Strictly Confidential: (For Internal and Restricted use only)
SeniorSecondary School Term IICompartment Examination,2022
Marking Scheme – PHYSICS THEORY (042)
(PAPER CODE – 55/ B/6)

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 _____(example 0-35 marks as given in Question Paper) has to be used. Please do not hesitate to award full marks if the answer deserves it.

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

12. Ensure that you do not make the following common types of errors committed by the Examiner in the past:-
    - Leaving answer or part thereof unassessed in an answer book.
    - Giving more marks for an answer than assigned to it.
    - Wrong 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 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 unassesed 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.

Q. No.	EXPECTED ANSWER / VALUE POINTS	Marks	Total Marks
	Section - A		
1.	Distinction between intrinsic and extrinsic semiconductor 1+1 <table><tr><th>Intrinsic Semiconductor</th><th>Extrinsic Semiconductor</th></tr><tr><td>1. These are pure semiconductors having no impurity.</td><td>1. These are the semiconductors doped either with pentavalent or trivalent impurity atoms.</td></tr><tr><td>2. They have low electrical conductivity.</td><td>2. Their conductivity is greater than that of intrinsic semiconductors.</td></tr><tr><td>3. The number density of electrons and holes is equal i.e $n_e = n_h$</td><td>3. The number density of electrons and holes is different depending on the type of doping.</td></tr></table> (Any two of the above /any other two difference)	1 1	2
2	(a) Explanation 2 Nuclear fusion is the source of energy generation in the proton- proton cycle taking place in the sun. In the core of the sun, due to extremely high temperature, hydrogen nuclei fuse together and form helium nuclei releasing thermonuclear energy. Alternatively Equations depicting fusion of four hydrogen nuclei i.e $$4{}_1^1H + 2e^- \rightarrow {}_2^4He + 2\nu + 6\gamma + 26.7\,\text{MeV}$$ $$\text{or } (4{}_1^1H + 4e^-) \rightarrow ({}_2^4He + 2e^-) + 2\nu + 6\gamma + 26.7\,\text{MeV}$$ **OR** Effect on photoelectric current with (i) Increase in intensity and justification ½ + ½ (ii) Decrease in frequency any justification ½ + ½ (b) (i) Increases : As the intensity of the incident radiation increases, the number of photons in the beam increases implying the emission of more number of photoelectrons. (ii) No Effect : As the decrease in frequency will effect the energy of the photon and not the number of photoelectrons.	1 1 ½ +½ ½ +½	2

3				
	Difference between drift and diffusion current 1 Net Current at p-n junction in equilibrium 1			

Drift Current: Movement of minority charge carriers (electrons and holes) due to the electric field generated across the junction, constitutes drift current.   ½

Diffusion current: Due to the concentration gradient across p-side & n-side, holes diffuse from p-side to n-side & electrons diffuse from n-side to p-side. The current so formed is diffusion current.   ½

Net current at p-n junction in equilibrium is zero.   1

      2

Section - B

4				
	(a) Definition of distance of closest approach 1 (b) Calculation of Kinetic energy 2			

(a)
Centre to centre distance between the α- particle and the nuclear when the kinetic energy of α- particle is completely converted to the potential energy of the system consisting α- particle and the nucleus.   1

Alternatively
Centre to centre distance between the α- particle and the target nucleus when α- particle stops momentarily before rebounding.

Alternatively
When an α- particle approaches a target nucleus in a head-on position, the minimum distance of the α- particle from the centre of the target nucleus just before it rebounds is called distance of closest approach.

(b) $r_0 = \dfrac{2\,Z\,e^2}{4\,\pi\epsilon_0 E_k}$ ½

$\therefore\ E_k = \dfrac{2\,Z\,e^2}{4\,\pi\epsilon_0 r_0}$ ½

$= \dfrac{9\times10^9 \times 2\times79\times(1.6\times10^{-19})^2}{28.8\times10^{-15}}$ ½

$= 126.4 \times 10^{-14}\,\text{J}$
$= 7.9\ \text{MeV}$ ½

      3

5.				
	Explanation of working 1 Two advantages 1+1			

Working – When LED is forward biased, electrons moves from n- side to p-side & holes from p- side to n-side, the concentration of minority charge carriers at the junction boundary increases. These excess minority   1

charge carriers combine with majority charge carriers near the junction boundary and release energy in the form of photon.

<u>Advantages</u>-Low operational voltage and less power/
fast action and no warm-up time required /
the bandwidth of emitted light is nearly monochromatic/
long life and ruggedness/
fast on-off switching capability.

(Any two)   1+1

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6. | a) Proof of same nuclear density | 2 |
    | b) Finding the radius of the nucleus | 1 |

(a) Mass of the nucleus= m A

Nuclear density $= \dfrac{\text{Mass}}{\text{Volume}}$ ½

$\qquad = \dfrac{m\,A}{\frac{4}{3}\pi R^3}$ ½

But R $= R_0 A^{1/3}$ ½

Nuclear density $= \dfrac{m}{\frac{4}{3}\pi R_0^3}$ which is constant   ½

(b) R= $R_0 A^{1/3}$ = 1.2 $(64)^{1/3}$ ½

R = 1.2 × 4 = 4.8 fm   ½   3

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7. | a) Definition and unit of power of lens | ½ + ½ |
    | b) Calculation of power | 2 |

(a) Power of a lens is defined as the tangent of the angle by which it converges and diverges a beam of light falling at unit distance from the optical centre.   ½
                        Alternatively
Power :- Ability to converge or diverge the beam of light incident on a lens.
                        Alternatively
Power of the lens is given by the reciprocal of its focal length.

S.I unit is dioptre or m^{-1}.   ½

(b) P = $\dfrac{1}{f}$ = (μ-1) $(\dfrac{1}{R_1} - \dfrac{1}{R_2})$ ½

$\qquad = (1.6 - 1)\,(\dfrac{1}{-0.1} + \dfrac{1}{0.3})$ ½

$\qquad = (0.6)\,(\dfrac{-3+1}{0.3})$ ½

	$= -4\ D$	½	3

8. (a)

(i) Explanation	1
(ii) Finding the required tube length of microscope	2

(a) (i) The magnification produced by a compound microscope is inversely proportional to the focal length of the objective and the eyepiece. Hence short focal length increases magnification.

Alternatively ... 1

$m = (\dfrac{L}{f_0})\ (\dfrac{D}{f_e})$, where f_0 and f_e are small then magnification m will be large.

... 1

(ii) $m = m_0 \times m_e = \dfrac{L \times D}{f_0 \times f_e}$

$30 = \dfrac{L \times (25)}{1.25 \times 5}$ ... ½

$\therefore\ L = 7.5$ cm ... ½

OR

(b)

(i) Effect on Interference Pattern	1
(ii) Calculation of the wavelength of light	2

(i) The central maxima will be white followed by coloured fringes. ... ½+½

(ii) $x = \dfrac{n\lambda D}{d}$ ... 1

$1.4 \times 10^{-2} = \dfrac{3 \times \lambda \times 1.4}{0.18 \times 10^{-3}}$ ... ½

$\lambda = 6 \times 10^{-7} m = 600 nm$ ... ½

3

9.

(a)Two differences	½ +½
(b) Ratio of de Broglie Wavelengths	2

(a)

Matter Waves	Electromagnetic Waves	
(1)Matter waves are associated with every moving mass.	(1)EM waves can only be produced by accelerating charged particles.	½
(2)Matter waves associated with moving particle cannot achieve a speed of 3×10^8 m/s.	(2)Speed of EM wave in free space is 3×10^8 m/s.	½

(Any other two difference)

(a) $\lambda = \dfrac{h}{m\upsilon} = \dfrac{h}{\sqrt{2m \times E}}$ where E is the kinetic energy of the particle   ½

$\dfrac{\lambda_D}{\lambda_T} = \dfrac{h}{\sqrt{2m_D E}} \times \dfrac{\sqrt{2m_T E}}{h}$ 1

$\dfrac{\lambda_D}{\lambda_T} = \sqrt{\dfrac{3}{2}}$ ½

3

10.

(a) Calculation of refractive index of the prism	1½
(b) Showing the refractive index $\mu = 2\cos\left(\dfrac{A}{2}\right)$	1½

(a) $\mu = \dfrac{\sin\left(\dfrac{A + D_m}{2}\right)}{\sin A/2}$ ½

$= \dfrac{\sin\left(\dfrac{60^o + 30^o}{2}\right)}{\sin 60/2}$ ½

$= \dfrac{\sin 45^o}{\sin 30^o} = \sqrt{2}$ ½

(b) $\mu = \dfrac{\sin\left(\dfrac{A + D_m}{2}\right)}{\sin A/2}$ ½

$= \dfrac{\sin\left(\dfrac{A + A}{2}\right)}{\sin A/2} = \dfrac{\sin A}{\sin A/2}$ ½

$\mu = \dfrac{2\sin A/2 \cos A/2}{\sin A/2} = 2\cos A/2$ ½

3

11 (a)

Naming of EM waves (i), (ii) & (iii)	½ + ½ + ½
One use of each EM wave	½ + ½ + ½

(i)   γ – rays   ½
      Uses – Radiotherapy / Sterilization and disinfection / Research   ½
      purpose (Any one)
(ii) Infrared Waves   ½
      Uses- Heat sensors/Thermal imaging/ night vision equipment /   ½
      Remote control (Any one)
(iii) UV rays   ½
      Uses – Water purification/ Killing of bacteria (Any one)   ½

OR

(b)

(i) Explanation of conditions for observing maximum and minimum intensity	2
(ii) Reason of sharp decrease of intensity	1

	(i) When the path difference (p) = d $\sin\theta$ = $(2n+1)\frac{\lambda}{2}$, then the secondary wavelets starting from consecutive parts of slit having a path difference of $\lambda/2$ except the last part, cancel each other contribution, leading to formation of maxima at a point on the screen.	1	
		When the path difference (p) = d $\sin\theta$ = $n\lambda$, then secondary wavelets starting from consecutive parts of the slit having path difference of $\lambda/2$ cancel each other contribution leading to formation of minima at a point on the screen.	1	
		(ii) Maximum intensity is obtained at a point on the screen when the path difference is $(2n+1)\frac{\lambda}{2}$. With increasing 'n' only one- third, one-fifth, one-seventh etc of the slit contribute, hence intensity of maxima decreases sharply. Alternatively With the increase of order (n) the number of secondary wavelets responsible for the formation of secondary maxima, decreases resulting in sharp decrease of intensity.	1	
				3
	Section - C			
12.	(a) (iv) (b) (iii) (c) (iii) (d) (iv) (e) (iv)	1 1 1 1 1	
				5