Series A2BAB/4

SET-3

प्रश्न-पत्र कोड
Q.P. Code 55/4/3

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 **15** 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 **15** 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. (क) दृश्य क्षेत्र में स्थित हाइड्रोजन परमाणु की स्पेक्ट्रमी श्रेणी का नाम लिखिए । इस श्रेणी की अधिकतम और निम्नतम तरंगदैर्घ्यों का अनुपात ज्ञात कीजिए । *2*

अथवा

(ख) द्रव्य तरंगें क्या हैं ? किसी प्रोटॉन और α-कण को समान विभवान्तर से त्वरित किया गया है । प्रोटॉन और α-कण से संबद्ध दे ब्रॉग्ली तरंगदैर्घ्यों का अनुपात ज्ञात कीजिए । *2*

2. किसी ठोस में ऊर्जा बैण्ड अन्तराल का क्या अर्थ है ? किसी चालक, विद्युतरोधी और अर्धचालक के लिए ऊर्जा बैण्ड आरेख खींचिए । *2*

3. रोधिका विभव की परिभाषा लिखिए । पश्चदिशिक बायस में वृद्धि होने पर किसी p-n संधि डायोड में ह्रासी स्तर की मोटाई क्यों विचरण करती है ? *2*

खण्ड ख

4. निम्नलिखित के कारण सहित उत्तर दीजिए : *3×1=3*

(क) किसी p-n संधि का प्रतिरोध अग्रदिशिक बायस में कम और पश्चदिशिक बायस में अधिक होता है ।

(ख) इलेक्ट्रॉनिक युक्तियों को बनाने के लिए नैज अर्धचालकों का मादन एक अनिवार्यता है ।

(ग) फोटोडायोडों को पश्चदिशिक बायस में प्रचालित किया जाता है ।

SECTION A

1. (a) Name the spectral series for a hydrogen atom which lies in the visible region. Find the ratio of the maximum to the minimum wavelengths of this series. *2*

OR

(b) What are matter waves ? A proton and an alpha particle are accelerated through the same potential difference. Find the ratio of the de Broglie wavelength associated with the proton to that with the alpha particle. *2*

2. What is meant by energy band gap in a solid ? Draw the energy band diagrams for a conductor, an insulator and a semiconductor. *2*

3. Define barrier potential. Why does the thickness of the depletion layer in a p-n junction diode vary with increase in reverse bias ? *2*

SECTION B

4. Answer the following, giving reason : *3×1=3*

(a) The resistance of a p-n junction is low when it is forward biased and is high when it is reversed biased.

(b) Doping of intrinsic semiconductors is a necessity for making electronic devices.

(c) Photodiodes are operated in reverse bias.

5. (क) नाभिकीय विखण्डन और नाभिकीय संलयन के बीच विभेदन कीजिए ।

(ख) ड्यूटीरियम का संलयन नीचे दी गयी अभिक्रिया के रूप में होता है :

$$ {}_{1}^{2}\mathrm{H} + {}_{1}^{2}\mathrm{H} \longrightarrow {}_{2}^{3}\mathrm{He} + {}_{0}^{1}\mathrm{n} + 3{\cdot}27\ \mathrm{MeV} $$

100 g ड्यूटीरियम के संलयन द्वारा किसी 500 W के विद्युत बल्ब को कितने समय तक जलाया जा सकता है ? *3*

6. संक्षेप में व्याख्या कीजिए कि किसी एकल झिरी पर विवर्तन के कारण किसी पर्दे पर चमकीली और काली फ्रिन्जें किस प्रकार बनती हैं । इस प्रकार व्याख्या कीजिए कि फ्रिन्जों की कोटि (n) में वृद्धि होने पर चमकीली फ्रिन्जों पर तीव्रता तेज़ी से क्यों घटती है । *3*

7. (क) (i) किसी खगोलीय दूरदर्शक द्वारा अनन्त पर प्रतिबिम्ब बनना दर्शाने के लिए नामांकित किरण आरेख खींचिए ।

(ii) कोई दूरदर्शक के अभिदृश्यक की फोकस दूरी 150 cm और नेत्रिका की फोकस दूरी 6·0 cm है । यदि अन्तिम प्रतिबिम्ब अनन्त पर बनता है, तो परिकलित कीजिए :

(I) इस समायोजन में नलिका की लम्बाई, और

(II) उत्पन्न आवर्धन । *3*

अथवा

(ख) (i) किसी संयुक्त सूक्ष्मदर्शी द्वारा स्पष्ट दर्शन की अल्पतम दूरी पर प्रतिबिम्ब बनना दर्शाने के लिए नामांकित किरण आरेख खींचिए ।

(ii) कोई लघु बिम्ब 4·0 cm फोकस दूरी के किसी आवर्धक लेंस से 3·0 cm दूरी पर स्थित है । ज्ञात कीजिए :

(I) बनने वाले प्रतिबिम्ब की स्थिति, और

(II) उत्पन्न रैखिक आवर्धन । *3*

5. (a) Differentiate between nuclear fission and nuclear fusion.

(b) Deuterium undergoes fusion as per the reaction :

$$_{1}^{2}H + _{1}^{2}H \longrightarrow _{2}^{3}He + _{0}^{1}n + 3{\cdot}27 \text{ MeV}$$

Find the duration for which an electric bulb of 500 W can be kept glowing by the fusion of 100 g of deuterium. *3*

6. Briefly explain how bright and dark fringes are formed on a screen due to the diffraction at a single slit. Hence, explain why the intensity at the bright fringes decreases sharply as their order (n) increases. *3*

7. (a) (i) Draw a labelled ray diagram showing the formation of the image at infinity by an astronomical telescope.

(ii) A telescope consists of an objective of focal length 150 cm and an eyepiece of focal length 6·0 cm. If the final image is formed at infinity, then calculate :

(I) the length of the tube in this adjustment, and

(II) the magnification produced. *3*

OR

(b) (i) Draw a labelled ray diagram showing the formation of the image at least distance of distinct vision by a compound microscope.

(ii) A small object is placed at a distance of 3·0 cm from a magnifier of focal length 4·0 cm. Find :

(I) the position of the image formed, and

(II) the linear magnification produced. *3*

8. किसी प्रोटॉन को विभवान्तर V से त्वरित किया जाता है । त्वरित होने पर इससे संबद्ध दे ब्रॉग्ली तरंगदैर्घ्य λ है । यदि प्रोटॉन को α-कण से प्रतिस्थापित कर दिया जाए, तो यदि इसे भी समान विभवान्तर V से त्वरित किया गया है, तो इससे संबद्ध दे ब्रॉग्ली तरंगदैर्घ्य ज्ञात कीजिए । इस α-कण का संवेग क्या होगा ? *3*

9. (क) किसी गाइगर-मार्सडेन प्रयोग में, $2{\cdot}56 \times 10^{-12}$ J ऊर्जा के किसी α-कण के लिए उपगमन की समीपस्थ दूरी परिकलित कीजिए । यह मानिए कि कण सम्मुख स्थिति में गोल्ड नाभिक ($Z = 79$) की ओर उपगमन करता है ।

(ख) यदि उपर्युक्त प्रयोग को समान ऊर्जा के प्रोटॉन द्वारा दोहराएँ, तो उपगमन की समीपस्थ दूरी का मान क्या होगा ? *3*

10. (क) उन विद्युत-चुम्बकीय तरंगों को पहचानिए :

(i) जिनका उपयोग रेडार प्रणाली में किया जाता है ।

(ii) जो फोटोग्राफिक प्लेटों को प्रभावित करते हैं ।

(iii) शल्यक्रिया में किया जाता है ।

इनका आवृत्ति परिसर लिखिए । *3*

अथवा

(ख) कोई समतल तरंगाग्र विरल माध्यम से सघन माध्यम में संचरण कर रहा है । हाइगेन्स सिद्धांत का उपयोग करके अपवर्तित तरंगाग्र दर्शाइए और स्नेल के नियम का सत्यापन कीजिए । *3*

11. कोई गोताखोर पानी ($\mu = \frac{4}{3}$) से होकर बाहरी दुनिया को पानी के पृष्ठ पर वृत्ताकार क्षेत्र में समाया हुआ देखता है । यदि गोताखोर के नेत्र पानी के पृष्ठ से $\sqrt{7}$ m नीचे हैं, तो इस वृत्त का क्षेत्रफल परिकलित कीजिए । *3*

8. A proton is accelerated through a potential difference V. After acceleration, the de Broglie wavelength associated with it is λ. If the proton is replaced by an alpha particle, then find the de Broglie wavelength associated with it if it were accelerated through the same potential difference V. What will be the momentum of the alpha particle ? *3*

9. (a) In Geiger-Marsden experiment, calculate the distance of closest approach for an alpha particle with energy $2{\cdot}56 \times 10^{-12}$ J. Consider that the particle approaches gold nucleus (Z = 79) in head-on position.

(b) If the above experiment is repeated with a proton of the same energy, then what will be the value of the distance of closest approach ? *3*

10. (a) Identify electromagnetic waves which :

(i) are used in radar system.

(ii) affect a photographic plate.

(iii) are used in surgery.

Write their frequency range. *3*

OR

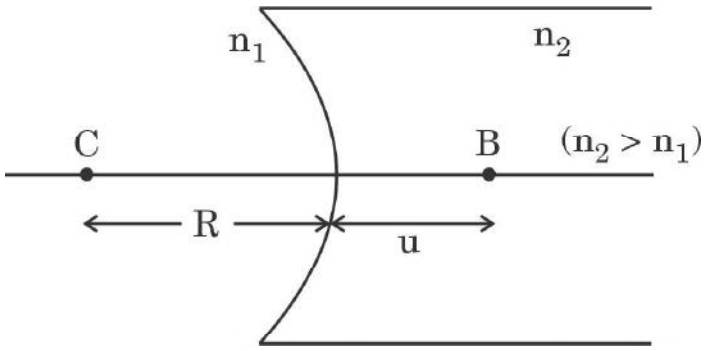
(b) A plane wavefront is propagating from a rarer into a denser medium. Use Huygens principle to show the refracted wavefront and verify Snell's law. *3*

11. A diver looking up through water ($\mu = \frac{4}{3}$) sees the outside world contained in a circular area on the surface of water. If the diver's eyes are $\sqrt{7}$ m below the surface of water, then calculate the area of the circle. *3*

खण्ड ग

12. अपवर्तनांक n_1 और n_2 के दो पारदर्शी माध्यम किसी गोलीय पारदर्शी पृष्ठ द्वारा पृथकित हैं । प्रकाश किरणें इस पृष्ठ पर आपतन करके दूसरी ओर के माध्यम में अपवर्तित हो जाती हैं । अपवर्तन के नियम गोलीय पृष्ठ के प्रत्येक बिन्दु पर वैध हैं । कोई लेंस दो पृष्ठों से घिरा कोई प्रकाशिक पारदर्शी माध्यम होता है जिसका कम-से-कम एक पृष्ठ गोलीय होना चाहिए । किसी लेंस की फोकस दूरी का निर्धारण दोनों पृष्ठों की वक्रता त्रिज्या, R_1 और R_2 तथा लेंस के प्रतिवेशी माध्यम के सापेक्ष माध्यम का अपवर्तनांक (n) द्वारा होता है । R_1 और R_2 के मानों द्वारा ही यह निर्धारित होता है कि कोई लेंस अभिसारी लेंस की भाँति व्यवहार करेगा अथवा अपसारी लेंस की भाँति व्यवहार करेगा । किसी लेंस की आपतित प्रकाश पुन्ज को अभिसरित करने अथवा अपसरित करने की योग्यता उस लेंस की क्षमता को परिभाषित करती है ।

(क) कोई बिम्ब आरेख में दर्शाए अनुसार बिन्दु B पर रखा गया है । बिम्ब दूरी (u) और प्रतिबिम्ब दूरी (v) के बीच कौन-सा संबंध सही है ?



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

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

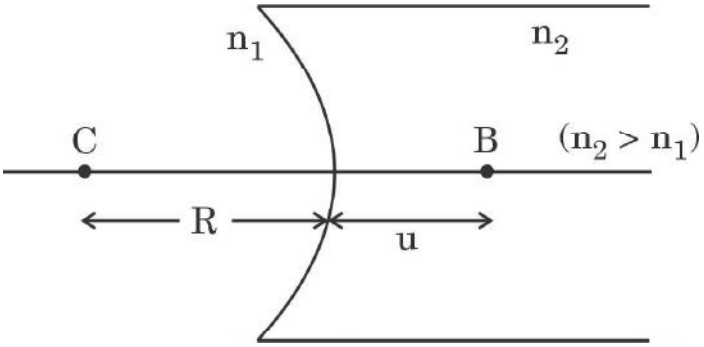
(iii) $\frac{n_2}{v} - \frac{n_1}{u} = \frac{(n_2 - n_1)}{R}$

(iv) $\frac{n_1}{v} - \frac{n_2}{u} = \frac{(n_1 - n_2)}{R}$

SECTION C

12. Two transparent media of refractive indices n_1 and n_2 are separated by a spherical transparent surface. The rays of light incident on the surface get refracted into the medium on the other side. The laws of refraction are valid at each point of the spherical surface. A lens is a transparent optical medium bounded by two surfaces, at least one of which should be spherical. The focal length of a lens is determined by the radii of curvature (R_1 and R_2) of its two surfaces and the refractive index (n) of the medium of the lens with respect to the surrounding medium. Depending on R_1 and R_2, a lens behaves as a diverging or a converging lens. The ability of a lens to diverge or converge a beam of light incident on it defines its power.

(a) An object is placed at the point B as shown in the figure. The object distance (u) and the image distance (v) are related as



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

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

(iii) $\frac{n_2}{v} - \frac{n_1}{u} = \frac{(n_2 - n_1)}{R}$

(iv) $\frac{n_1}{v} - \frac{n_2}{u} = \frac{(n_1 - n_2)}{R}$

(ख) कोई बिन्दुकित बिम्ब वायु में वक्रता त्रिज्या R के किसी उत्तल गोलीय अपवर्ती पृष्ठ के सामने दूरी 'R' पर स्थित है । यदि पृष्ठ के दूसरी ओर का माध्यम काँच है, तो बनने वाला प्रतिबिम्ब :

(i) वास्तविक है और काँच में बनता है ।

(ii) वास्तविक है और वायु में बनता है ।

(iii) आभासी है और काँच में बनता है ।

(iv) आभासी है और वायु में बनता है ।

(ग) कोई बिम्ब किसी समोत्तल लेंस के सामने 2F दूरी पर स्थित है । बनने वाला प्रतिबिम्ब है :

(i) वास्तविक और साइज़ में बिम्ब के बराबर ।

(ii) आभासी और साइज़ में बिम्ब के बराबर ।

(iii) वास्तविक और साइज़ में बिम्ब से बड़ा ।

(iv) आभासी और साइज़ में बिम्ब से छोटा ।

(घ) 10 cm फोकस दूरी का कोई पतला अभिसारी लेंस और 20 cm फोकस दूरी का कोई पतला अपसारी लेंस एक-दूसरे के सम्पर्क में समाक्ष रखे हैं । इस संयोजन की क्षमता है :

(i) – 5 D

(ii) + 5 D

(iii) + 15 D

(iv) – 15 D

(b) A point object is placed in air at a distance 'R' in front of a convex spherical refracting surface of radius of curvature R. If the medium on the other side of the surface is glass, then the image is :

(i) real and formed in glass.

(ii) real and formed in air.

(iii) virtual and formed in glass.

(iv) virtual and formed in air.

(c) An object is kept at 2F in front of an equiconvex lens. The image formed is :

(i) real and of the size of the object.

(ii) virtual and of the size of the object.

(iii) real and enlarged.

(iv) virtual and diminished.

(d) A thin converging lens of focal length 10 cm and a thin diverging lens of focal length 20 cm are placed coaxially in contact. The power of the combination is :

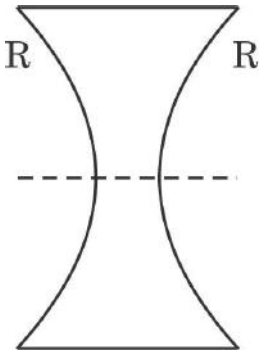
(i) – 5 D

(ii) + 5 D

(iii) + 15 D

(iv) – 15 D

(ङ) फोकस दूरी 'f' के किसी समावतल लेंस को, आरेख में दर्शाए अनुसार, बिन्दुकित रेखा के अनुदिश दो सर्वसम भागों में काटा गया है । इनमें प्रत्येक भाग की फोकस दूरी होगी :



(i) $\frac{f}{4}$

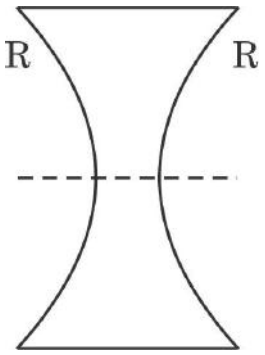
(ii) $\frac{f}{2}$

(iii) f

(iv) 2f

5×1=5

(e) An equiconcave lens of focal length 'f' is cut into two identical parts along the dotted line as shown in the figure. The focal length of each part will be :



(i) $\frac{f}{4}$

(ii) $\frac{f}{2}$

(iii) f

(iv) 2f

5×1=5

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SeniorSecondary School ,Term II Examination2022

Marking Scheme – PHYSICS (SUBJECT CODE – 042)

(PAPER CODE – 55/4/3)

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 0-35 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 35answer 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.

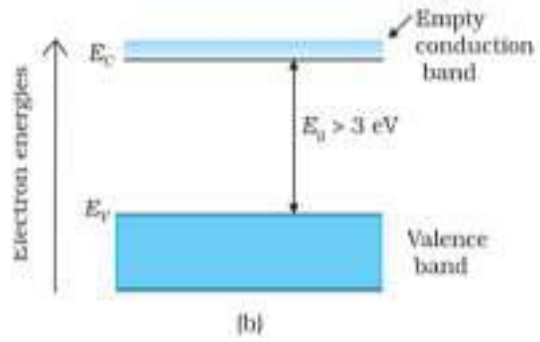
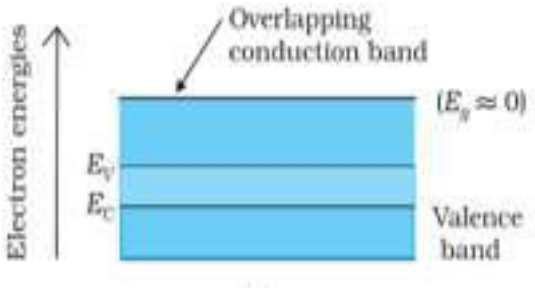
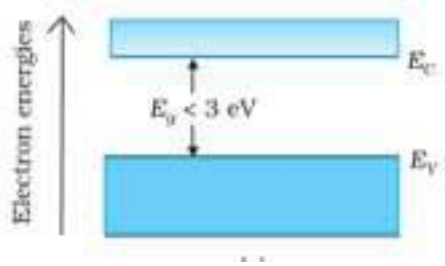
MARKING SCHEME

Senior Secondary School Examination TERM–II, 2022

PHYSICS (Subject Code–042)

[Paper Code : 55/4/3]

Q. No.	EXPECTED ANSWER / VALUE POINTS	Marks	Total Marks
1.	**a)** • Name of Spectral Series ½ • Ratio of the wavelength $1\frac{1}{2}$		
	Balmer Series	½	
	$\frac{1}{\lambda} = R\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$	½	
	$\frac{1}{\lambda_{max}} = R\left(\frac{1}{2^2} - \frac{1}{3^2}\right)$ $(n_f = 2, \quad n_i = 3)$	½	
	$\lambda_{max} = \frac{36}{5R}$		
	$\frac{1}{\lambda_{min}} = R\left(\frac{1}{2^2} - \frac{1}{\infty}\right)$ $(n_f = 2, \quad n_i = \infty)$		
	$\lambda_{min} = \frac{4}{R}$		
	$\frac{\lambda_{max}}{\lambda_{min}} = \frac{9}{5}$	½	
	OR		
	b) • Definition /meaning of matter waves ½ • Ratio of de- Broglie Wavelength $1\frac{1}{2}$		
	Wave associated with moving material particle	½	
	$\lambda = \frac{h}{\sqrt{2qmV}}$	½	
	$\therefore \frac{\lambda_p}{\lambda_\alpha} = \sqrt{\frac{q_\alpha m_\alpha}{q_p m_p}}$		
	$\therefore \frac{\lambda_p}{\lambda_\alpha} = \sqrt{\frac{2e \cdot 4m}{e \cdot m}}$	½	
	$= \frac{2\sqrt{2}}{1}$	½	
			2

2.	• Meaning of energy Band gap $\frac{1}{2}$ • Energy Band Diagram of Conductor, Insulator & Semiconductor (½ + ½ + ½) **Energy gap :** The gap between the top of the valence band and bottom of the conduction band is called the energy band gap.  ENERGY BAND DIAGRAM FOR INSULATOR  ENERGY BAND DIAGRAM FOR CONDUCTOR  ENERGY BAND DIAGRAM FOR SEMICONDUCTOR	½ ½ ½ ½	2
3.	• Definition of Barrier Potential 1 • Explanation of thickness of depletion region 1 *(i)* It is the potential developed across the p-n junction which tends to prevent the movement of majority charge carriers from both sides. *(ii)* Under reverse bias, direction of applied voltage is same as the direction of barrier potential. As a result barrier height increase & the depletion region widens due to change in electric field.	1 1	2

	SECTION-B		
4.	a) For explaining reason 1 b) For explaining reason 1 c) For explaining reason 1		
	a) When a *p-n* junction is forward biased, the junction width decreases and as a result, its resistance also decreases.	½	
	On the other hand, when a *p-n* junction is reverse biased, the junction width increases and as a result, its resistance also increases.	½	
	b) Conductivity of intrinsic semi-conductors is very low. Hence, no electronic device can be developed using them.	1	
	Dopping increases conductivity, hence makes intrinsic semiconductor suitable for making electronic devices.		
	c) It is easier to observe the change in the current with change in light intensity if a reverse bias is applied.	1	
	Alternatively		
	The fractional change due to photo-effects on the minority charge carriers dominated reverse bias current, is more easily measurable than the fractional change in forward bias current.		3

5.

a) Distinguishing nuclear fission & fusion	1
b) Calculation of duration	2

a) Nuclear fission – The process of breaking a very heavy nucleus into lighter nuclei, having mass number in the range of middle mass number ($30 < A < 170$). ½

Nuclear Fusion- It is the process of joining of very light nuclei ($A \leq 10$) to form a heavier nucleus. ½

b) No. of atoms in 100 g $= \frac{6{\cdot}023\times10^{23}}{2}\times100 = 3{\cdot}0115\times10^{25}$ ½

Energy released/atom $= \frac{3{\cdot}27\ \text{MeV}}{2} = 1{\cdot}635\ \text{MeV}$

Total energy released $= 3{\cdot}0115\times10^{25}\times1{\cdot}635\ \text{MeV}$

$= 3{\cdot}0115\times1{\cdot}635\times10^{25}\times1{\cdot}6\times10^{-13}$

$= 7{\cdot}878\times10^{12}\ \text{J}$ ½

$t = \frac{E}{P}$ ½

$= \frac{7{\cdot}878\times10^{12}\ \text{J}}{500\ \text{J/s}} = 1.5756\times10^{10}\ \text{s}$ ½

$= \frac{1.5756\times10^{10}}{3{\cdot}15\times10^{7}} \simeq 500y$

Alternatively :

$E = \frac{MQ}{2m_d}$ ½

$= \frac{(0{\cdot}1\ \text{kg})\times(3{\cdot}27\ \text{MeV})}{2(2{\cdot}04)\times(1{\cdot}66\times10^{-27}\ \text{kg}/4)}$

$= 0{\cdot}0492\times10^{27} = 4{\cdot}92\times10^{25}\ \text{MeV}$ ½

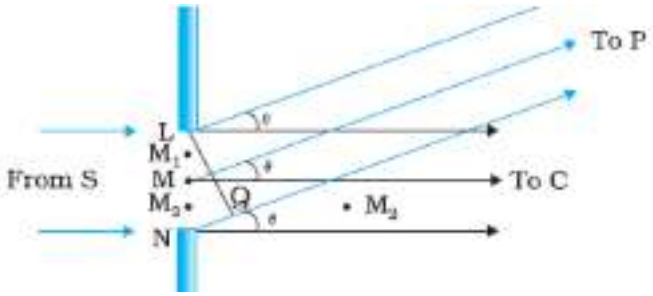
$t = \frac{E}{P}$ ½

$= \frac{(4{\cdot}92\times10^{25})\times(1{\cdot}6\times10^{-13})}{500} = 1.5756\times10^{10}\ \text{s}$ ½

$= \frac{1.5756\times10^{10}}{3{\cdot}15\times10^{7}} \simeq 500y$

3

6.	Brief Explanation of bright and dark fringes in diffraction 2 Explanation of decrease in intensity with increasing 'n' 1		



Dividing the slit into smaller parts, and adding their contributions at P with the proper phase differences. The path difference NP – LP between the two edges of the slit, NP – LP = NQ = $a \sin\theta \approx a\theta$ ½

At the central point *C* on the screen, the angle θ is zero. All path differences are zero and hence all the parts of the slit contribute in phase. This gives maximum intensity at C, ½
Similarly other secondary maxima will be formed at $\theta = (n+1/2)\,\lambda/a$,

For minima (zero intensity) the contributions from M_1 and M_2 are 180° out of phase and cancel in the direction $\theta = \lambda/a$. where λ is the path difference. ½
Similarly other minima are formed due to cancellation of contributions. At an angle $\theta = n\lambda/a$, where $n = \pm1, \pm2, \pm3, ...$ ½

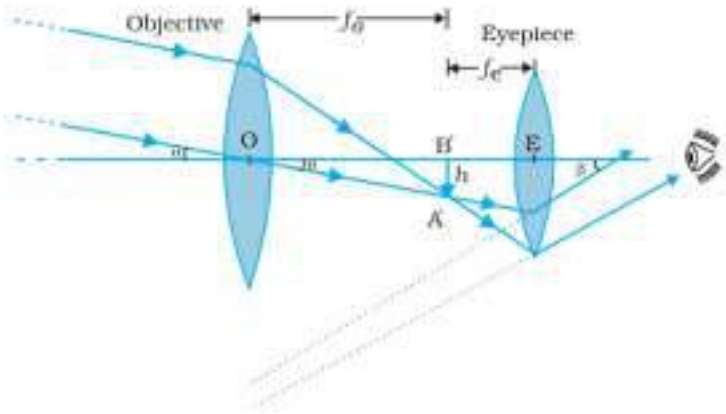
Consider an angle $\theta = 3\lambda/2a$ which is midway between two of the dark fringes. Divide the slit into three equal parts. If we take the first two thirds of the slit, the path difference between the two ends would be λ. ½

The first two-thirds of the slit can be divided into two halves which have a λ/2 path difference. The contributions of these two halves cancel, only the remaining one-third of the slit contributes to the intensity at a point between the two minima. Which will be much weaker than the central maximum (where the entire slit contributes in phase). Similarly there are maxima at $(n + 1/2)\,\lambda/a$ with $n = 2, 3$, etc. These become weaker with increasing *n*, since only one-fifth, one-seventh, etc., of the slit contributes in these cases. ½

3

7.	a) (i) Labelled Diagram –	1	
	(ii) (I) Length of tube calculation	1	
	(II) Calculation of magnification	1	

(a) (i)



1

(ii) Given $f_o = 150$ cm, $f_e = 6\ cm$

(I) Length of the tube $L = f_o + f_e$ ½

$= 150 + 6$

$L = 156\ cm$ ½

(II) $m = \dfrac{f_o}{f_e}$ ½

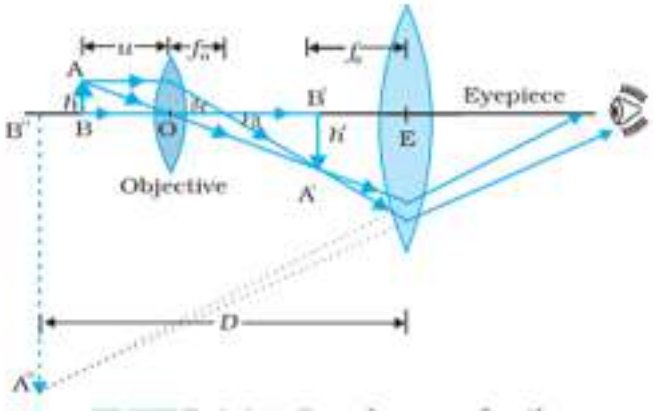
$\dfrac{150}{6} = 25$ ½

3

OR

7.	b) (i) Labelled Diagram –	1	
	(ii) (I) Position of image calculation	1	
	(II) Calculation of linear magnification	1	

(b) (i)



Ray diagram of image formation by a compound microscope

1

(ii) Given u= -3 cm f = 4 cm

(I) Using $\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$ ½

$$\frac{1}{v}=\frac{1}{u}+\frac{1}{f}=\frac{1}{-3\cdot0}+\frac{1}{4\cdot0}$$

$$\frac{1}{v}=\frac{-4+3}{12}=-\frac{1}{12} \qquad v=-12 \text{ cm}$$ ½

(II) Linear magnification $m=\frac{v}{u}$ ½

$$m=\frac{-12}{-3}=4$$ ½

8.

• Finding de- Broglie wavelength	$1\frac{1}{2}$
• Finding the momentum of α particles	$1\frac{1}{2}$

$$\lambda_p=\frac{h}{\sqrt{2q_p m_p V}},$$ ½

$$\lambda_\alpha=\frac{h}{\sqrt{2\cdot 2q_p\cdot 4m_p V}}$$ ½

$$\frac{\lambda_\alpha}{\lambda_p}=\frac{1}{2\sqrt{2}}$$ ½

$$\lambda_\alpha=\frac{h}{p_p}, \quad \lambda_\alpha=\frac{h}{p_\alpha}$$ ½

$$\frac{p_\alpha}{p_p}=\frac{1}{2\sqrt{2}},$$ ½

$$p_\alpha = 2\sqrt{2}\, p_p$$ ½

3

9.

- Calculation of distance of closest approach for α-particle $1\frac{1}{2}$
- Calculation of distance of closest approach for photon $1\frac{1}{2}$

a) For α particles, distance of closest approach

$$r_\alpha = \frac{1}{4\pi\varepsilon_0}\frac{2Ze^2}{E_k}$$ ½

$$r_\alpha = \frac{9\times10^9\times2\times79\times(1.6\times10^{-19})^2}{2.56\times10^{-12}}$$ ½

$$= 14{\cdot}22\times10^{-15}\ \text{m}$$

$$= 14.22\ \text{fm}$$ ½

b) For proton, distance of closest approach

$$r_p = \frac{1}{4\pi\varepsilon_0}\frac{Ze^2}{E_k}$$ ½

$$r_p = \frac{r_\alpha}{2}$$ ½

$$= 7{\cdot}11\times10^{-15}\ \text{m}$$ ½ 3

10. a)

- Identification of e.m. wave $1\frac{1}{2}$
- Frequency range $1\frac{1}{2}$

(i) Microwave ½

10^{10}Hz – 10^{12}Hz ½

(ii) X-rays. ½

10^{16}Hz – 10^{20}Hz ½

Alternatively

Gamma Ray

10^{20}Hz – 10^{24}Hz

(iii) Gamma Ray ½

10^{20}Hz – 10^{24}Hz ½

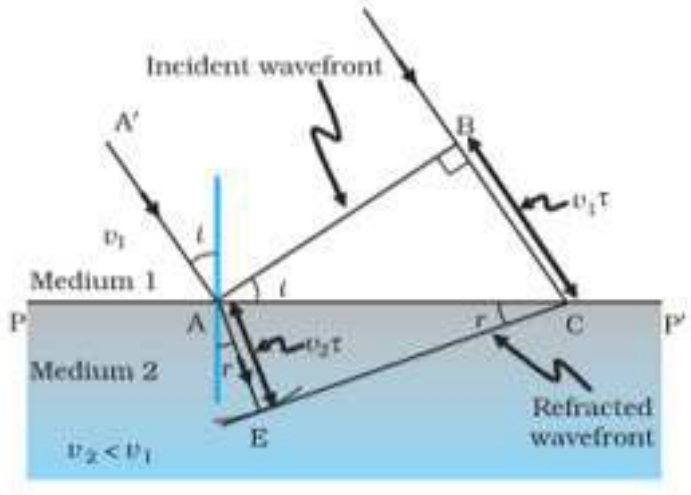
Alternatively

Infrared Radiations

10^{12}Hz – 10^{14}Hz 3

b) **OR**

- Showing refracted wavefront 1
- Verification of Snell's law 2



1

We consider, refracted wavefront CE and triangles ABC & AEC. From the triangles we obtained

$$\sin i = \frac{BC}{AC} = \frac{v_1\tau}{AC}$$ ½

$$\sin r = \frac{AE}{AC} = \frac{v_2\tau}{AC}$$ ½

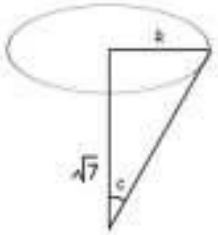
Thus $\frac{\sin i}{\sin r} = \frac{v_2}{v_1}$ ½

We know $n = \frac{c}{v}$, So $\frac{\sin i}{\sin r} = \frac{n_2}{n_1}$

which is the Snell's law. ½

11.

- Calculation of critical angle 1
- Calculation of radius circle $1\frac{1}{2}$
- Calculation of Area ½



$$\text{Sin C} = \frac{1}{\mu}$$ ½

$$\text{Sin C} = \frac{3}{4}$$ ½

$$\text{Sin C} = \frac{R}{\sqrt{R^2+7}}$$ ½

	$\frac{3}{4} = \frac{R}{\sqrt{R^2+7}}$ R = 3m Area = πR^2 $= 3.14 \times (3)^2$ $= 28.26\ m^2$	½ ½ ½	3
12.	*(a)* (iv) $\frac{n_1}{v} - \frac{n_2}{u} = \frac{(n_1 - n_2)}{R}$ *(b)* (iv) virtual and formed in air *(c)* (i) real and of the size of the object *(d)* (ii) + 5D *(e)* (iii) f	1 1 1 1 1	5

* * *