Sample Question Paper (PHYSICS)

CLASS-XII (2017-18)

Time Allowed: 3Hours Maximum Marks: 70

General Instructions

1. All questions are compulsory. There are 26 questions in all.
2. This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
3. Section A contains five questions of one mark each, Section B contains five questions of two marks each, Section C contains twelve questions of three marks each, Section D contains one value based question of four marks and Section E contains three questions of five marks each.
4. There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all the three questions of five marks weightage. You have to attempt only one of the choices in such questions.
5. You may use the following values of physical constants wherever necessary.

$c = 3 \times 10^{8}$ m/s

$h = 6.63 \times 10^{-34}$ Js

$e = 1.6 \times 10^{-19}$ C

$\mu_o = 4\pi \times 10^{-7}$ T m A^{-1}

$\varepsilon_0 = 8.854 \times 10^{-12}$ $C^2 N^{-1} m^{-2}$

$\frac{1}{4\pi\varepsilon_0} = 9 \times 10^{9}$ N m^2 C^{-2}

$m_e = 9.1 \times 10^{-31}$ kg

mass of neutron = 1.675×10^{-27} kg

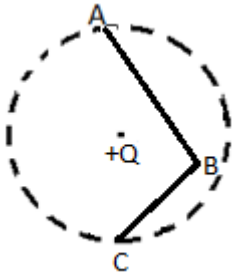
mass of proton = 1.673×10^{-27} kg

Avogadro's number = 6.023×10^{23} per gram mole

Boltzmann constant = 1.38×10^{-23} JK^{-1}

Section – A

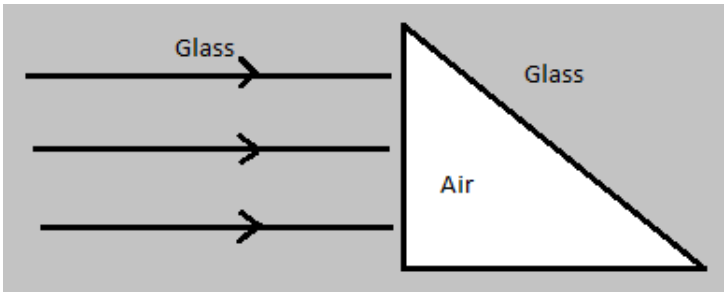
1. In the given figure, charge +Q is placed at the centre of a dotted circle. Work done in taking another charge +q from A to B is W_1 and from B to C is W_2. Which one of the following is correct: $W_1 > W_2$, $W_1 = W_2$ and $W_1 < W_2$?



2. Plot a graph showing the variation of current 'I' versus resistance 'R', connected to a cell of emf E and internal resistance 'r'.

3. State the factors on which the refractive index of a material medium for a given wavelength depends.

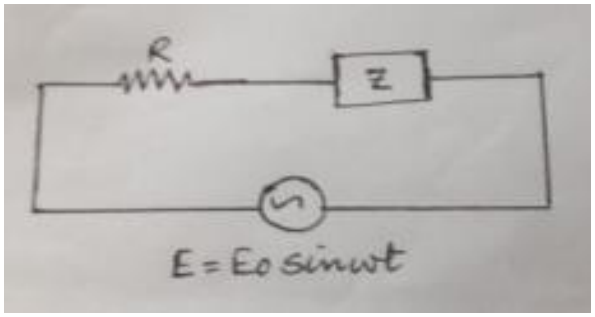
4. Sketch the emergent wavefront.



5. In the wave picture of light, intensity of light is determined by square of the amplitude of wave. What determines the intensity of light in the photon picture of light?

Section – B

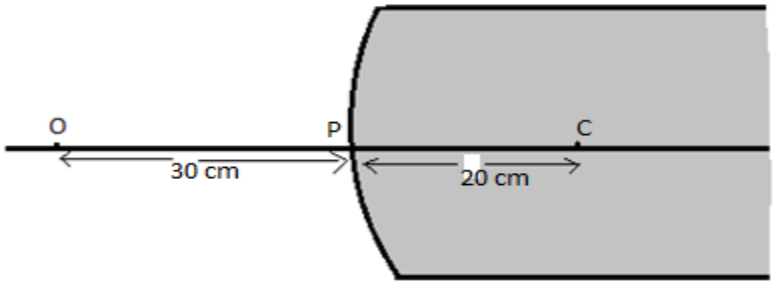
6. (a)An alternating voltage $E = E_o \sin\omega t$ is applied to a circuit containing a resistor R connected in series with a black box. The current in the circuit is found to be $I = I_o \sin(\omega t + \pi/4)$.



(i) State whether the element in the black box is a capacitor or inductor.
(ii) Draw the corresponding phasor diagram and find the impedance in terms of R.

7. The magnetic field in a plane electromagnetic wave is given by:
$B_y = 12 \times 10^{-8} \sin (1.20 \times 10^7 z + 3.60 \times 10^{15} t)$ T. Calculate the
(i) Energy density associated with the Electromagnetic wave
(ii) Speed of the wave

8. A spherical convex surface of radius of curvature 20 cm, made of glass ($\mu = 1.5$) is placed in air. Find the position of the image formed, if a point object is placed at 30 cm in front of the convex surface on the principal axis.



9. Name the optoelectronic device used for detecting optical signals and mention the biasing in which it is operated. Draw its I- V characteristics.

10. Give reason, why high frequency carrier waves are needed for effective transmission of information signals.

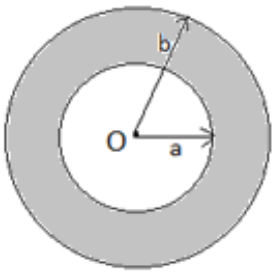
OR

What is the range of frequencies used for T.V. transmission? State two factors by which the range of TV signals can be increased.

Section – C

11. (a) How many electrons must be added to one plate and removed from the other so as to store 25.0 J of energy in a 5.0 nF parallel plate capacitor?
(b) How would you modify this capacitor so that it can store 50.0 J of energy without changing the charge on its plates?

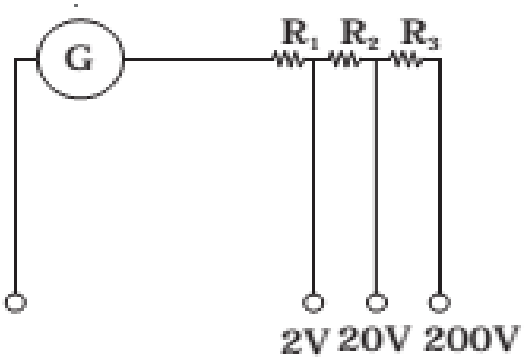
12. A point charge +Q is placed at the centre O of an uncharged hollow spherical conductor of inner radius 'a' and outer radius 'b'. Find the following:
(a) The magnitude and sign of the charge induced on the inner and outer surface of the conducting shell.
(b) The magnitude of electric field vector at a distance (i) $r = \frac{a}{2}$, and (ii) $r = 2b$, from the centre of the shell.



13. The following table gives the length of three copper wires, their diameters, and the applied potential difference across their ends. Arrange the wires in increasing order according to the following:
    (a) The magnitude of the electric field within them,
    (b) The drift speed of electrons through them, and
    (c) The current density within them.

Wire no.	Length	Diameter	Potential Difference
1	L	3d	V
2	2L	d	V
3	3L	2d	2V

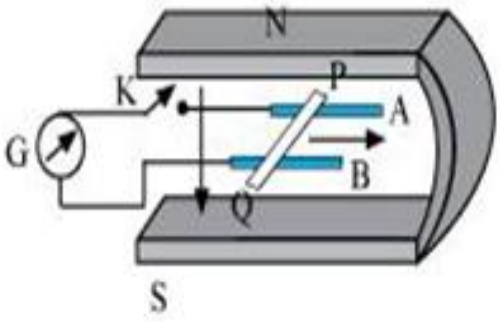
14. A multirange voltmeter can be constructed by using a galvanometer circuit as shown in the figure. We want to construct a voltmeter that can measure 2V, 20V and 200V using a galvanometer of resistance 10Ω and that produces maximum deflection for current of 1 mA. Find the value of R1, R2 and R3 that have to be used.



15. Figure shows a metal rod PQ of length *l*, resting on the smooth horizontal rails AB positioned between the poles of a permanent magnet. The rails, rod and the magnetic field B are in three mutually perpendicular directions. A galvanometer G connects the rails through a key 'k'. Assume the magnetic field to be uniform. Given the resistance of the closed loop containing the rod is R.
    (i) Suppose K is open and the rod is moved with a speed v in the direction shown. Find the polarity and the magnitude of induced emf.
    (ii) With K open and the rod moving uniformly, there is no net force on the electrons

in the rod PQ even though they do experience magnetic force due to the motion of the rod. Explain.

(iii) What is the induced emf in the moving rod if the magnetic field is parallel to the rails instead of being perpendicular?



16. With the help of a diagram, explain the principle of a device which changes a low voltage into a high voltage but does not violate the law of conservation of energy. Give any one reason why the device may not be 100% efficient.

17. In a double slit experiment, the distance between the slits is 3 mm and the slits are 2 m away from the screen. Two interference patterns can be seen on the screen one due to light with wavelength 480 nm, and the other due to light with wavelength 600 nm. What is the separation on the screen between the fifth order bright fringes of the two interference patterns?

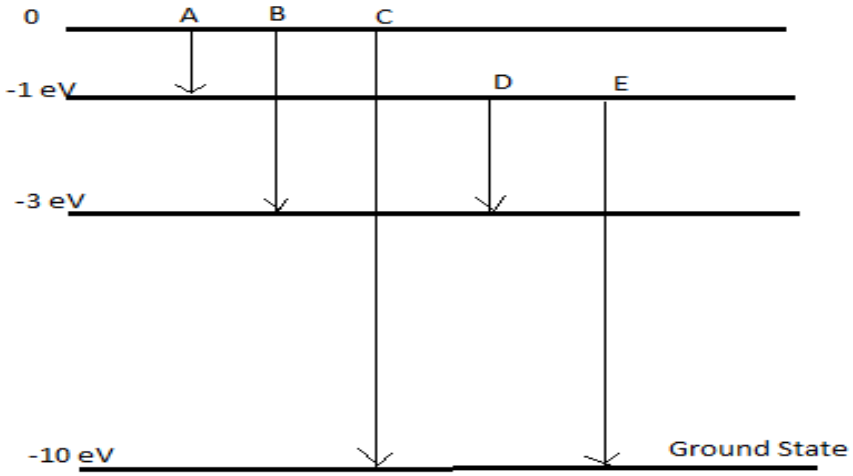
18. What do you understand by the statement 'Light from the sun is unpolarised'. Explain how does sunlight gets polarized by the process of scattering?

19. Explain how does (i) photoelectric current and (ii) kinetic energy of the photoelectrons emitted in a photocell vary if the frequency of incident radiation is doubled, but keeping the intensity same? Show the graphical variation in the above two cases.

OR

(i) Name the experiment which confirms the existence of wave nature of electrons. Derive the expression for de-Broglie wavelength of an electron moving under a potential difference of V volts. (ii) An electron and a proton have the same Kinetic Energy. Which of these particles has the shorter de-Broglie wavelength?

20. The energy levels of an atom of element X are shown in the diagram. Which one of the level transitions will result in the emission of photons of wavelength 620 nm? Support your answer with mathematical calculations.



21. Draw a graph showing the variation of binding energy per nucleon versus the mass number A. Explain with the help of this graph, the release of energy in the process of nuclear fission and fusion.

22. A message signal of frequency 20 KHz and peak voltage of 20 volts is used to modulate a carrier signal of frequency 2 MHz and peak voltage of 40 volts. Determine (i) modulation index, (ii) the side bands produced. Draw the corresponding frequency spectrum of amplitude modulated signal.

Section - D

23. When Deepak studied the electrical circuits and the current flowing through them, he became curious about the range of the currents we come across in daily life. He collected the data and presented in a tabular form as shown below. He then studied the instruments used to detect and measure current, however could not understand the difference between an ammeter and an ideal ammeter and thus went to his teacher for the explanation.

S.No.	Description	Magnitude of current
1	Domestic Appliance	Few amperes
2	Lightning	Ten thousand amperes
3	Nervous system	microamperes
4	Galvanometer	Few milliamperes
5	Semiconductors	Few milliamperes

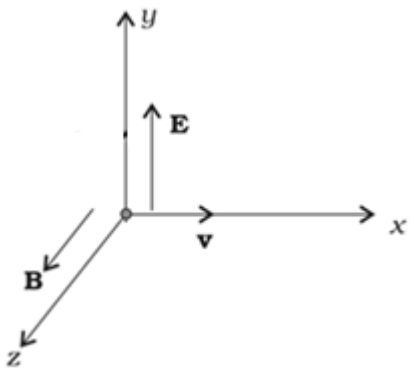
(i) What values did Deepak have?

(ii) As domestic appliances carry electric current of the order of few amperes, write one safety precaution we should take while working with them.

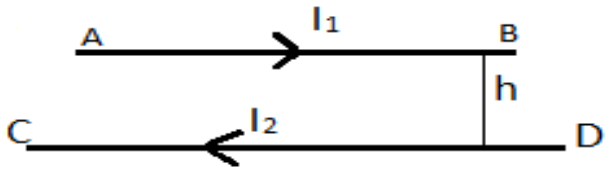
(iii) An ammeter of resistance R_A is connected in series with a resistor R and a battery of emf E and internal resistance r. The current flowing through this circuit is I_A. What will be the current flowing through the circuit if the given ammeter is replaced by an ideal ammeter and find the percentage error in measuring the current through an ammeter?

Section - E

24.(a) A particle of charge q is moving with velocity v in the presence of crossed Electric field E and Magnetic field B as shown. Write the condition under which the particle will continue moving along x- axis. How would the trajectory of the particle be affected if the electric field is switched off?



(b) A horizontal wire AB of length 'l' and mass 'm' carries a steady current I_1, free to move in vertical plane is in equilibrium at a height of 'h' over another parallel long wire CD carrying a steady current I_2, which is fixed in a horizontal plane as shown. Derive the expression for the force acting per unit length on the wire AB and write the condition for which wire AB is in equilibrium.

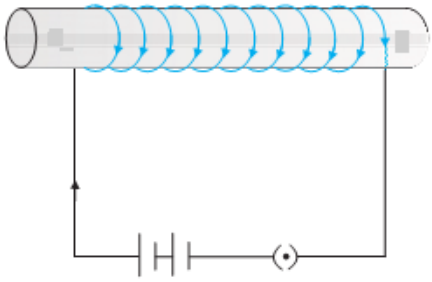


OR

(a) An electron in the ground state of Hydrogen atom is revolving in a circular orbit of radius R. Obtain the expression for the orbital magnetic moment of the electron in

terms of fundamental constants.

(b) Draw the magnetic field lines for a current carrying solenoid when a rod made of (i) copper, (ii) aluminium and (iii) iron are inserted within the solenoid as shown.



25. (a)Draw a ray diagram of compound microscope for the final image formed at least distance of distinct vision?

(b) An angular magnification of 30X is desired using an objective of focal length 1.25 cm and an eye piece of focal length 5 cm. How will you set up the compound microscope for the final image formed at least distance of distinct vision?

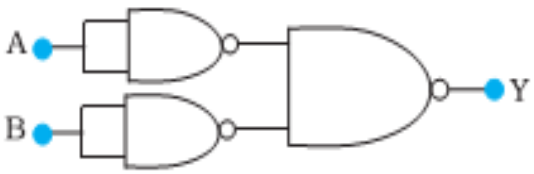
OR

(a) Draw a ray diagram of an astronomical telescope for the final image formed at least distance of distinct vision?

(b) An astronomical telescope has an angular magnification of magnitude 5 for distant objects. The separation between the objective and an eye piece is 36 cm and the final image is formed at infinity. Calculate the focal length of the objective and the focal length of the eye piece?

26.(a)With proper diagram, explain the movement of charge carriers through different parts of the transistor and hence show that $I_E = I_B + I_C$.

(b) Identify the logic operation carried out by the circuit shown below and write its truth table.



OR

Draw a circuit diagram to study the input and output characteristics of an n-p-n transistor in its common emitter configuration.
Draw the typical input and output characteristics and explain how these graphs are used to calculate current amplification factor of the transistor.

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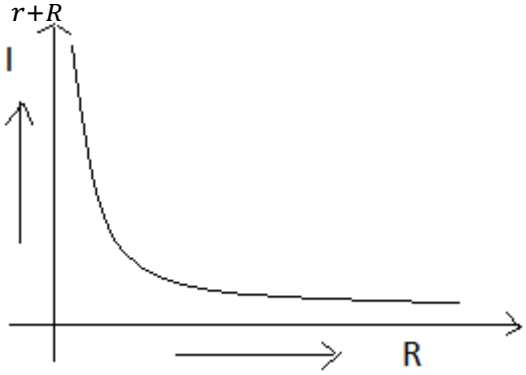
Marking Scheme
PHYSICS
SAMPLE QUESTION PAPER-2018

Section- A

1. As $V_A - V_B = V_B - V_C$ magnitude of work done is same. (1)

2. $I = \frac{E}{r+R}$

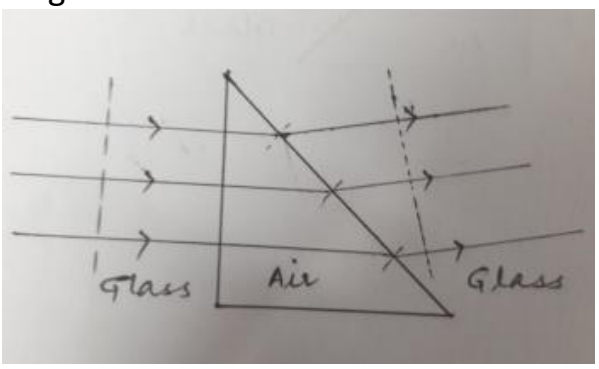


(1)

3. Factors are :

(i) magnetic permeability of the medium (1/2)
(ii) electric permittivity of the medium (1/2)

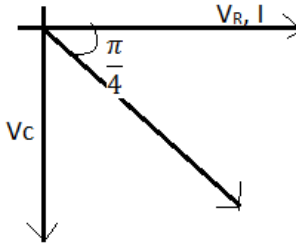
4. Diagram (1)



5. In photon picture, intensity is determined by the number of photons crossing per unit time. (1)

Section – B

6. As the current leads the voltage by $\frac{\pi}{4}$, the element used in black box is a 'capacitor'.(½)
   (ii) Phasor diagram (½)



tan $\frac{\pi}{4}$ = V_c / V_R
Vc = VR
Xc = R
Impedance Z = $\sqrt{(Xc^2 + R^2)}$ (½)
Z = R$\sqrt{2}$ (½)

7. (i) Energy density u = $\frac{B^2}{\mu_0}$ (½)
u= 11.5 X 10^{-9} J/m^3. (½)

(ii) Speed = $\frac{\omega}{k}$ (½)
speed= 3 X 10^8 m/s (½)

8. $\mu_2/v - \mu_1/u = (\mu_2 - \mu_1)/ R$ (½)
correct sign convention (½)
1.0/v – 1.5/-30 = (1.0 – 1.5) / 20 (½)
v = - 13.3 cm (½)

9. Photodiode (½) Reverse biasing (½)
I-V characteristics NCERT page no. 487 (1)

10.a) need for long antenna diminishes, with explanation (1)
power is inversely proportional to (wavelength)^2 (½),
signals from different transmitters can be distinguished(½)

OR

Range: 76-88 MHz and 420-890 MHz (1)
Factors: by increasing height of transmitting antenna and using repeater stations. (1)

Section- C

11.(a) C = 5 X 10^{-9} F, U = 25 J
U = Q^2/ 2C (½)
Q^2 = 2 U C = 2 X 25 X 5 X 10^{-9}
Q = 5 X 10^{-4} C (½)
Q = n e (½)

n = $\frac{Q}{e}$ = 3.125 X 10^{15} electrons (½)

(b) Without changing charge on the plates, we can make C half. C = $\frac{\varepsilon o\ A}{d}$, i.e. double the plate separation or inserting dielectric of dielectric of a value such that C becomes (1).

12.(a) As the electrostatic field inside a conductor is zero, using Gauss's law,
charge on the inner surface of the shell = -Q (½)
Charge on the outer surface of the shell = +Q (½)

(b) To show using Gauss's law expression
Expression for electric field for radius, r=$\frac{a}{2}$: E = $\frac{1}{4\pi\varepsilon o}\frac{4Q}{a^2}$ (1)
Expression for electric field for radius, r = 2b : E = $\frac{1}{4\pi\varepsilon o}\frac{Q}{4b^2}$ (1)

13. (i) E1 = $\frac{V}{L}$, E2 = $\frac{V}{2L}$, E3 = $\frac{2V}{3L}$ (½)
E2 < E3 < E1 (½)

(ii) V_d α E (½)
V_{d2}< V_{d3}< V_{d1} (½)

(iii) I = nAe V_d / J= σE (½)
J = n e V_d
J2 < J3<J1 (½)

14.NCERT Exemplar Q4.21 R_1, R_2, R_3 (each 1 mark)

15.NCERT pg no. 301 Q6.14 (1 mark each part)

16.Device : Transformer (½)
Diagram on page number 260 NCERT part I (1)
Principle: statement of mutual induction (1)
Efficiency: Assuming no energy losses, the transformer is 100% efficient i.e. $I_pV_p= I_sV_s$. (½)

17.$\beta = \lambda D / d$ (½)
5^{th} bright = $5\beta_1 = 5\lambda_1 D/d = 5 \times 480 \times 10^{-9} \times 2 / 3 \times 10^{-3} = 16 \times 10^{-4}$m (1)
5^{th} bright = $5\beta_2 = 5\lambda_2 D/d = 5 \times 600 \times 10^{-9} \times 2 / 3 \times 10^{-3} = 20 \times 10^{-4}$ m (1)
distance between two 5^{th} bright fringes = $(20 – 16) \times 10^{-4} = 4 \times 10^{-4}$ m (½)

18. 'Light from the sun is unpolarised' means the electric field vector vibrates in all possible directions in the transverse plane rapidly and randomly. (1)

Polarisation of sunlight by the method of scattering: page number 379 of NCERT part II : Diagram + explanation. (1+1)

19. i) Page no. 391 figure 11.4 +explanation (½ +1)

ii) Page no. 392 + explanation (½ + 1)

OR

(i) Davisson- Germer experiment (½)

An electron of charge e, mass m accelerated through a potential difference of v volts, Kinetic energy equals the work done (eV) on it by the electric field:

K = eV (½)

K = $\frac{p^2}{2m}$, p = $\sqrt{(2mk)}$ (½)

p= $\sqrt{(2meV)}$

the de- Broglie wavelength λ of the electron is :

λ = $\frac{h}{p}$ (½)

λ= $\frac{h}{\sqrt{(2meV)}}$ (½)

(ii) For same KE, λ α $\frac{1}{\sqrt{m}}$

As mass of proton is greater than that of electron, ∴ $\lambda_p < \lambda_e$. (½)

20. E = hc / λ = 6.6. x 10^{-34} x 3 x 10^8 / 620 x 10^{-9} (1)

= 3.2 x 10^{-19} J (½)

= 3.2 x 10^{-19} / 1.6 x 10^{-19} = 2 eV (½)

This corresponds to the transition "D" (1)

21. NCERT figure 13.1 on page no. 444 (1)

Fission (1) , Fusion (1)

22.(i) Modulation Index = A_m / A_c = 20/40 = 0.5 (½ + ½)

The side bands are (2000 + 20) KHz

= 2020 KHz and (2000 - 20) KHz

= 1980 KHz (½ + ½)

Amplitude versus ω for amplitude modulated signal : page number 525 NCERT part (ii) Figure 15.9, Ac = 40 volts, $\mu A_c/2$ = 10 volts. (1)

Section -D

23. (a) critical thinking, hard working (1)

(b) One should not touch electrical appliances with wet hands/ any one

precaution. (1)

(c) $I_A = \frac{E}{r+R+R_A}$ (½)

For an ideal ammeter $R_A = 0$

$I = \frac{E}{r+R}$ (½)

Percentage error: $(\frac{I-I_A}{I})$ X 100 = $(\frac{R_A}{R+r+R_A})$ X 100 (1)

Section –E

24. (a) Condition qE = q vB (½)

$v = \frac{E}{B}$ (½)

Trajectory becomes helical about the direction of magnetic field (1)

(b) To derive the expression of magnetic force acting per unit length of the wire:

$\frac{F_m}{l} = \frac{\mu_0 I_1 I_2}{2\pi h}$, upwards on wire AB (2)

At equilibrium Magnetic Force per unit length = mass per unit length X g

$\frac{\mu_0 I_1 I_2}{2\pi h} = \frac{m}{l} g$ (1)

OR

(a) Using the condition $mvr = \frac{nh}{2\pi}$ (1/2)

For H-atom n=1, $v = \frac{h}{2\pi mr}$

Time period $T = \frac{2\pi r}{v}$

$\therefore T = \frac{4\pi^2 mr^2}{h}$, $I = \frac{Q}{T} = \frac{eh}{4\pi^2 mr^2}$ (1/2)

M = I A (1/2)

$M = (\frac{eh}{4\pi^2 mr^2})(\pi r^2)$

$M = \frac{eh}{4\pi m}$ (1/2)

(b) Diagram for magnetic field lines Cu- diamagnetic (1)

Al- Paramagnetic (1)

Fe- Ferromagnetic (1)

25. (a) Diagram (2) + labelling (½)

(b) $m_e = 1 + 25/5 = 6$ (½)

$m_o = 30 / m_e = 5$ (½)

$m_o = v_o / -u_o v_o = - 5 u_o$

$1/f_o = 1/v_o - 1/u_o f_o = - (5/6)\ u_o$ (½)

$u_o = 1.5$ cm , $v_o = 7.5$ cm

$u_e = - 4.17$ cm (½)

Length of the tube = $u_e + v_o = 11.67$ cm (½)

OR

(a) Diagram (2) + labelling (½)

(b) $m = - f_o / f_e$ (½)
$f_o = 5\ f_e$ (½)
$L = f_o + f_e$ (½)
$f_e = 36/6 = 6$ cm (½)
$f_o = 30$ cm (½)

26. (a) circuit diagram (1)
NCERT page no.492 (explanation: 2)

(b) NCERT page no. 511 Q. No.14.17 Logic operation (1) Truth table (1)

OR
Diagram (1 ½)
Input Characteristics (1 ½)
Output Characteristics (1 ½)
Current amplification factor (½)

PHYSICS SQP 2017-18

S.No.	Units	VSA (1 Mark)	SA-I (2 Marks)	SA-II (3 Marks)	Value based (4 Marks)	LA (5 Marks)	Total
1	Electrostatics	1(1) (E)		6(2) A(N)+H			15 (6)
	Current Electricity	1(1) (K)		3(1) E	4(1) (E)		
2	Magnetic Effects of Current & Magnetism			3(1) U		5(1) (A)	16 (5)
	Electromagnetic Induction and Alternating currents		2(1) (U)	6(2) A+U			
3	Electromagnetic Waves	1(1) (H)	2(1) U(N)				17(7)
	Optics	1(1) (H)	2(1) A(N)	6(2) A(N)+U		5(1) (H)	
4	Dual Nature of Matter and Radiation	1(1) (K)		3(1) A			10(4)
	Atoms and Nuclei			6(2) E+K			
5	Electronic devices		2(1) (K)			5(1) (U)	12(4)
	Communication Systems		2(1) A(N)	3(1) U			
	Total	5(5)	10(5)	36(12)	4(1)	15(3)	70(26)

Abbreviations

N(H)	Numerical + HOTS
N (U)	Numerical + Understanding
N (A)	Numerical + Application
K	Knowledge
U	Understanding
A	Application

H	HOTS
EMD	Evaluation and Multi disciplinary

Marks wise weightage to different typology of questions

Typology (Marks)	Number of Questions(Marks)	Marks (questions)
K (7 marks)	3(3) + 4(2)	7(5)
U (21 Marks)	2(1) + 9 (3) +10(2)	21(6)
A (21 Marks)	4(2) +12(4) + 5(1)	21(7)
H (10 Marks)	1(1) + 9(3)	10(4)
EMD (11 Marks)	1(1) + 6 (2) + 4 (1)	11(4)
Total		70 (26)