Senior Secondary School Term II Compartment Examination, 2022
Marking Scheme – PHYSICS THEORY (042)
(PAPER CODE –55/6/1)

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.

Q. No.	EXPECTED ANSWERS / VALUE POINTS	Marks	Total Marks
	Section A		

1.	a)
	
	 i) Reason of using shortwave band 1
	 ii) Reason of experimental demonstration in low frequency region 1
	
	 i) Ionosphere reflects waves in these bands.
	
	 ii) The frequency that we get even with modern electronic circuits is hardly about 10^{11} Hz, this is why experimental demonstration of electromagnetic waves had to come in low frequency region.
	 OR
	 b)
	 i) Diagram 1
	 ii) Identification of wave ½
	    Use ½
	
	 i)
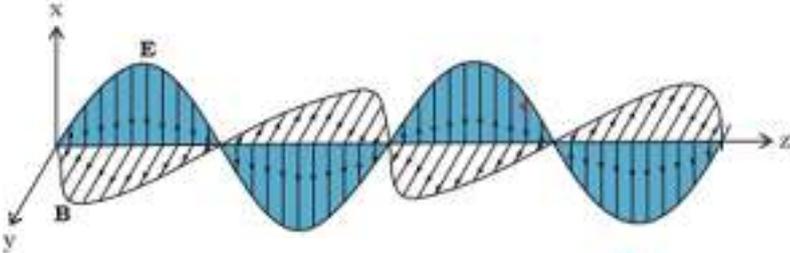	
	 [Note : Award full marks even if a student takes E and B on Y and X axis.]
	
	 ii) X rays
	    Use : As a diagnostic tool in medicine / treatment of cancer / or any other.
		
		 1
		
		 1
		
		 1
		
		 ½
		 ½
			
			 2

2	a) Reason 1
	 b) Finding value of Kinetic energy ½
	    Finding value of potential energy ½
	
	 a) Alpha particle reverses its direction of motion , due to strong repulsive force, exerted by positively charged nucleus without even actually touching the gold nucleus.
	
	 b) $E_n = -3.4 eV$ (given)
	    $E_k = -E_n = 3.4 eV$
	    $U = 2E_n = -6.8\ eV$
		
		 1
		
		 ½
		 ½
			
			 2

3	a) Reason 1 b) Definition of intensity of light in photon picture 1			

a) The crystal maintains an overall charge neutrality as the charge of additional charge carriers is just equal and opposite to that of the ionised cores in the lattice.	1	
b) It is defined as the energy transmitting per unit area, per unit time. Alternatively: It is proportional to number of photons per unit area per unit time.	1	2

Section - B

4	a)	a) Ray diagram 1 b) Derivation of angular magnification 2		

Linear magnification due to objective (m_o)

$$m_o = \frac{h'}{h} = \frac{L}{f_o} \qquad \text{-------------------------- (1)}$$

½

Linear magnification due to eye piece (m_e) when final image is formed at near point (D)

$$m_e = 1 + \frac{D}{f_e} \qquad \text{--------------------------(2)}$$

½

Total magnification $m = m_o \times m_e$

½

$$m = \frac{L}{f_o}\left(1 + \frac{D}{f_e} \right)$$

½

OR

b)	a) Ray diagram 1 b) Derivation 2	

1

for small angles,

$\tan \angle NOM = \frac{MN}{OM}$

$\tan \angle NCM = \frac{MN}{MC}$

$\tan \angle NIM = \frac{MN}{MI}$

Now, for $\Delta NOC, \angle i$ is the exterior angle. Therefore, $\angle i = \angle NOM + \angle NCM$

$i = \frac{MN}{OM} + \frac{MN}{MC}$

Similarly,

$r = \angle NCM - \angle NIM$

i.e. $r = \frac{MN}{MC} - \frac{MN}{MI}$

By Snell's law

$n_1 \sin i = n_2 \sin r$

or for small angles , $\sin i \approx i$ and $\sin r \approx r$

$n_1 i = n_2 r$

Substituting i and r , we get

$\frac{n_1}{OM} + \frac{n_2}{MI} = \frac{n_2 - n_1}{MC}$

Where OM , MI and MC represent magnitude of distances.

Applying the Cartesian sign convention

OM = -u , MI = +v , MC = +R

Substituting these in equation , we get

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

5.	a) Finding the ratio of intensity of bright and dark fringes 2 b) Calculating the wavelength 1		

a)

$r = \frac{A_1}{A_2} = \sqrt{\frac{I_1}{I_2}} = \sqrt{\frac{9}{1}} = \frac{3}{1}$

$\frac{I_{max}}{I_{min}} = \frac{(r+1)^2}{(r-1)^2} = \left(\frac{4}{2}\right)^2 = \frac{4}{1}$

b) Wavelength of refracted light

$\lambda = \frac{\lambda_{air}}{n} = \frac{3 \times 600}{4} = \frac{1800}{4}$

= 450 nm

6. (a)	a) Explanation 1 Two differences 1 + 1			

Maximum intensity is obtained at a point on the screen when the path difference is $(2n+1)\dfrac{\lambda}{2}$. 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

Differences (any two)
1. Diffraction is a pattern formed as a result of superposition of waves from different portions of the same wave front. Interference is a pattern on a screen a result of superposition of single slit diffraction from two slits.
2. In diffraction pattern width of central maximum is twice the width of secondary maxima. In interference pattern width of each maxima is same.
3. In diffraction pattern intensity of maxima goes on decreasing as we move away from central maximum. In interference pattern intensity of all maxima is same.
4. In diffraction pattern there is no absolute minima. In interference pattern absolute minima depends on amplitude of waves superposing.

1+1

OR

(b)	Diagram 1 Verification of Snell's law 2
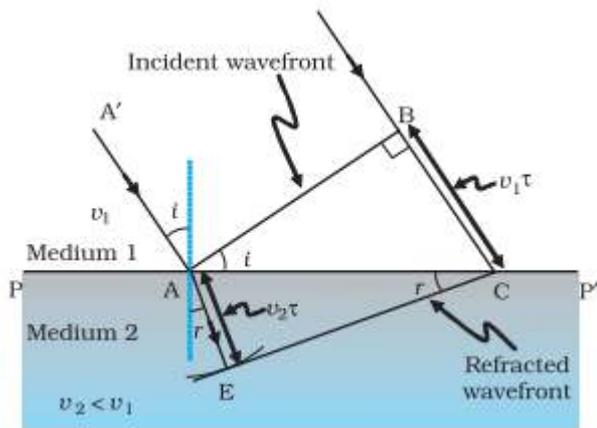
Consider the triangles ABC and AEC, we readily obtain

$$Sin\ i = \frac{BC}{AC} = \frac{v_1\tau}{AC}$$

And

$$Sin\ r = \frac{AE}{AC} = \frac{v_2\tau}{AC}$$

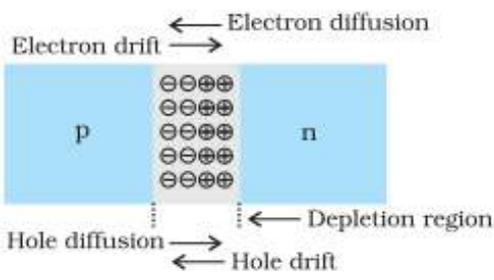where i and r are the angles of incidence and refraction, respectively.
Thus we obtain

1

½

$$\frac{Sin\ i}{Sin\ r} = \frac{v_1}{v_2} \qquad \text{------(1)}$$

½

If c represents the speed of light in vacuum, then,

$$n_1 = \frac{c}{v_1}$$

½

and

$$n_2 = \frac{c}{v_2}$$

are known as the refractive indices of medium 1 and medium 2, respectively. In terms of the refractive indices, eq. (1) can be written as

$n_1 \sin i = n_2 \sin r$

This is the Snell's law of refraction.

½

3

7.

a)	Ratio of de- Broglie wavelengths and justification	½ + ½
b)	Identification of wavelengths and its justification	½ + ½
	Calculation of threshold frequency	1

a) de- Broglie wavelength , $\lambda = \frac{h}{mv}$

$$\frac{\lambda_\alpha}{\lambda_p} = \frac{m_p}{m_\alpha}$$

½

As, $m_\alpha > m_p \Rightarrow \lambda_p > \lambda_\alpha$

½

b) For photoelectric emission wavelength of radiation must be lesser than the threshold wavelength.

½

Thus lights of wavelength 430 nm and 450 nm can cause photoelectric emission

½

Threshold frequency (v_o)

½ + ½

$$v_o = \frac{c}{\lambda_o} = \frac{3 \times 10^8}{600 \times 10^{-9}} = 5 \times 10^{14} \text{ Hz}$$

3

8.

a)	Obtaining Bohr's second postulate from de-Broglie hypothesis	2
b)	Identification of transition of electron	½ + ½
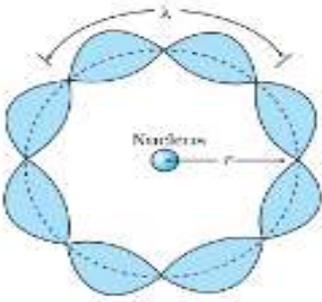
a) For an electron moving in n^{th} circular orbit of radius r_n, the total distance is circumference of the orbit.

Thus $2\pi\ r_n = n\lambda$ ....(1) where n = 1, 2, 3 --------

½

λ is de-Broglie wavelength associated with the electron in the nth orbit.

Now $\lambda = \frac{h}{p} = \frac{h}{mv_n}$ ....(2)

½

From equation (1) and (2)

	$2\pi \, r_n = \dfrac{nh}{mv_n}$	½	
	$mv_n \, r_n = \dfrac{nh}{2\pi}$	½	
	Which is quantum condition proposed by Bohr for the angular momentum of the electron.		
	b) For Balmer series of hydrogen spectrum		
	$$\dfrac{1}{\lambda} = R\left(\dfrac{1}{2^2} - \dfrac{1}{n^2}\right)$$		
	(i) For maximum wavelength : transition of electron is from n = 3 to n=2	½	3
	(ii) For minimum wavelength: transition of electron is from n = ∞ to n= 2	½	

9.

a) Verifying nature of reaction	2
b) Ratio of nuclear density	1

a) Mass of reactants = (1.007825+3.016049) u = 4.023874 u	½	
Mass of products = (2x 2.014102) u = 4.028204 u	½	
Mass of reactants < Mass of products	½	
Hence, reaction is Endothermic	½	
b) 1:1	1	3

10.

V-I characteristics of p-n junction	1
a) Explanation of independency of reverse bias current on breakdown voltage	1
b) Explanation of sudden increase in current at breakdown voltage	1

[Note : Do not deduct marks for not writing the values on the axis.]

a) The current is not limited by the magnitude of the applied voltage but is limited due to the concentration of the minority carriers on either side of the junction.　　1

	b) At the breakdown voltage, a large number of covalent bonds break, resulting in the increase of large number of charge carriers. Hence current increases suddenly.	1	3
11.	a) Diagram ½ Explanation of formation of p-n junction 1½ b) Explanation of the need to join p and n type semiconductor at atomic level 1		
	a)	½	
	During the formation of p-n junction due to concentration gradient across p and n sides, holes diffuse from p side to n side and electrons diffuse from n side to p side This motion of charge carriers gives rise to diffusion current across the junction. Diffusion of electrons develops a layer of positive charge on n side of the junction and diffusion of holes develops a layer of negative charge on p side of the junction. Due to this space charge region on either side of the junction an electric field is developed. This electric field drifts charge carriers across the junction and sets up drift current in a direction opposite to diffusion current. This process continues until the diffusion current is equal to drift current. Thus p-n junction is formed.	½ ½ ½	
	c) No, Any slab, howsoever flat, will have roughness much larger than the inter-atomic spacing (~2 to 3 Å) and hence continuous contact at the atomic level will not be possible. The junction will behave as a discontinuity for the flowing charge carriers.	1	3
	Section C		
12.	a) (ii) b) (iv) c) (ii) d) (ii) e) (iv)	1 1 1 1 1	5