Series : A4BAB/3

SET-3

प्रश्न-पत्र कोड
Q.P. Code **55/3/3**

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 **12** हैं ।

(II) प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को छात्र 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, 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 ।

NOTE

(I) Please check that this question paper contains **12** 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 candidates 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*

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सामान्य निर्देश :

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

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

(ii) *यह प्रश्न पत्र तीन खंडों में विभाजित है – खंड 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) *लॉग टेबल का उपयोग कर सकते हैं, यदि आवश्यक हो, लेकिन कैल्कुलेटर 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 $= 1.675 \times 10^{-27}$ kg

प्रोटॉन का द्रव्यमान $= 1.673 \times 10^{-27}$ kg

आवोगाद्रो संख्या $= 6.023 \times 10^{23}$ प्रति ग्राम मोल

बोल्ट्ज़मान नियतांक $= 1.38 \times 10^{-23}$ JK^{-1}

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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 :*** *Q. Nos. **1** to **3** are of **2** marks each.*

(iv) ***Section B :*** *Q. Nos. **4** to **11** are of **3** marks each.*

(v) ***Section C :*** *Q. No. **12** is a case study based questions of **5** marks.*

(vi) *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.*

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

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

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

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खण्ड – क

1. (a) (i) समस्थानिकों और समभारिकों के बीच विभेदन कीजिए। **2**

(ii) दो नाभिकों के विभिन्न परमाणु द्रव्यमान A_1 और A_2 हैं। क्या ये नाभिक आवश्यक रूप से समान तत्व के समस्थानिक हैं ? व्याख्या कीजिए।

अथवा

(b) (i) उन कारकों का नाम लिखिए जिन पर किसी पृष्ठ से प्रकाश-विद्युत उत्सर्जन निर्भर करता है।

(ii) किसी प्रकाश सुग्राही पदार्थ के लिए देहली आवृत्ति की परिभाषा लिखिए।

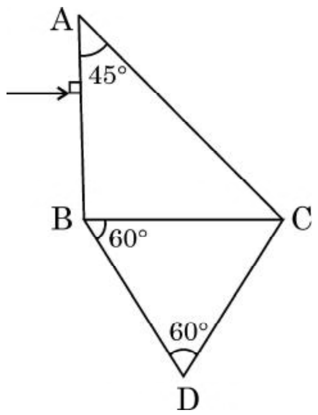
2. किसी p-n संधि में रोधिका विभव बनने की व्याख्या कीजिए। **2**

3. जब शुद्ध जर्मेनियम का मादन (i) किसी त्रिसंयोजक और (ii) किसी पंचसंयोजक अशुद्धि से किया जाता है तो निर्मित अपद्रव्यी अर्धचालक का नाम लिखिए। इस प्रकार निर्मित अपद्रव्यी अर्धचालकों के ऊर्जा बैण्ड आरेख खींचिए। **2**

खण्ड – ख

4. (a) पूर्ण आन्तरिक परावर्तन के लिए दो आवश्यक शर्तें लिखिए।

(b) आरेख में दर्शाए अनुसार दो प्रिज्मों ABC और DBC को व्यवस्थित किया गया है। वायु के सापेक्ष इन दोनों प्रिज्मों के क्रांतिक कोण क्रमशः 41.1° और 45° हैं। प्रिज्मों के संयोजन से प्रकाश किरण के पथ को आरेखित कीजिए। **3**



अथवा

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SECTION – A

1. (a) (i) Distinguish between isotopes and isobars. **2**

(ii) Two nuclei have different mass numbers A_1 and A_2. Are these nuclei necessarily the isotopes of the same element ? Explain.

OR

(b) (i) Name the factors on which photoelectric emission from a surface depends.

(ii) Define the term 'threshold frequency' for a photosensitive material.

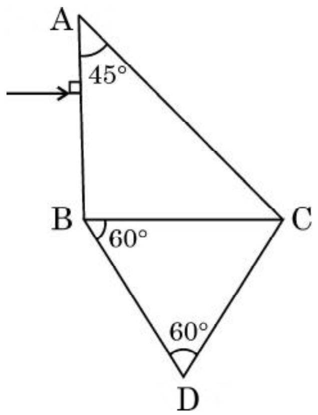
2. Explain the formation of the barrier potential in a p-n junction. **2**

3. Name the extrinsic semiconductors formed when a pure germanium is doped with (i) a trivalent and (ii) pentavalent impurity. Draw the energy band diagrams of extrinsic semiconductors so formed. **2**

SECTION – B

4. (a) Write two necessary conditions for total internal reflection.

(b) Two prisms ABC and DBC are arranged as shown in figure.



The critical angles for the two prisms with respect to air are 41.1° and 45° respectively. Trace the path of the ray through the combination. **3**

OR

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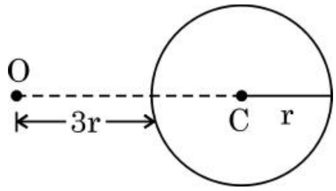
(a) कोई बिम्ब किसी अभिसारी लेंस के सामने स्थित है । वह शर्तें प्राप्त कीजिए जिसमें इस लेंस द्वारा उत्पन्न आवर्धन (i) ऋणात्मक और (ii) धनात्मक होता है ।

(b) कोई बिन्दुकित बिम्ब किसी काँच के गोले के सामने आरेख में दर्शाए अनुसार O पर स्थित है । इस गोले द्वारा प्रतिबिम्ब बनना दर्शाइए ।



5. किसी धातु का कार्यफलन 2.31 eV है । इस धातु के पृष्ठ पर 6.4×10^{14} Hz आवृत्ति के प्रकाश के आपतित होने पर प्रकाशविद्युत उत्सर्जन होता है । (i) आपतित विकिरणों की ऊर्जा, (ii) उत्सर्जित इलेक्ट्रॉनों की अधिकतम गतिज ऊर्जा और (iii) पृष्ठ का निरोधी विभव परिकलित कीजिए । **3**

6. यंग के किसी द्वि-झिर्री प्रयोग में 600 nm और 500 nm की दो तरंगदैर्ध्यों से बने प्रकाश पुन्ज का उपयोग किया गया है । झिर्री-पृथकन 1.0 mm और पर्दे को झिर्रियों के तल से 0.60 m की दूरी पर रखा गया है ।

(i) 500 nm तरंगदैर्ध्य के लिए केन्द्रीय उच्चिष्ठ से दूसरी चमकीली फ्रिन्ज की दूरी,

(ii) केन्द्रीय उच्चिष्ठ से वह कम से कम दूरी जिस पर दोनों तरंगदैर्ध्यों के कारण बनी चमकीली फ्रिन्जें संपाती हैं । **3**

7. (a) λ_1, λ_2 और λ_3 तरंगदैर्ध्य की विद्युत-चुम्बकीय तरंगों का उपयोग क्रमशः रेडार निकायों में, जल शोधकों में और टीवी के सुदूर स्विचों में किया जाता है ।

(i) इन विद्युत-चुम्बकीय तरंगों को पहचानिए, तथा

(ii) इनमें प्रत्येक के लिए एक-एक स्रोत लिखिए । **3**

अथवा

(b) (i) दो प्रकाश स्रोतों के कलासंबद्ध होने के लिए दो शर्तों का उल्लेख कीजिए ।

(ii) दो झिर्रियों के कारण उत्पन्न व्यतिकरण पैटर्न और एकल झिर्री के कारण विवर्तन पैटर्न के बीच दो अन्तर लिखिए ।

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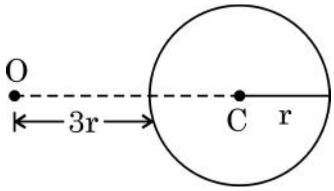
(a) An object is placed in front of a converging lens. Obtain the conditions under which the magnification produced by the lens is (i) negative and (ii) positive.

(b) A point object is placed at O in front of a glass sphere as shown in figure.



Show the formation of image by the sphere.

5. The work function of a metal is 2.31 eV. Photoelectric emission occurs when light of frequency 6.4×10^{14} Hz is incident on the metal surface. Calculate : (i) the energy of the incident radiation, (ii) the maximum kinetic energy of the emitted electron and (iii) the stopping potential of the surface. **3**

6. A beam of light consisting of two wavelengths 600 nm and 500 nm is used in a Young's double slit experiment. The slit separation is 1.0 mm and the screen is kept 0.60 m away from the plane of the slits. Calculate :
   (i) the distance of the second bright fringe from the central maximum for wavelength 500 nm, and
   (ii) the least distance from the central maximum where the bright fringes due to both the wavelengths coincide. **3**

7. (a) Electromagnetic waves of wavelengths λ_1, λ_2 and λ_3 are used in radar systems, in water purifiers and in remote switches of TV, respectively.
   (i) Identify the electromagnetic waves, and
   (ii) Write one source of each of them. **3**

OR

(b) (i) State two conditions for two light sources to be coherent.
   (ii) Give two points of difference between an interference pattern due to a double – slit and a diffraction pattern due to a single slit.

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8. किसी एकल झिर्री के विवर्तन पैटर्न में केन्द्रीय उच्चिष्ठ की कोणीय चौड़ाई में किस प्रकार का परिवर्तन होगा, यदि

(i) हरे प्रकाश के स्थान पर नारंगी प्रकाश का उपयोग किया जाए,

(ii) पर्दे को झिर्री के निकट लाया जाए, और

(iii) झिर्री की चौड़ाई कम कर दी जाए ?

प्रत्येक प्रकरण में अपने उत्तर की पुष्टि कीजिए । **3**

9. संक्षेप में व्याख्या कीजिए कि किसी सौर सेल में emf किस प्रकार उत्पन्न होती है । इसके लिए I-V अभिलाक्षणिक आरेखित कीजिए । **3**

10. (a) जेम्स चॉडविक ने 1932 में उस समय उदासीन विकिरणों का अध्ययन किया था जब अल्फा–कणों द्वारा बेरिलियम नाभिकों पर बमबारी की गयी थी । उन्होंने यह निष्कर्ष निकाला कि उत्सर्जित विकिरण न्यूट्रॉनों के हैं प्रोटॉनों के नहीं । व्याख्या कीजिए ।

(b) दो नाभिकों में प्रोटॉनों और न्यूट्रॉनों की संख्या भिन्न होने पर भी उनकी त्रिज्या समान हो सकती है । व्याख्या कीजिए । **3**

11. (a) किसी कक्षा में हाइड्रोजन परमाणु की ऊर्जा -1.51 eV है । इस कक्षा में इलेक्ट्रॉन की गतिज और स्थितिज ऊर्जाएँ क्या हैं ?

(b) किसी हाइड्रोजन परमाणु में इलेक्ट्रॉन लगभग 1.0×10^{-15} m व्यास के नाभिक से लगभग 5.3×10^{-11} m दूरी पर पाया जाता है । यह मानते हुए कि हाइड्रोजन परमाणु 5.3×10^{-11} m त्रिज्या का गोला है तो इसके आयतन के कितने अंश को नाभिक ने घेर रखा है ? **3**

खण्ड – ग

प्रकरण अध्ययन

12. संयुक्त सूक्ष्मदर्शी दो अभिसारी लेंसों से मिलकर बनता है । जिनमें एक लेंस जिसका द्वारक छोटा और फोकस दूरी कम होती है उसे अभिदृश्यक कहते हैं तथा दूसरे लेंस को जिसका द्वारक कुछ बड़ा होता है और फोकस दूरी भी कुछ अधिक होती है उसे नेत्रिका कहते हैं । दोनों लेंसों को किसी नलिका में इस प्रकार व्यवस्थित किया जाता है कि इन दोनों लेंसों के बीच की दूरी को परिवर्तित किया जा सके । किसी लघु बिम्ब को अभिदृश्यक के सामने इसकी फोकस दूरी से कुछ अधिक दूरी पर रखा जाता है । अभिदृश्यक इस बिम्ब का प्रतिबिम्ब बनाता है, जो नेत्रिका के लिए बिम्ब की भांति कार्य करता है । नेत्रिका फिर बिम्ब का अंतिम आवर्धित प्रतिबिम्ब बना देती हैं । **$1 \times 5 = 5$**

I. किसी संयुक्त सूक्ष्मदर्शी में अभिदृश्यक और नेत्रिका द्वारा बनाए गए प्रतिबिम्ब होते हैं क्रमशः:

(A) आभासी, वास्तविक (B) वास्तविक, आभासी

(C) आभासी, आभासी (D) वास्तविक, वास्तविक

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8. In a diffraction pattern due to a single slit, how will the angular width of central maximum change, if

(i) Orange light is used in place of green light,

(ii) the screen is moved closer to the slit,

(iii) the slit width is decreased ?

Justify your answer in each case. **3**

9. Briefly explain how emf is generated in a solar cell. Draw its I-V characteristics. **3**

10. (a) James Chadwick, in 1932, studied the emission of neutral radiations when Beryllium nuclei were bombarded with alpha particles. He concluded that emitted radiations were neutrons and not photons. Explain.

(b) Two nuclei may have the same radius, even though they contain different number of protons and neutrons. Explain. **3**

11. (a) The energy of hydrogen atom in an orbit is –1.51 eV. What are kinetic and potential energies of the electron in this orbit ?

(b) The electron in a hydrogen atom is typically found at a distance of about 5.3×10^{-11} m from the nucleus which has a diameter of about 1.0×10^{-15} m. Assuming the hydrogen atom to be a sphere of radius 5.3×10^{-11} m, what fraction of its volume is occupied by the nucleus ? **3**

SECTION – C
CASE STUDY

12. A compound microscope consists of two converging lenses. One of them, of smaller aperture and smaller focal length is called objective and the other of slightly larger aperture and slightly larger focal length is called eye-piece. Both the lenses are fitted in a tube with an arrangement to vary the distance between them. A tiny object is placed in front of the objective at a distance slightly greater than its focal length. The objective produces the image of the object which acts as an object for the eye-piece. The eye piece, in turn produces the final magnified image. **1 × 5 = 5**

I. In a compound microscope the images formed by the objective and the eye-piece are respectively

(A) virtual, real (B) real, virtual

(C) virtual, virtual (D) real, real

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II. किसी संयुक्त सूक्ष्मदर्शी के कारण आवर्धन निम्नलिखित में से किस पर निर्भर *नहीं करता* है ?

(A) अभिदृश्यक और नेत्रिका के द्वारक

(B) अभिदृश्यक और नेत्रिका की फोकस दूरी

(C) नलिका की लम्बाई

(D) उपयोग किया गया प्रकाश

III. संयुक्त सूक्ष्मदर्शी के संदर्भ में कौन सा कथन *सही नहीं* है ?

(A) दोनों लेंस कम फोकस दूरी के होते हैं ।

(B) दोनों लेंसों की फोकस दूरी कम करने पर आवर्धन क्षमता बढ़ जाती है ।

(C) दोनों लेंसों के बीच की फोकस दूरी (fo + fe) से अधिक होती है ।

(D) दोनों लेंसों की अदला-बदली करके इस सूक्ष्मदर्शी का उपयोग दूरदर्शक के रूप में किया जा सकता है ।

IV. किसी संयुक्त सूक्ष्मदर्शी में अभिदृश्यक 10X का और नेत्रिका 20X की है । इस सूक्ष्मदर्शी के कारण आवर्धन होगा

(A) 2 (B) 10

(C) 30 (D) 200

V. किसी संयुक्त सूक्ष्मदर्शी के अभिदृश्यक और नेत्रिका की फोकस दूरियाँ क्रमशः 1.2 cm और 3.0 cm हैं । बिम्ब अभिदृश्यक से 1.25 cm दूरी पर स्थित है । यदि अन्तिम प्रतिबिम्ब अनन्त पर बनता है, तो सूक्ष्मदर्शी की आवर्धन क्षमता होगी

(A) 100 (B) 150

(C) 200 (D) 250

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II. The magnification due to a compound microscope *does not* depend upon

(A) the aperture of the objective and the eye-piece

(B) the focal length of the objective and the eye-piece

(C) the length of the tube

(D) the colour of the light used

III. Which of the following is *not correct* in the context of a compound microscope ?

(A) Both the lenses are of short focal lengths.

(B) The magnifying power increases by decreasing the focal lengths of the two lenses.

(C) The distance between the two lenses is more than (fo + fe).

(D) The microscope can be used as a telescope by interchanging the two lenses.

IV. A compound microscope consists of an objective of 10X and an eye-piece of 20X. The magnification due to the microscope would be

(A) 2 (B) 10

(C) 30 (D) 200

V. The focal lengths of objective and eye-piece of a compound microscope are 1.2 cm and 3.0 cm respectively. The object is placed at a distance of 1.25 cm from the objective. If the final image is formed at infinity, the magnifying power of the microscope would be

(A) 100 (B) 150

(C) 200 (D) 250

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SeniorSecondary School ,Term II Examination2022

Marking Scheme – PHYSICS (SUBJECT CODE — 042)

(PAPER CODE — 55/3/3)

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 totalled 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.

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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 35answer books per day in other subjects (Details are given in Spot Guidelines). f the This is in view o .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 un assessed in an answer book.
    - Giving more marks for an answer than assigned to it.
    - Wrong totalling 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 totalling on the title page.
    - Wrong totalling 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 un assessed portion, non-carrying over of marks to the title page, or totalling 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 totalled 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.

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MARKING SCHEME

Senior Secondary School Examination TERM–II, 2022

PHYSICS (Subject Code — 042)

[Paper Code — 55/3/3]

Maximum Marks : 35

Q. No.	EXPECTED ANSWER / VALUE POINTS	Marks	Total marks
	SECTION—A		
1.	**a)** Distinction between isotopes and isobars 1 Explanation 1		
	(i) Isotopes – These are the atoms having same atomic number (Z) but different atomic mass(A).	½	
	Isobars – The atoms of different element having same atomic masses.	½	
	(ii) No, the mass number of a nucleus is the sum of number of proton(Z) and number of neutrons (N) / $A = Z + N$ / Two nuclei with different mass numbers A_1 and A_2 , may have , have different Z .	½ + ½	2
	OR		
	b) Two factors 1 Definition of threshold frequency 1		
	(i) Factors		
	(a) Frequency of incident radiation	½	
	(b) Work function of the surface	½	
	(ii) The minimum frequency of the incident radiation below which photoelectric emission does not take place.	1	2
2	Explanation of movement of charge carriers / diffusion 1 Formation of the barrier potential 1		
	The diffusion of electrons from n-region to p-region and that of the holes from p-region to n-region creates positive charge on the n-side and negative charge on the p-side which causes a difference of potential across the junction.	1	2
	This potential, setup across the junction tends to prevent the movement of electrons from the n-region to p-region .This is called barrier potential.	1	
3	(a) Naming of semiconductor ½ + ½ (b) Drawing of energy band diagram ½ + ½		

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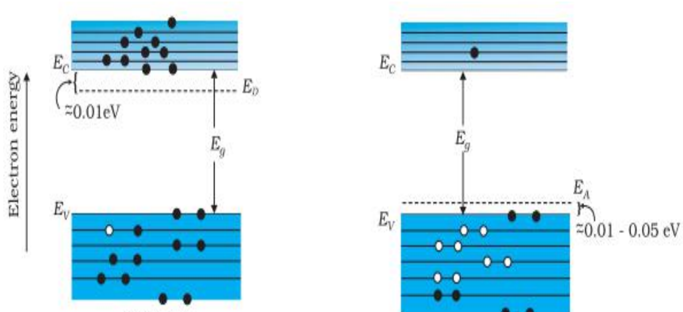
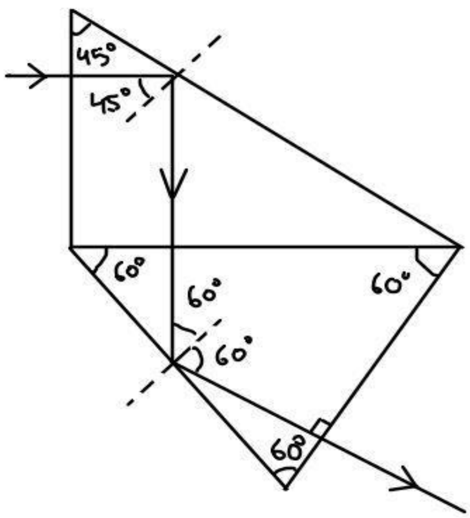
	a) (i) p-type semiconductor (ii) n-type semiconductor **b)**  (a) $T > 0K$ one thermally generated electron-hole pair + 9 electrons from donor atoms (b) $T > 0K$	½ ½ ½ + ½	2
	Section B		
4.	**a)** (a) Two necessary conditions 2 (b) Tracing the path of the ray 1 a) Two conditions (i) The light must travel from an optically denser medium to a rarer medium. (ii) Angle of incidence should be greater than the critical angle. (b)  **OR** **b)** (a) Obtaining conditions for two cases 2 (b) Formation of image 1	1 1 1	3

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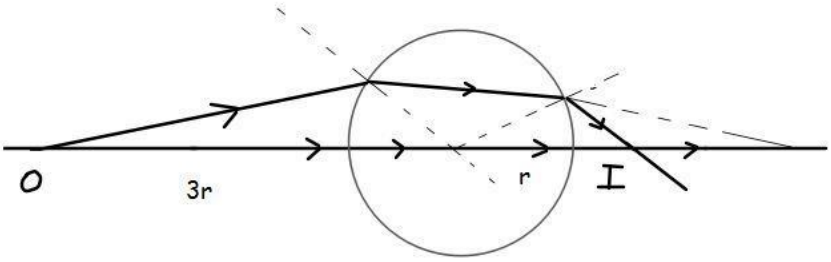
	(a) Two conditions $m = \frac{h'}{h} = \frac{v}{u}$ (i) For real images / when object is placed beyond F, As u is negative and v is positive.. (ii) for virtual image / when object is kept between F and the optical centre of the lens. As u and v both are negative. 	½ + ½ ½ + ½ 1	3
5.	(i) Calculation of energy - 1 (ii) Maximum kinetic energy - 1 (iii) Stopping potential - 1 i) $E = h\nu$ $= 6.63 \times 10^{-34} \times 6.4 \times 10^{14}$ $= 4.24 \times 10^{-19}$ J =2.65 eV ii) $K_{max} = E - \phi_0$ $= 2.65 - 2.31$ $= 0.34$eV iii) $eV_o = K_{max}$ $V_o = 0.34$ V	½ ½ ½ ½ ½ ½	3
6.	(i) Distance of bright fringe for central maxim 1 ½ (ii) Least distance from central maxima where bright fringes due to both wavelength coincide 1 ½ i) $x_n = n\frac{\lambda D}{d}$ $x_2 = \frac{2 \times 500 \times 10^{-19} \times 0.60}{10^{-3}}$ $= 0.6$ mm ii) $n_1\lambda_1 = n_2\lambda_2$	½ ½ ½ ½	

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	$n \times 600 = (n + 1)\, 500$ $n = 5$ $x_5 = \frac{5\lambda D}{d}$ $x_5 = \frac{2x600x10^{-9}x0.60}{10^{-3}}$ $= 1.8$ mm	½ ½	3
7.	**a)** (i) Identification of the three em waves — 1 ½ (ii) Sources of the three em waves — 1 ½ EM Waves — Sources λ_1 → Microwaves — magnetron valve / klystron valve / gun diodes λ_2 → Ultra Violet — high voltage gas discharge tube λ_3 → Infra red — hot bodies and molecules **OR**	½+ ½ ½+ ½ ½+ ½	3
	b) (i) Two conditions — 1 (ii) Two points of difference — 2 (i) The two sources should emit the waves in the same phase or with a constant phase difference . The two sources must continuously emit light wave of the same wavelength. (ii) **Interference**: 1) Intensity of all bright bands are nearly same 2) All fringes are of same width. **Diffraction**: 1) Intensity of bright bands decreases rapidly on both sides of central maxima. 2) All the fringes are not of same width / the width of central maximum is double that of the width of secondary maxima. Or any other two differences.	½ ½ 1+1	3
8.	Effect on angular width of central maximum in the three cases — 1 ½ Justification for the three cases — 1 ½		

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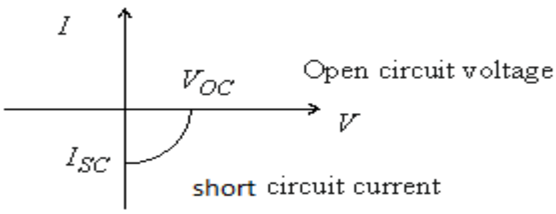
	In diffraction pattern the angular width of central maximum $=\frac{2\lambda}{a}$ where a is the slit width and λ is the wavelength. (i) Increases As $\theta=\frac{2\lambda}{a}$ and $\lambda_{orange} > \lambda_{green}$ (ii) No change / no effect As θ does not depend upon the distance of the screen from the slit(D) (iii) Increases As θ is inversely proportional to the slit width(a). (Note :- Give ½ mark , if only the formula $\theta=\frac{2\lambda}{a}$ is given.)	½ ½ ½ ½ ½ ½	3
9.	Generation of emf — 2 I - V characteristics — 1 Three processes due to which emf is generated in a solar cell are . (i) Generation of electron-hole pairs due to light incident close to the junction. (ii) Separation of electrons and holes due to electric field of the depletion region. Electrons swept to n-side and holes to p-side. (iii) The electrons reaching the n-side are collected by the front contact and the holes reaching the p-side are collected by the back contact. • Thus p-side becomes positive and n-side becomes negative giving rise to photovoltage. 	½ ½ ½ ½ 1	3
10	(a) Explanation for conclusion by James Chadwick — 1 ½ (b) Explanation for same radius of nuclei — 1 ½ a) If the neutral radiation consisted of photons then from the conservation of energy and momentum, the energy of photons would have to be much higher than the energy available from the bombardment of beryllium nuclei with α- particles. He assumed that the neutral radiation consists of a new type of neutral particles called neutron	1 ½	

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	b)Radius R of a nucleus depends on mass number A, $R \alpha A^{\frac{1}{3}}$ Where $A = N + Z$ In case of Isobars mass number is same but N and Z are not equal.	½ ½ ½	3
11	(a) Finding the Kinetic and potential energy of electron 1+1 Calculation of fraction of volume occupied by nucleus 1 E= -1.51eV $K = - E$ =1.51 eV $U = 2E$ = -3.02eV Fraction of volume occupied by the nucleus $= \frac{\frac{4}{3}\pi r^3 nucleus}{\frac{4}{3}\pi r^3 atom}$ $= \left(\frac{r_{nucleus}}{r_{atom}}\right)^3$ $= \left(\frac{0.5x10^{-15}}{5.3x10^{-11}}\right)^3$ $= 8.3 \times 10^{-16}$	½ ½ ½ ½ ½ ½	3
	SECTION—C		
12.	(I) (B) real , virtual (II) (A) The aperture of the objective and the eye piece (III) (D) The microscope can be used as a telescope by interchanging the two lenses. (IV) (D) 200 (V) (C) 200	1 1 1 1 1	5

* * *

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