Marking Scheme
Strictly Confidential
(For Internal and Restricted use only)
Senior Secondary School Supplementary Examination, July- 2023
SUBJECT NAME: PHYSICS   SUBJECT CODE: 042   PAPER CODE :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.
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 various rules of the Board and 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 due marks be awarded to them. In class-XII,** 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, due marks should be awarded.
4	The Marking scheme carries only suggested value points for the answers. These are in the nature of Guidelines only and do not constitute the complete answer. The students can have their own expression and if the expression is correct, the due marks should be awarded accordingly.
5	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. If there is any variation, the same should be zero after deliberation and discussion. 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.
6	Evaluators will mark(√) wherever answer is correct. For wrong answer CROSS 'X" be marked. Evaluators will not put right (✓)while evaluating which gives an impression that answer is correct and no marks are awarded. **This is most common mistake which evaluators are committing.**
7	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.
8	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.
9	If a student has attempted an extra question, answer of the question deserving more marks should be retained and the other answer scored out with a note **"Extra Question"**.
10	No marks to be deducted for the cumulative effect of an error. It should be penalized only once.
11	A full scale of marks 70 has to be used. Please do not hesitate to award full marks if the answer deserves it.
12	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).
13	Ensure that you do not make the following common types of errors committed by the Examiner in the past:- Giving more marks for an answer than assigned to it. ● Wrong totaling of marks awarded on an answer. ● Wrong transfer of marks from the inside pages of the answer book to the title page. Wrong question wise totaling on the title page. ● Leaving answer or part thereof unassessed in an answer book. ● ● Wrong totaling of marks of the two columns on the title page. ● Wrong grand total. ● Marks in words and figures not tallying/not same. ● 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.
14	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.
15	Any un assessed 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.
16	The Examiners should acquaint themselves with the guidelines given in the "**Guidelines for spot Evaluation**" before starting the actual evaluation.
17	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.
18	The candidates are entitled to obtain photocopy of the Answer Book on request on payment of the prescribed processing fee. All Examiners/Additional Head Examiners/Head Examiners are once again reminded that they must ensure that evaluation is carried out strictly as per value points for each answer as given in the Marking Scheme.

<table>
<tr><td colspan="4" align="center">**MARKING SCHEME: PHYSICS(042)**</td></tr>
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<tr><td colspan="4" align="center">**SECTION A**</td></tr>
<tr><td>1.</td><td>(d) Zero</td><td>1</td><td>1</td></tr>
<tr><td>2.</td><td>(a) Zero</td><td>1</td><td>1</td></tr>
<tr><td>3.</td><td>(a) 0.18A</td><td>1</td><td>1</td></tr>
<tr><td>4.</td><td>(b) $\dfrac{4E}{3}$</td><td>1</td><td>1</td></tr>
<tr><td>5.</td><td>(c) $\dfrac{\mu_o I_1 I_2}{2\pi d}$, attractive</td><td>1</td><td>1</td></tr>
<tr><td>6.</td><td>(d) B</td><td>1</td><td>1</td></tr>
<tr><td>7.</td><td>(a) $\dfrac{1}{\sqrt{\mu_o \varepsilon_o}}$</td><td>1</td><td>1</td></tr>
<tr><td>8.</td><td>(a) 2f</td><td>1</td><td>1</td></tr>
<tr><td>9.</td><td>(d) $\dfrac{2}{3}$ times</td><td>1</td><td>1</td></tr>
<tr><td>10.</td><td>(b) 270 nm</td><td>1</td><td>1</td></tr>
<tr><td>11.</td><td>(c) -3.4 eV</td><td>1</td><td>1</td></tr>
<tr><td>12.</td><td>(b) Balmer series</td><td>1</td><td>1</td></tr>
<tr><td>13.</td><td>(b) Al</td><td>1</td><td>1</td></tr>
<tr><td>14.</td><td>(d) Germanium</td><td>1</td><td>1</td></tr>
<tr><td>15.</td><td>(b) the depletion layer width decreases and barrier height is reduced.</td><td>1</td><td>1</td></tr>
<tr><td>16.</td><td>(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).</td><td>1</td><td>1</td></tr>
<tr><td>17.</td><td>(c) Assertion (A) is true, but Reason (R) is false.</td><td>1</td><td>1</td></tr>
<tr><td>18.</td><td>(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).</td><td>1</td><td>1</td></tr>
<tr><td colspan="4" align="center">**SECTION B**</td></tr>
<tr><td>19.</td><td>

Formula of magnetic flux	½
Formula of magnetic field	½
Calculation of radius	1

</td><td></td><td></td></tr>
</table>

	$\phi = BNA$	½	
	$B = \dfrac{\mu_o IN}{2r}$	½	
	$\phi = N \times \dfrac{\mu_o NI}{2r} \times \pi r^2$		
	$\Rightarrow \pi^2 \times 10^{-5} = \dfrac{4\pi \times 10^{-7} \times (100)^2 \times 2 \times r^2}{2r}$	½	
	r = 0.25 cm	½	2
20.	(a)		

(a)

(i) Identification and wavelength range ½ + ½	
(ii) Identification and wavelength range ½ + ½	

(i) Microwave   ½
   Wavelength range (1mm-0.1m)   ½

(ii) Infrared wave   ½
    Wavelength range (700nm-1mm)   ½

OR

(b)

Two characteristics of EM wave	½ + ½
Name of radiation	½
Range of frequency	½

1. EMW travel with speed of light in vaccum.
2. EMW carries energy and momentum.
3. Speed of EMW in vaccum is given by

   $c = \dfrac{1}{\sqrt{\mu_o \varepsilon_0}}$ ½ + ½

4. EMW are transverse in nature
5. In EMW electric and magnetic field are perpendicular to each other and to the direct propagation.

                              (any two)
Not: Award full marks, if a student write any other characteristics.
Ultraviolet(UV)   ½
Frequency range 10^{15}-10^{17} Hz   ½

2

21.	(a)		
	Explanation 2		
	The intensity of light of a secondary maxima goes on decreasing with the order of maxima because the intensity of central maxima is due to wavelets from all part of slit. First secondary maxima is due to wavelets from one third part of the slit and second secondary maxima is due to wavelets from one fifth part of slit and so on. Thus intensity of secondary maxima goes on decreasing and is lesser than central maxima.		
	OR		
	(b)		
	Effect on fringe width (β) 1 Reason 1		
	$\beta' = \dfrac{\beta}{\mu}$ Fringe width will decrease	1	
	$\beta = \dfrac{\lambda D}{d}$	½	
	$\lambda' = \dfrac{\lambda}{\mu}$		
	$\Rightarrow \beta' = \dfrac{\lambda' D}{d} = \dfrac{\lambda D}{d\mu} = \dfrac{\beta}{\mu}$	½	
			2
22.	Lens maker's formula ½ Expression of focal length of equiconvex lens ½ Finding focal length of each part 1		
	$\dfrac{1}{f} = (n-1)(\dfrac{1}{R_1} - \dfrac{1}{R_2})$ For equiconvex lens $R_1 = R$, $R_2 = -R$	½	
	$\dfrac{1}{f} = (n-1)(\dfrac{1}{R} + \dfrac{1}{R})$		
	$\dfrac{1}{f} = (n-1)(\dfrac{2}{R})$ _____(i) After cutting in two parts	½	

	$R_1 = R \qquad R_2 = \infty$ $\dfrac{1}{f'} = (n-1)(\dfrac{1}{R_1} + \dfrac{1}{\infty})$ $\dfrac{1}{f'} = (n-1)(\dfrac{1}{R})$ _____(ii) From (i) and (ii) $f' = 2f$	½ ½	2
23.	Formula of radius ½ Finding the ratio of radii 1½ $R = R_o A^{\frac{1}{3}}$ $\dfrac{R_1}{R_2} = (\dfrac{A_1}{A_2})^{\frac{1}{3}}$ $\qquad = (\dfrac{27}{8})^{\frac{1}{3}}$ $\dfrac{R_1}{R_2} = \dfrac{3}{2}$	½ ½ 1	2
24.	Explanation of formation of valence band 1½ Explanation of formation of conduction band ½ In a crystal, the atoms are close to each other and therefore the electrons interact with each other and also with neighboring atomic cores. This interaction of electrons causes the formation of energy bands. The energy band which includes the energy level of electrons is called valence band. The energy band above the valence band is called conduction band.	1½ ½	2
25.	Explanation of formation of depletion region 2 When a hole diffuses from p→n due to the concentration gradient, it leaves behind an ionized acceptor (negative	2	

		charge) which is immobile. As the holes continue to diffuse,a layer of negative charge(or negative space charge region) on the p-side of the junction is developed. The space charge region on either side of the junction together is known as depletion region.			
					2
		SECTION C			
26.		(a)Calculation of new value of drift speed 1½ (b) Calculate of new value of resistance of conductor 1 ½			
		(a) $$V_d = (\frac{eV}{ml})\tau$$		½	
		$$V'_d = (\frac{eV}{ml'})\tau$$		½	
		$$l' = 1.25l$$			
		$$V'_d = (\frac{V_d}{1.25}) = \frac{4}{5}V_d$$		½	
		(b) $$A \times l = A' \times l'$$		½	
		$$l' = 1.25l$$			
		$$A' = \frac{A}{1.25}$$			
		$$R' = \rho\frac{l'}{A'} = \rho\frac{1.25 \times 1.25l}{A}$$		½	
		$$R' = \frac{25}{16}R$$		½	
					3
27.		(a) (i) Calculations of emf at the ends of rod 1 (ii) Calculations of emf between centre and one end of the rod 2			
		(i) Zero		1	

	(ii)			

(ii)

$$\varepsilon = \frac{1}{2}Bl^2\omega$$ ½

$$\varepsilon = \frac{1}{2}Bl^2(2\pi\nu)$$

$$\varepsilon = \frac{1}{2}\times 0.2 \times (20\times 10^{-2})^2 \times (2\pi\times 5)$$ ½

$$\varepsilon = 0.125 V$$

$$\varepsilon = 125\times 10^{-3} V$$ 1

OR

(b)

Calculation of change in magnetic flux	1½
Calculation of induced emf	1½

$$B = 100\times 10^{-3} T$$

$$A = (10\times 10^{-2})^2 \, m^2$$

$$N = 100$$

$$\phi_i = BA$$

$$= (100\times 10^{-3})\times (10^{-2})$$ ½

$$= 10^{-3} \, Tm^2$$

$$\phi_f = 0$$ ½

$$\Delta\phi = \phi_f - \phi_i$$

$$= -10^{-3} \, Tm^2$$ ½

$$\varepsilon = -N\frac{\Delta\phi}{\Delta t}$$ ½

$$\varepsilon = -100\times \frac{(-10^{-3})}{0.2}$$ ½

$$\varepsilon = 0.5\times 10^{-2} = 5mV$$ ½

3

28.			
	Statement of Lenz's law	1	
	Showing consistency with conservation of energy	2	

Lenz's Law
The polarity of induced emf is such that it tends to produce a current which opposes the change in magnetic flux that produced it.

1

The e.m.f. induced opposes the causes of its change. So in order to change the magnetic flux work is always needed to

2

	be done. This work done gets converted to induced e.m.f. Hence this is consistent with conservation of energy.			3
29.	(a) Obtaining relation between atomic mass unit(u) and electron volt (eV) 1½ (b) Calculating energy output in eV 1½			

(a) $E = \Delta mc^2$ ½

$\Delta m = 1.66 \times 10^{-27}\,\text{kg}$

$E = \dfrac{1.66 \times 10^{-27} \times (3 \times 10^8)^2}{1.6 \times 10^{-19}}\,\text{eV}$ ½

$E = 931.5 \times 10^6\,\text{eV}$ ½

(b)

$E = mc^2$ ½

m = 0.5 kg

$E = (0.5) \times (3 \times 10^8)^2\,\text{J}$

$E = 4.5 \times 10^{16}\,\text{J}$

$E = \dfrac{4.5 \times 10^{16}}{1.6 \times 10^{-19}}\,\text{eV}$ ½

$E = 2.8 \times 10^{23}\,\text{eV}$ ½

3

30.	(a)		

(a) Einstein's equation	½
(i) Explanation for existence of threshold frequency	1
(ii)Showing linearity relation between V_o and v	1
Calculations of the Planck's constant from V_o versus v graph	½

(a) Einstein's photoelectric equation

$$hv = \phi_o + E_k^{max}$$

½

(i) $E_k^{max} = hv - \phi_o$

$E_k^{max} = h(v - v_o)$

In case $v < v_o$, $E_k^{max} < 0$

Which is not possible

So, no frequency is possible below threshold frequency

1

(ii)

$$hv = \phi_0 + eV_o$$

$$eV_o = hv - \phi_0$$

$$V_o = \frac{h}{e}v - \frac{\phi_o}{e}$$

Which is equation of a straight line

1

as $\frac{h}{e} = m$ (slope of the line)

So by calculating slope of the line Planck's constant can be calculated.

½

OR

(b)

(i) Obtaining expression for radius	1
(ii) Bohr's postulate	½
Showing n^2 proportionality relation	1½

(i) Electrostatic force between the electron and the nucleus.

$$F = \frac{ke^2}{r^2}$$

½

At it provides centripetal force

$$\frac{ke^2}{r^2} = \frac{mv^2}{r}$$

$$r = \frac{ke^2}{mv^2}$$

(ii) "Electrons revolves around the nucleus only in those orbits for which the angular momentum is some integral multiple of $\frac{h}{2\pi}$"   ½

    ½

$$mvr = \frac{nh}{2\pi}$$

$$v = \frac{nh}{2\pi mr} \underline{\hspace{3cm}}(2)$$

Substituting value of 'v' from equation (2) in equation(1)   ½

$$r = \frac{ke^2 h}{mn^2 h^2} \times 4\pi^2 m^2 r^2$$

$$r = \frac{n^2 h^2}{4\pi^2 mke^2}$$ ½

$$r \propto n^2$$

    ½   3

SECTION D

31.	(a)		
	(i) Reason for using small test charge 1		
	(ii) Identifying the direction of force 1		
	(iii) Calculating the net force 3		

(i) So that it does not disturb the distribution of charges whose electric field is to be measured. Otherwise field will be different from the actual field.   1

(ii) It will move in the direction of electric field.   1

(iii) $F = F_2 - F_1$ 1

$$= \frac{kQ_2 Q_3}{r_{23}^2} - \frac{kQ_1 Q_3}{r_{13}^2}$$

$$F = \frac{9 \times 10^9 \times 16 \times 2.5 \times 10^{-12}}{(12 \times 10^{-2})^2} - \frac{9 \times 10^9 \times 40 \times 2.5 \times 10^{-12}}{(36 \times 10^{-2})^2}$$

$$F = 25 - 6.94$$

$$F = 18.06 \, N$$ 1

OR

(b)

(i) (1) Finding change in capacitance with charge in plate area	1
(2) Finding change in capacitance with change in seperation	1
(ii)(1) Effective capacitance in parallel	1½
(2) Ratio of energy stored in parallel to series combination	1½

(i) (1) $C \propto A$ 1

    Capacitance gets doubled

   (2) $C \propto \dfrac{1}{d}$

    Capacitance reduces to half   1

(ii) $\dfrac{C}{3} = 1\mu F$ _____(given)

    $C = 3\mu F$

   (1)Effective capacitance in parallel   1½

      $C_P = 3C = 3 \times 3\mu F$

      $C_P = 9\mu F$

   (2) $U = \dfrac{1}{2}CV^2$ 1½

    $\dfrac{U_P}{P_S} = \dfrac{C_P}{C_S} = \dfrac{9}{3} = 3:1$

                                                                  5

32. (a)

(i) Answer	1
Justification	1
(ii) Calculation of radius	1 ½
Calculation of energy in eV	1 ½

(i) Yes, the final speed v would be equal to its initial speed v_o.   1

Because the magnetic fore is perpendicular to the direction of motion of the charged particle.   1

(ii) $r = \dfrac{mv}{qB}$ ½

$= \dfrac{9.1 \times 10^{-31} \times 3 \times 10^6}{1.6 \times 10^{-19} \times 6 \times 10^{-4}}$

$= 2.8$ cm   1

K.E $= \frac{1}{2}mv^2$

$$= \frac{\frac{1}{2} \times 9.1 \times 10^{-31} \times (3 \times 10^6)^2}{1.6 \times 10^{-19}} \, eV$$

$= 25.59$ eV   ½

OR   1

(i) Deriving expression for force on a current carrying
wire   3
(ii) Finding the magnitude and direction of magnetic field
                                                                1+1

(i) Consider a wire of length l, area of cross- section A and
having number density of free electrons n and carrying
electric current I.
Total number of charge carriers in the wire = nlA.
If $\vec{v}_d$ is drift velocity of electrons, magnetic force experience   ½
by the electrons is
$\vec{F} = -(nlA)e\vec{v}_d \times \vec{B}$ 1
As $I\vec{l} = -enlA\vec{v}_d$
$\vec{F} = I(\vec{l} \times \vec{B})$ ½
                                                                                1
(ii) $B = \frac{2\mu_o I}{4\pi r}$ ½

$B = \frac{2 \times 10^{-7} \times 30}{1} = 0.6 \times 10^{-5} T$ ½

Magnetic field is directed towards **SOUTH**   1

                                                                                5

33.	(a)		

(i) Definition of wave front   ½
Direction of beam of light   ½
(ii) Statement of Huygens principle   1
Explaining the propagation of light   1
(iii) Two necessary conditions   1+ 1

(i) A wavefront is defined as a surface of constant phase.   ½
   Perpendicular   ½

(ii) Each point of the wavefront is the source of a secondary
disturbance and the wavelets emanating from these points

	spread out in all directions with the speed of the wave. These wavelets emanating from the wavefront are usually referred to as secondary wavelets and if we draw a common tangent to all these spheres, we obtain the new position of the wavefront at a later time.	1		
	All the secondary sources emit wavelets and tangent drawn to all the wavelets gives the position of new wavefront at any later time.	1		
	(iii) (i)Two sources must emit light of same frequency. (ii)Phase difference between two light sources either should be zero or having a constant phase difference i.e. should not change with time.	1 1		

OR

(i) Factors on which focal length or lens depends	1+1
(ii) Explaining two conditions	1+1
(iii) Explanation of zero power	1

	(i) Radius of curvature of two faces of lens Refractive index of lens with respect to surrounding	1		
	(ii) (1) If the refractive index of material of surrounding medium is equal to refractive index of lens	1		
	(2)If the refractive of surrounding medium is more than the refractive index of converging lens	1		
	(iii) yes If one lens is converging and other is diverging, both having same power.	½ ½		
			5	
	SECTION E			
34.				

(i) Finding the charge on latex sphere	1
(ii) Finding the direction of electric field	1
(iii) Calculation of magnitude of electric field	2

OR

(iii) Calculation of magnitude of charge on latex sphere	2

	(i) Charge on latex sphere : negative	1		
	(ii) Direction of electric field between the plates – Downward	1		
	(iii) $$E = \frac{V}{d}$$	1		

	$E = \dfrac{1.24 \times 10^3 V}{0.62 \times 10^{-2} m} = 2 \times 10^5 V m^{-1}$	1	
	OR		
	(iii) $qE = mg$	1	
	$q = \dfrac{mg}{E} = \dfrac{1.85 \times 10^{-13} \times 10}{2 \times 10^5} = 9.25 \times 10^{-18} C$	1	
			4
35.	(i) Effect of increasing refractive index on critical angle 1 (ii) Explanation 1 (iii) Definition of optical fibre 1 　　Two uses ½ + ½ **OR** (iii) Finding the angle of deviation 2		
	(i) $\sin i_c = \dfrac{1}{\mu}$. If μ of denser medium increases, critical angle (i_c) decreases.	1	
	(ii) For this we take isosceles right angled prism. We allow incident light to fall normally on one of the two mutually perpendicular faces. It will deviated by 90° after total internal reflection	1	
	(iii) Optical fibres are very fine fibres made of glass. Through these fibres optical signals can be transmitted without appreciable loss of energy, using the phenomena of total internal reflection. Uses: Endoscopy Communication	1 ½ + ½	
	OR (iii) Angle of deviation $= 90^o - i_c$	2	
			4