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Senior School Certificate Examination-2020
Marking Scheme – PHYSICS THEORY (042)
(55/B)

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. **Evaluation is a 10-12 days mission for all of us. Hence, it is necessary that you put in your best efforts in this process.**
2. 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.**
3. 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.
4. 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.**
5. 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.
6. 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.
7. If a student has attempted an extra question, answer of the question deserving more marks should be retained and the other answer scored out.
8. No marks to be deducted for the cumulative effect of an error. It should be penalized only once.
9. A full scale of marks 0-70 has to be used. Please do not hesitate to award full marks if the answer deserves it.
10. Every examiner has to necessarily do evaluation work for full working hours i.e. 8 hours every day and evaluate 20 answer books per day in main subjects and 25 answer books per day in other subjects (Details are given in Spot Guidelines).
11. 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.

12. 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.

13. 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.

14. The Examiners should acquaint themselves with the guidelines given in the Guidelines for spot Evaluation before starting the actual evaluation.

15. 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.

16. 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: PHYSICS

QUESTION PAPER CODE: 55(B)

Q.No.	Value Points/Expected Answer	Marks	Total Marks
	SECTION A		
1	(B) $\frac{\sigma}{\epsilon_o}$	1	1
2	(A) Converging lens of f=100 cm	1	1
3	(D) $> \frac{K}{2}$	1	1
4	(D) $C_1 = 12\mu C;\ C_2 = 12\mu C$	1	1
5	(C) n^2R	1	1
6	(A) $\frac{md}{(m+1)^2}$	1	1
7	(D) Photoelectric emission will not take place.	1	1
8	(C) The complete image will be formed with decrease in intensity.	1	1
9	(A) V/8	1	1
10	(A) Motion of electrons from n to p side and holes from p to n side.	1	1
11	Less than one	1	1
12	Full marks even if not attempted [Question is wrong]	1	1
13	Equilibrium	1	1
14	50%	1	1
15	-27.2 eV	1	1
16	If they cross at a point then there will be two directions of the resultant field at that point which is not possible.	1	1
17	The horizontal component of Earth magnetic field is zero at the magnetic pole/ angle of dip at the magnetic pole is 90^0.	1	1
18	Most of the shorter wavelengths (violet and blue light) are scattered.	1	1

	OR Magnifying power of compound microscope is more than that of the simple microscope.		
19	At the resonance maximum power is dissipated in the circuit (through resistance)	1	1
20	Spherical /converging OR 1. High resolving power 2. No chromatic aberration 3. Less spherical aberration 4. Sharper and brighter image [Any two]	1 ½ + ½	1
	SECTION B		
21	Formula $\phi = \frac{q}{\epsilon_o}$ ½ mark Substitution ½ mark Calculation and result 1 mark $\phi = \frac{q}{\epsilon_o} \quad \therefore q = \phi\epsilon_0$ $q = -4\pi \times 10^3\ \epsilon_0 = -4\pi\epsilon_0 \times 10^3$ $\frac{-1}{9 \times 10^9} \times 10^3$ $= -1.1 \times 10^{-7}$C	½ ½ 1	2
22	Formula $\vec{F} = q(\vec{v} \times \vec{B})$ ½ mark Definition 1 ½ mark $\vec{F} = q(\vec{v} \times \vec{B})$ $F = qvB\ sin\theta$ $B = F/qv\ sin\theta$ $B = F\ (q = 1C, v = 1\ m/s\ and\ \theta = 90^0$ When a force 1N acts on a unit charge moving perpendicular to a magnetic field with a unit speed, then the magnetic field is said to be of 1 tesla. OR	½ ½ 1	2

Two differences	1 +1 marks

	Diamagnetic	Paramagnetic
Susceptibility	Negative (less than zero)	Positive (Between 0 and 1)
Permeability	Between 0 and 1	More than one
Behaviour in external magnetic field	Weekly repelled	Weekly attracted
Effect of temperature	No effect	Intensity of magnetisation decreases

[Any two]

1+1 2

23

Maximum wavelength λ_{max}	½ mark
Minimum wavelength λ_{min}	½ mark
Ratio $\frac{\lambda_{max}}{\lambda_{min}}$	1 mark

$$\frac{1}{\lambda} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

½

For minimum wavelength λ_{min}- Electron jumps from n=3 to n=1

$$\frac{1}{\lambda_{min}} = R\left[\frac{1}{1^2} - \frac{1}{3^2}\right] = \frac{8R}{9}$$

½

$$\lambda_{min} = \frac{9}{8R}$$

For maximum wavelength electron jumps from n=3 to n=2

$$\frac{1}{\lambda_{max}} = R\left[\frac{1}{2^2} - \frac{1}{3^2}\right] = R\left[\frac{1}{4} - \frac{1}{9}\right] = \frac{5R}{36}$$

$$\lambda_{max} = \frac{36}{5R}$$

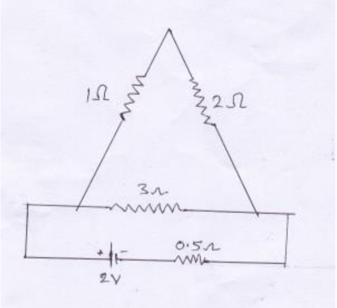
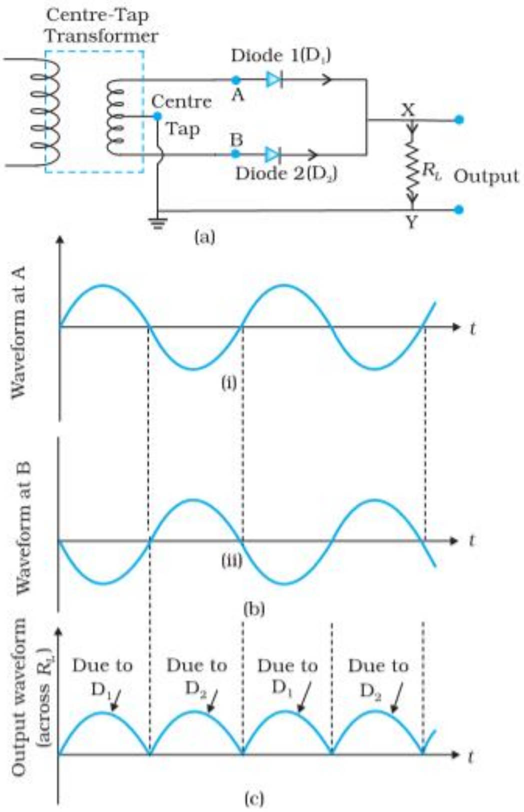
½

$$\therefore \frac{\lambda_{max}}{\lambda_{min}} = \frac{36 \times 8R}{5R \times 9} = \frac{32}{5}$$

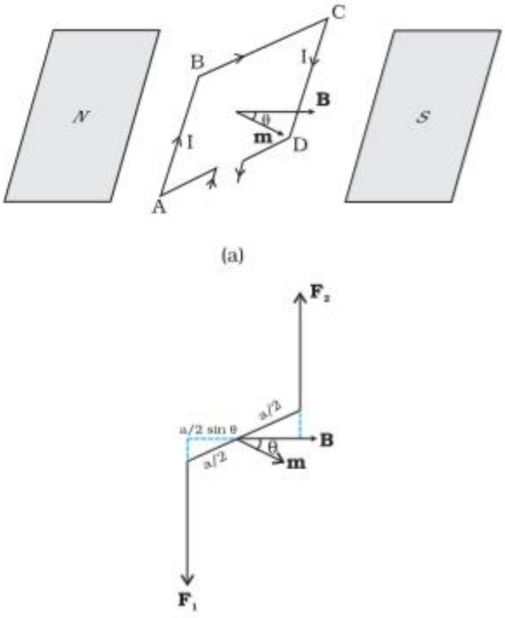
½ 2

24

Circuit diagram	½ mark
Equivalent Resistance	1 mark
Value of electric current	½ mark

		½	
	$R_s = 1 + 2 = 3\Omega$ $R_p = \frac{3 \times 3}{3 + 3} = 1.5\Omega$	1	
	$R_{net} = 1.5 + 0.5 = 2\Omega$ $I = \frac{E}{R_{net}} = \frac{2}{2} = 1A$	½	2
25	Principle ½ mark Circuit diagram ½ mark Working 1mark		
	Principle p-n junction allows the current to pass only when it is forward bias. OR p-n junction diode offers very low resistance in forward bias and very high resistance in reverse bias.	½	
		½	

	For 1st half cycle, one of the diode (say D_1) is in forward bias and D_2 will be in reverse bias. In 2nd half cycle, diode D_1 will be in reverse bias and D_2 will be in forward bias.	1	2
26	Formula ½ mark Calculation 1 ½ mark		
	$N = N_0 \times \left(\frac{1}{2}\right)^n$ $N = N_0 - \frac{7}{8}N_0 = \frac{N_0}{8}$	½	
	$\therefore \frac{N_0}{8} = N_0 \times \left(\frac{1}{2}\right)^n$ n=3	1	
	$\therefore$ Time = n ×half life = 3×20 = 60 days	½	
	Alternatively $N = N_0\, e^{\lambda t}$ $N = \frac{N_0}{8}$ $\therefore \frac{N_0}{8} = N_0 e^{-\lambda t}$ $\Rightarrow 8 = e^{-\lambda t}$ $\Rightarrow 3 \log_e 2 = \lambda t$ $\Rightarrow 3 = \frac{\lambda}{\log_e 2} t$	½	
	$3 = \frac{\lambda}{0.693} t$	1	
	$\because T_{1/2} = 20\ days = \frac{0.693}{\lambda}$ $\Rightarrow 3 = \frac{t}{20}$ t=60 days	½	2
	OR		
	Formula ½ mark Calculation 1 ½ mark		
	$N = N_0 \times \left(\frac{1}{2}\right)^n$	½	
	$N = \frac{3.125}{100} N_0 = \frac{N_0}{32}$ $\frac{N_0}{32} = N_0 \times \left(\frac{1}{2}\right)^n$		

	n=5, $T_{1/2}$ =12.5 years Time taken = n × $T_{1/2}$ =5 × 12.5=62.5 years [alternate method using the formula $N = N_0\, e^{-\lambda t}$ is also accepted]	1 ½	2
27	Diagram ½ mark Derivation 1 ½ mark  (a) (b) $F_1 = F_2 = IbB$ $\tau = F_1 \frac{a}{2} sin\theta + F_2 \frac{a}{2} sin\theta$ $\tau = IabBsin\theta$ $\tau = IABsin\theta$ $\therefore \vec{m} = I\vec{A}$ $\Rightarrow \vec{\tau} = \vec{m} \times \vec{B}$	½ ½ ½ ½	2
SECTION C			
28	a) Energy stored in 900 PF capacitor 1 mark b) Energy stored in the system after disconnecting 2 marks a) C=900 PF=900 × $10^{-12}F$ V=100V $\therefore U_i = \frac{1}{2}CV^2 = \frac{1}{2} \times 900 \times 10^{-12} \times 100^2$ $= 4.5 \times 10^{-6}J$ b) Common Potential $V = \frac{C_1V_1 + C_2V_2}{C_1 + C_2}$	1	

	$V = \frac{900 \times 100 + 0}{900 + 900} = 50V$ ∴Energy stored in the system $U_f = \frac{1}{2}(C_1 + C_2)V^2$ $= \frac{1}{2}(900 + 900) \times 10^{-12} \times 50^2$ $= 2.25 \times 10^{-6}J$	1 1	3
29	(a) Angle of minimum deviation 1 ½ mark (b) Refractive index of material 1 ½ mark a) A=60^0 $\Rightarrow i = \frac{3}{4} \times 60 = 45^0$ For ray passes symmetrically angle of deviation should be minimum $\delta = 2i - A$ $= 2 \times 45 - 60 = 30^0$ b) $r = \frac{A}{2} = \frac{60}{2} = 30^0$ For Snell's law $\mu = \frac{\sin i}{\sin r} = \frac{\sin 45}{\sin 30}$ $= \frac{1}{\sqrt{2}} \times 2 = \sqrt{2}$ =1.414	½ ½ ½ ½ ½ ½	3
30	(a) To prove that current lags behind the voltage by $\frac{\pi}{2}$ 1 ½ mark (b) Reason 1 ½ mark a) $V = V_o sin\omega t$ from Kirchoff's Law $V - L\frac{dI}{dt} = 0$ $\Rightarrow \frac{dI}{dt} = \frac{V}{L} = \frac{V_0}{L} sin\omega t$ $dI = \frac{V_0}{L} sin\omega t \; dt$ $\Rightarrow \int dI = \int \frac{V_0}{L} sin\omega t dt$ $I = \frac{V_o}{\omega L}(-\cos \omega t) + c$	½ ½	

	$= \frac{V_o}{\omega L} \sin\left(\omega t - \frac{\pi}{2}\right)$ $\Rightarrow I = I_0 \sin\left(\omega t - \frac{\pi}{2}\right)$ b) In a.c. circuit when iron rod is inserted, then opposition (reactance) $X_L = \omega L \quad inceases$ $\because L = \frac{\mu_r \mu_o N^2 A}{l} \quad increases$ $\therefore$current decreases Hence brightness of the bulb decreases	½ ½ ½ ½	3
31	a) Definition of resolving power 1 mark b) Expression of magnifying power 1 mark c) Objective Lens: 1D 1 mark a) It is the ability of compound microscope to form separate image of two closely lying point objects. b) $m = \frac{f_o}{-f_e} \; or \; \frac{f_0}{\lvert f_e \rvert}$ c) $f = \frac{1}{P}$ $\therefore f_1 = \frac{1}{10} = 0.1m$ $f_2 = \frac{1}{1} = 1m$ $f_2 > f_1 \;\Rightarrow f_2 \; will\ be\ used\ as\ objective\ lens$	1 1 1	3
32	a) Definition of threshold frequency 1 mark b) Einstein equation ½ mark Calculation of frequency 1 ½ mark a) The minimum frequency of incident radiation/ cut off frequency, below which no photoelectric emission takes place, is called threshold frequency. b) $\phi = 2.5\ eV$ $V_0 = 4.1V$ Einstein photoelectric equation $eV_0 = hv - \phi_o$ $hv = eV_0 + \phi_o$ $= 4.1eV + 2.5\ eV$ $= 6.6\ eV$	1 ½ ½	

	$\therefore \upsilon = \frac{6.6eV}{h} = \frac{6.6 \times 1.6 \times 10^{-19}}{6.63 \times 10^{-34}}$ $\approx 1.6 \times 10^{15}Hz$	1	3
33	a) Principle ½ mark working 1 ½ mark b) Necessity of radial and magnetic field 1 mark (a) Principle: A current carrying tool experience the torque in the magnetic field Working: When current flows through the coil, the torque act on it in the radial magnetic field $\tau = NIAB - - - - - - - - - - - -1$ The restoring torque provided by spring $\tau = K\phi - - - - - - - - - - - - - 2$ K=torsional constant At equilibrium $NIAB = K\phi$ $I = \left(\frac{K}{NAB}\right)\phi$ $I = G\phi$ where G is equals to Galvanometer constant (b) It makes the deflecting torque independent of orientation of coil in the magnetic field (i.e. $\theta = 90^0$)/ Increase the strength of magnetic field	½ ½ ½ ½ 1	3
34	a) Formation of barrier potential 2 mark b) Effect on the width (i) decrease in forward bias ½ mark (ii)increase in reverse bias ½ mark (a) Diffusion process and drift continues until diffusion current equals drift current. At this equilibrium potential barrier is formed, which prevent the flow of charge. (b) (i) Decreasing in forward bias (ii) Increase in Reverse bias	2 ½ ½	3

SECTION D

35

(a) Definition of potential gradient	1 mark
(b) Principle of Potentiometer	1 mark
[award ½ mark if student writes only Potentiometer]	
(c) Method of increasing sensitivity	1 mark
(d) Advantage of potentiometer over voltmeter	1+1

(a) The variation of potential with distance / length is called potential gradient. 1

(b) The potential difference with the length of wire is directly proportional to length of the portion of uniform wire/ potential gradient is constant. 1

(c)(i) By increasing the length 1

(ii) By connecting resistance in series

[any one]

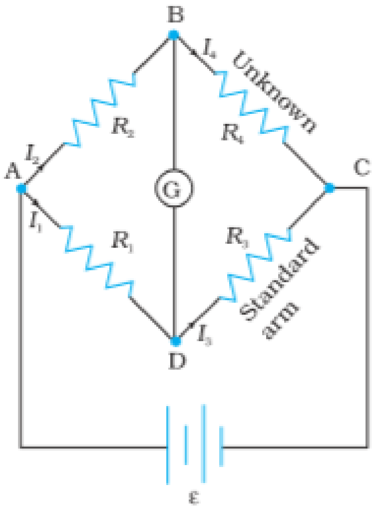
(d) (i) Potentiometer measures the e.m.f. in open circuit so its reading is always accurate. 1

(ii) Voltmeter always measure the potential difference in closed circuit hence reading will never be accurate. 1

OR

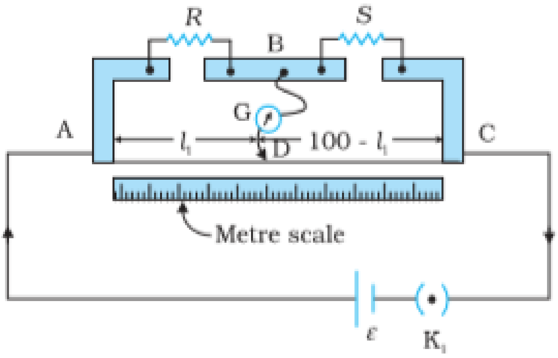
(a) Balance condition in wheatstone Bridge	
(circuit + derivation)	½ + 1 ½ mark
(b) Circuit diagram of metre Bridge	1 mark
Mathematical expression	1 mark
(c) Precaution in metre Bridge	1 mark

(a)



½

By applying Kirchoff's law in loops ADBA and CBDC

	$-I_1R_1 + 0 + I_2R_2 = 0 \qquad (Ig = 0) \qquad -(1)$	½	
	And		
	$I_2R_4 + 0 - I_1R_3 = 0 \qquad -(2)$	½	
	$\Rightarrow \frac{I_1}{I_2} = \frac{R_2}{R_1} \qquad from\ (1)$		
	And		
	$\frac{I_1}{I_2} = \frac{R_4}{R_3} \qquad from\ (2)$		
	From (1) and (2)		
	$\frac{R_2}{R_1} = \frac{R_4}{R_3}$	½	
	(b)		
		1	
	The four arms AB, BC, DA and CD [with resistances R, S, R_{cml_1} and $R_{cm(100-l_1)}$] obviously form wheatstone bridge with AC as the battery arm and BD the galvanometer arm.		
	The balance condition of wheatstone bridge.		
	$\frac{R}{S} = \frac{R_{cm}l_1}{R_{cm}(100-l_1)} = \frac{l_1}{(100-l_1)}$	½	
	By finding the length l_1, the unknown resistance 'R' is known in terms of standard known resistance S		
	$R = S\frac{l_1}{(100-l_1)}$	½	
	(c) The balance point should be obtained at the midpoint of metre bridge wire.	1	5
36	(a) Construction ½ mark Principle ½ mark (b) Expression of secondary voltage 1½ marks Expression of secondary current 1½ marks (c) Factors for energy losses ½ +½ mark		
	(a) Construction:	½	
	Description of transformer		
	Mutual Induction	½	

	(b) Induced e.m.f in primary coil $e_p = -N_p \frac{d\phi}{dt} - - - - - - - - - - - -1$	½	
	Induced e.m.f in secondary coil $e_s = -N_p \frac{d\phi}{dt} - - - - - - - - - - - - - 2$	½	
	From 1 and 2 $\frac{e_s}{e_p} = \frac{N_s}{N_p} - - - - - - - - - - - - - 3$		
	If there is no loss of power	½	
	Input power = Output power $e_p I_p = e_s I_s$	½	
	$\Rightarrow \frac{e_s}{e_p} = \frac{I_p}{I_s} - - - - - - - - - - - - - 4$	½	
	$\Rightarrow \frac{I_p}{I_s} = \frac{N_s}{N_p} = - - - - - - - - - - - - -5$	½	
	(c) copper loss/ flux leakage / Iron loss (any two)	½ + ½	5
	OR		
	(a) Principle 1 mark (b) Working and explanation 2 marks (c) frequency of cyclotron and its independency 1+1 marks		
	(a) Principle: A charged particle can be accelerated by using small oscillating electric field and strong perpendicular magnetic field OR A charged particle can be accelerated by applying crossed electric and magnetic field and its frequency is independent of energy.	1	
	(b) When charged particle is released between the two Dee's it acquires circular path due to perpendicular magnetic field. The charged particle is accelerated again and again due to oscillating electric field applied across the Dee's perpendicular to magnetic field. Every time it accelerates acquire the path of longer radius	1	
	Magnetic force = centripetal force $qvB = \frac{mv^2}{r}$ $r = \frac{mv}{qB}$	½	
	(c) Time period $T = \frac{2\pi r}{v}$	½	
	$\therefore \nu = \frac{1}{T} = \frac{v}{2\pi r}$	1	
	$\nu = \frac{vqB}{2\pi mv} = \frac{qB}{2\pi m} = constant$	½	
	It is independent of velocity i.e. energy.	½	5

37

(a) Diffraction pattern	1 mark
(b) Effect on (i) Angular width	1 mark
(ii) Linear width	1 mark
(c) Difference between interference and diffraction (2 points)	1 + 1 marks

(a) Diffraction pattern due to bending of light through the edge of slit 1

(b) (i)

$$\theta = \frac{2\lambda}{a}$$ ½

No effect on angular width as it is independent from distance (D) ½

(ii)

$$\beta = \frac{2\lambda D}{a}$$ ½

Linear width increases with increase in the distance (D) ½

(c)

Interference	Diffraction
(1) It is obtained due to superposition of two light waves coming from coherent sources.	(1) It is obtained due to superposition of two light waves originating from two different parts of the same wave front.
(2) Number of equally spaced bright and dark bands.	(2) Centrally bright maxima which is twice as wide as other maxima.
(3) Intensity of all bright fringes are same.	(3) Intensity goes on decreasing away from central maxima.

(any two) 2 5

OR

(a) Definition of coherent sources	1 mark
Necessity of coherent source	1 mark
(b) Derivation of resultant intensity	2 marks
Condition of dark and bright fringe	½ + ½ mark

(a) Coherent sources:

Two sources which emit continuous light of same frequency nearly same amplitude and have constant or zero phase difference are called coherent. 1

In absence of coherent sources, the phase difference between two sources will change with time and no stable pattern which will be obtained 1

	(b) Two coherent sources are $y_1 = a\ cos\omega t$ And $y_2 = a\cos(\omega t + \phi)$ the resultant displacement will be given by $y = y_1 + y_2$ $y = a\cos\ \omega t + a\cos(\omega t + \phi)$ $y = 2a\cos{}^{\phi}/_{2}\ .\ \cos(\omega t + {}^{\phi}/_{2})$ ∴ the amplitude of resultant displacement is $2a\cos{}^{\phi}/_{2}$ and resultant intensity $I = 4a^2cos^2\,{}^{\phi}/_{2}$ $\Rightarrow I = 4I_0cos^2\,{}^{\phi}/_{2}$ Condition for bright fringe $\phi = 2n\pi$ where n= 0,1,2,3…. Condition for dark fringe $\phi = (2n+1)\frac{\pi}{2}$ n=1,2,3….	1 1 ½ ½	5