 3$, $x_n = 3.5$mm and for $n = 4$, $x_{n,} = 4.5$mm) 3

9.

Calculation of energy and momentum	1+1
Calculation of speed	1

(a) Energy of photon, $E = h\nu$

$$E = h\frac{c}{\lambda} = \frac{6\cdot 63\times 10^{-34}\times 3\times 10^{8}}{331\cdot 5\times 10^{-9}}$$ ½

$E = 6\times 10^{-19}$ J ½

momentum(p)

$$p = \frac{h}{\lambda} \qquad \text{½}$$

$$= \frac{6{\cdot}63\times10^{-34}}{331{\cdot}5\times10^{-9}} \qquad \text{½}$$

$$p = 2\times10^{-27} \text{ kg ms}^{-1}$$

(b) Momentum of H atom = momentum of the photon $= 2\times10^{-27}$ kg ms^{-1} ½

$$p = mu$$

$$u = \frac{p}{m} = \frac{2\times10^{-27}}{1{\cdot}67\times10^{-27}} \text{ ms}^{-1} \qquad \text{½}$$

$$u = 1{\cdot}20 \text{ ms}^{-1} \qquad \text{½} \qquad 3$$

10.

Calculation of $\angle r_2$	1 ½
Calculation of angle of minimum deviation	1 ½

(i) As the emergent ray grazes along the side AC, therefore

$$\frac{1}{\sqrt{2}} = \frac{\sin r_2}{\sin 90^0} \qquad 1$$

$$\therefore\ r_2 = 45° \qquad \text{½}$$

(ii) $$\mu = \frac{\sin(\frac{A+\delta m}{2})}{\sin\frac{A}{2}} \qquad \text{½}$$

$$\sqrt{2} = \frac{\sin(\frac{60^0+\delta m}{2})}{\sin 30^0} \qquad \text{½}$$

$$\therefore \delta_m = 30^0 \qquad \text{½} \qquad 3$$

11.

(a)

Arranging the e-m radiations in ascending order of frequency	1
Uses of any two radiation	½ + ½ + ½ + ½

(i) Radio waves < microwaves < X-rays < gamma rays — 1

(ii) Two uses each of any two of the radiation

Radio waves-

- TV transmission
- Radio broadcast
- Mobile communication
- Radio telescope

Microwaves-

- Microwave oven
- Speed of automobiles
- Radar
- Air craft navigation

Gamma rays-

- Treatment of cancer
- Sterilisation and disinfection

X rays-

- Diagnostic tool in medicine
- Treatment for certain forms of cancer

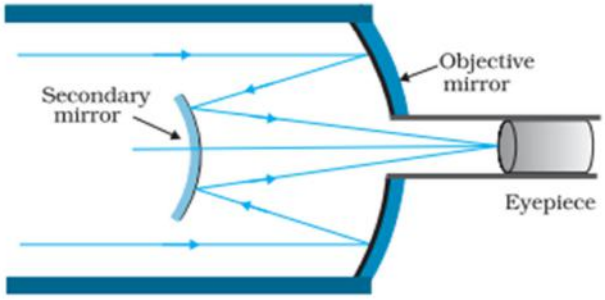
(Two uses of any two of these radiations) — 2

OR

(b)

Ray Diagram and explanation of working	2
Advantages	½ + ½

Ray diagram of reflecting telescope Working



1 ½

Working: Parallel beam of light gathered by objective mirror is reflected to the secondary mirror, which further forms the image in front of the eyepiece. — ½

(**Note:** Deduct ½ marks for not showing the direction of propagation of rays and give full credit for the ray diagram of Newtonian telescope)

	Two Advantages (Any Two) • High resolving power • No chromatic aberration • Reduced spherical aberration • Brighter image is formed • Easy mechanical support • Large magnifying power	½ + ½	3
	SECTION—C		
12.	(i)—a (ii)—b (iii)—c (iv)—b (v) —b	1 1 1 1 1	5

* * *