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Senior Secondary School Term II Examination, 2022

Marking Scheme – PHYSICS (SUBJECT CODE – 042)

(PAPER CODE – 55/4/1)

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 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 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.

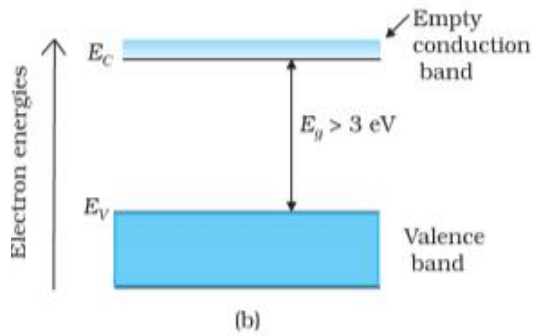
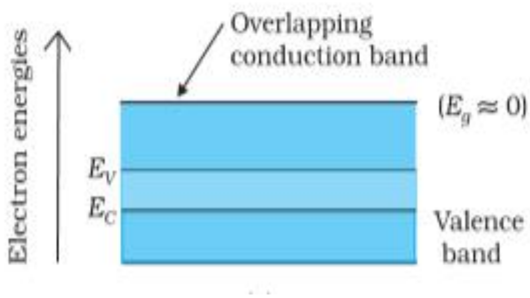
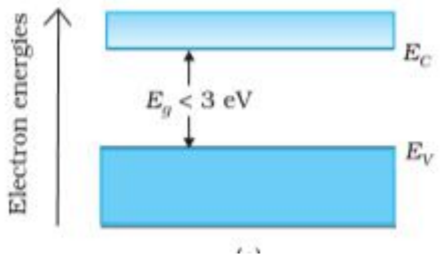
17. The Board permits candidates to obtain photocopy of the Answer Book on request in an RTI application and also separately as a part of the re-evaluation process on payment of the processing charges.

MARKING SCHEME

Senior Secondary School Examination TERM–II, 2022

PHYSICS (Subject Code–042)

[Paper Code : 55/4/1]

Q. No.	EXPECTED ANSWER / VALUE POINTS	Marks	Total Marks
1.	• Meaning of energy Band gap $\frac{1}{2}$ • Energy Band Diagram of Conductor, Insulator & Semiconductor (½ + ½ + ½)		
	The gap between the top of the valence band and bottom of the conduction band is called the energy band gap.	½	
	 ENERGY BAND DIAGRAM FOR INSULATOR	½	
	 ENERGY BAND DIAGRAM FOR CONDUCTOR	½	
	 ENERGY BAND DIAGRAM FOR SEMICONDUCTOR	½	2

2.	• Name of Spectral Series ½ • Ratio of the wavelength $1\frac{1}{2}$ **a)** Balmer Series $\frac{1}{\lambda} = R\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$ $\frac{1}{\lambda_{max}} = R\left(\frac{1}{2^2} - \frac{1}{3^2}\right)$ ($n_f = 2$, $n_i = 3$) $\lambda_{max} = \frac{36}{5R}$ $\frac{1}{\lambda_{min}} = R\left(\frac{1}{2^2} - \frac{1}{\infty}\right)$ ($n_f = 2$, $n_i = \infty$) $\lambda_{min} = \frac{4}{R}$ $\frac{\lambda_{max}}{\lambda_{min}} = \frac{9}{5}$ **OR** • Meaning of matter waves ½ • Ratio of de- Broglie wavelength $1\frac{1}{2}$ **b)** Wave associated with moving material particle $\lambda = \frac{h}{\sqrt{2qmV}}$ $\therefore \frac{\lambda_p}{\lambda_\alpha} = \sqrt{\frac{q_\alpha m_\alpha}{q_p m_p}}$ $\therefore \frac{\lambda_p}{\lambda_\alpha} = \sqrt{\frac{2e \cdot 4m}{e \cdot m}}$ $= \frac{2\sqrt{2}}{1}$	½ ½ ½ ½ ½ ½ ½ ½	2
3.	• Naming the device $\frac{1}{2}$ • Any three Uses $1\frac{1}{2}$		

	Light emitting diode (LED)	½	
	Advantages of LED (Any three of the following)	½+½+½	
	(i) Low operational voltage and less power *(ii)* Fast on-off switching capability *(iii)* The bandwidth of emitted light is 100 Å to 500 Å or in other words it is nearly (but not exactly) monochromatic. *(iv)* Long life and ruggedness. *(v)* Fast action and no warm up time required **(Note- Give credit of half mark to the students for writing electric bulb or other relevant device, and further credit $1\frac{1}{2}$ marks if they mention the advantages of written device only)**		2
	SECTION-B		
4.	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 ≤ 10) to form a heavier nucleus.	½	
	b) No. of atoms in 100 g $= \dfrac{6{\cdot}023\times10^{23}}{2}\times100 = 3{\cdot}0115\times10^{25}$	½	
	Energy released/atom $= \dfrac{3{\cdot}27\text{ MeV}}{2} = 1{\cdot}635\text{ MeV}$		
	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	
	$t = \dfrac{E}{P}$	½	
	$= \dfrac{7{\cdot}878\times10^{12}\text{ J}}{500\text{ J/s}} = 1.5756\times10^{10}\text{ s}$	½	
	$= \dfrac{1.5756\times10^{10}}{3{\cdot}15\times10^{7}} \simeq 500y$		3

	Alternatively : $E = \frac{MQ}{2m_d}$ $= \frac{(0{\cdot}1\text{ kg})\times(3{\cdot}27\text{ MeV})}{2(2{\cdot}04)\times(1{\cdot}66\times10^{-27}\text{ kg}/4)}$ $= 0{\cdot}0492\times10^{27} = 4{\cdot}92\times10^{25}$ MeV $t = \frac{E}{P}$ $= \frac{(4{\cdot}92\times10^{25})\times(1{\cdot}6\times10^{-13})}{500} = 1.5756\times10^{10}$ s $= \frac{1.5756\times10^{10}}{3{\cdot}15\times10^{7}} \simeq 500y$	½ ½ ½ ½	
5.	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. On the other hand, when a *p-n* junction is reverse biased, the junction width increases hence resistance increases. b) Conductivity of intrinsic semi-conductors is very low. Hence, no electronic device can be developed using them. 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. **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.	½ ½ 1 1	3
6.	a) Calculation of distance of closest approach $1\frac{1}{2}$ b) Calculation of distance of closest approach $1\frac{1}{2}$		

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

7.

- Explanation of bright and dark fringes. 1
- Derivation of the expression of fringe width. 2

We get bright fringes, when waves from two coherent sources meet at a point on the screen with a phase difference ½

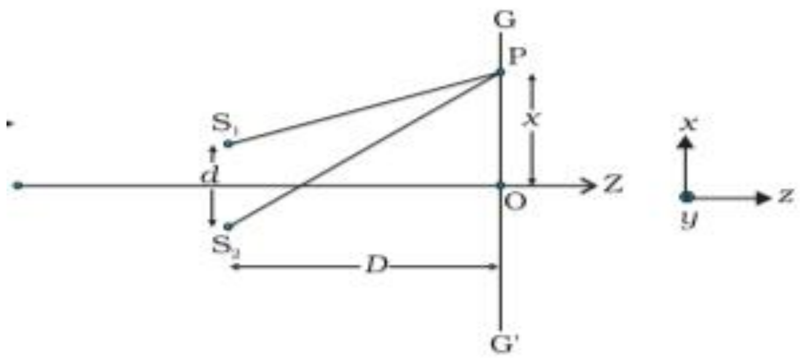
$\Delta\phi = 2n\pi$ (n= 1,2,3…….)

We get dark fringes, when waves from two coherent sources meet at a point on the screen with a phase difference ½

$\Delta\phi = (2n+1)\pi$ (n= 1,2,3…….)

(Note: Give full credit for explaining using path difference)

½



For maxima, $S_2P - S_1P = n\lambda \qquad n = 0,1,2,3........ \qquad (1)$

From figure, $(S_2P)^2-(S_1P)^2=\left[D^2+\left(x+\frac{d}{2}\right)^2\right]-\left[D^2+\left(x-\frac{d}{2}\right)^2\right]=2xd$

$$S_2P-S_1P=\frac{2xd}{S_2P-S_1P}$$

$$S_2P\approx S_1P\approx D$$

$$S_2P-S_1P=\frac{2xd}{2D}=\frac{xd}{D} \qquad (2)$$

½

From equation (1) & (2)

$$n\lambda=\frac{xd}{D}$$

$$x_n=\frac{n\lambda D}{d} \qquad for\ n^{th}\ \max ima$$

½

Similarly for (n+ 1)th maxima

$$x_{n+1}=\frac{(n+1)\lambda D}{d}$$

$\therefore$ fringe width $= x_{n+1} - x_n = \frac{\lambda D}{d}$

½

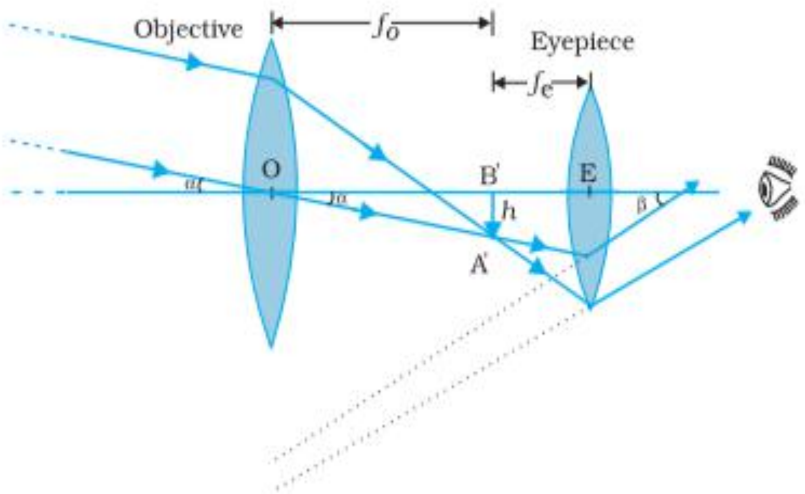
Note- Give full credit, if a student derives this relation using condition of minimum intensity.

3

8.

(a)	(i) Labelled ray diagram of astronomical telescope–	1
	(ii) (I) Calculation of length of tube	1
	(II) Calculation of magnification	1

a) (i)



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(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

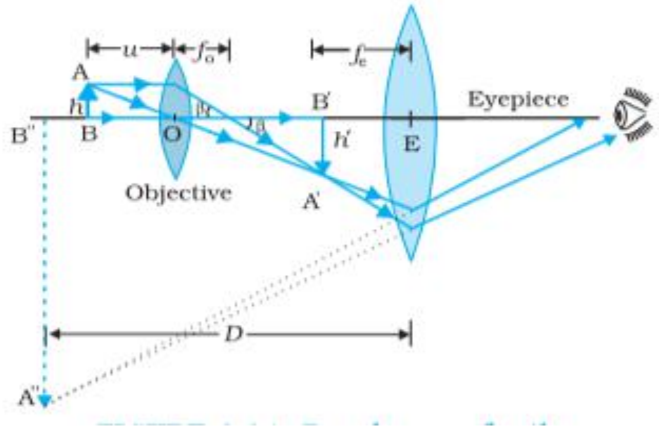
(II) $m = \dfrac{f_o}{f_e}$ ½

$\dfrac{150}{6} = 25$ ½

OR

b) (i) Labelled ray diagram of compound microscope –	1
(ii) (I) Position of image calculation	1
(II) Calculation of linear magnification	1

b) i)



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Ray diagram of image formation by a compound microscope

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

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

$\dfrac{1}{v} = \dfrac{1}{u} + \dfrac{1}{f} = \dfrac{1}{-3{\cdot}0} + \dfrac{1}{4{\cdot}0}$

$\dfrac{1}{v} = \dfrac{-4+3}{12} = -\dfrac{1}{12}$ $v = -12$ cm ½

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

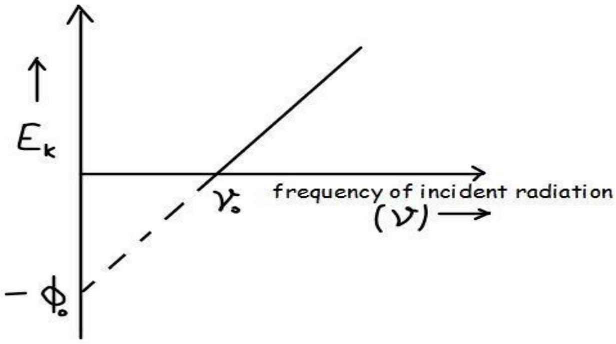
$m = \dfrac{-12}{-3} = 4$ ½

3

9.

(a) Maximum kinetic energy vs frequency graph	1
(b) (I) Justification for more E_K	1
(II) Justification for more number of emission of electron	1

(a)



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(b) (I)

$$E_K = h\nu - \phi_0$$ ½

as $\nu_Y > \nu_R$

$$(E_K)_y > (E_K)_R$$ ½

For a given photosensitive surface, K.E. of photo-electrons will be more for yellow light.

(II) Since the number of photons incident on unit area per unit time for same intensity of two lights will be more in Red light ($N_R > N_Y$) hence more number of photoelectrons will be ejected for Red light. 1

3

10.

a) Finding Angle of minimum deviation	1
b) Finding Refractive index of material of prism	1
c) Finding Angle of refraction at the point P	1

(a) As the ray passes symmetrically

$\angle i = \angle e$ and $\delta = \delta_m$

$$\therefore \quad i + e = A + \delta$$ ½

$$2i = A + \delta_m$$

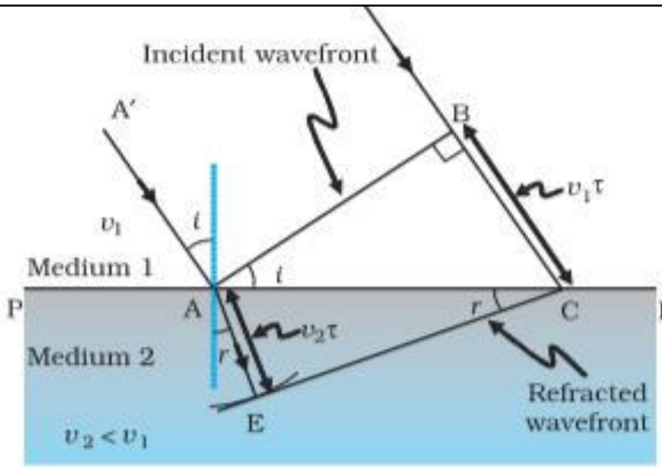
$$\delta_m = 2i - A = 90° - 60°$$

$$= 30°$$ ½

(b)

$$\mu = \frac{\sin\frac{(A+\delta_m)}{2}}{\sin A/2}$$ ½

$$= \frac{\sin 45°}{\sin 30°} = \sqrt{2}$$ ½

	(c) As $\delta = \delta_m$ $r_1 = r_2$ (Alternatively) Hence, r_1 (Angle of refraction at P) $1 \times \sin 45 = \mu \sin r_1$ $1 \times \frac{1}{\sqrt{2}} = \sqrt{2} \sin r_1$ $\therefore \angle r_1 = 30°$	 ½ ½	 3
11.	a) • Identification of e.m. wave $1\frac{1}{2}$ • Frequency range $1\frac{1}{2}$		
	(i) Microwave 10^{10}Hz – 10^{12}Hz	½ ½	
	(ii) X-rays. 10^{16}Hz – 10^{20}Hz **Alternatively** Gamma Ray 10^{20}Hz – 10^{24}Hz	½ ½	
	(iii) Gamma Ray 10^{20}Hz – 10^{24}Hz **Alternatively** Infrared Radiations 10^{12}Hz – 10^{14}Hz	½ ½	
	OR (b) • 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 $\sin i = \frac{BC}{AC} = \frac{v_1 \tau}{AC}$ $\sin r = \frac{AE}{AC} = \frac{v_2 \tau}{AC}$ Thus $\frac{\sin i}{\sin r} = \frac{v_2}{v_1}$ We know $n = \frac{c}{v}$, So $\frac{\sin i}{\sin r} = \frac{n_2}{n_1}$ which is the Snell's law.	 ½ 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

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