Registration No | | | | | | | **SET 2**

ALL KERALA COMMON MODEL EXAMINATION
PHYSICS (042)
CLASS XII (2023-24)

TIME: 3 Hours **MAX.MARKS: 70**

General Instructions:

(1) There are 33 questions in all. All questions are compulsory

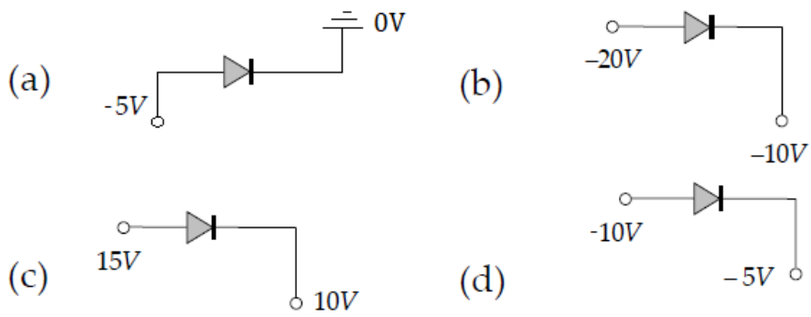
(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.

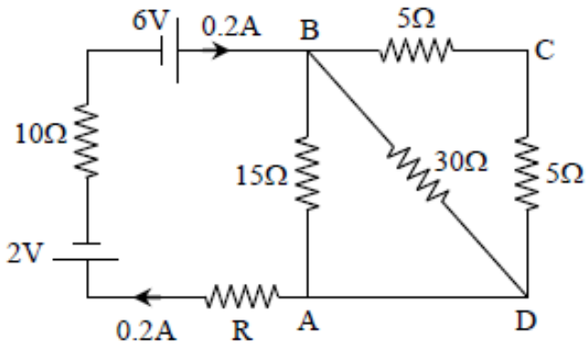
(3) Section A contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, Section B contains five questions of two marks each, Section C contains seven questions of three marks each, Section D contains two case study based questions of 4 marks each and Section E contains three long questions of five marks each.

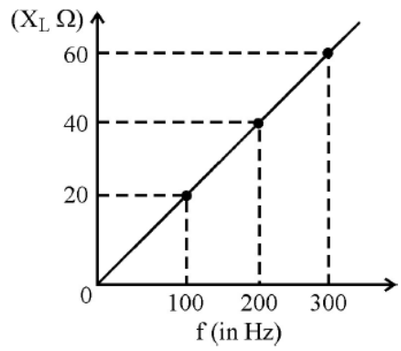
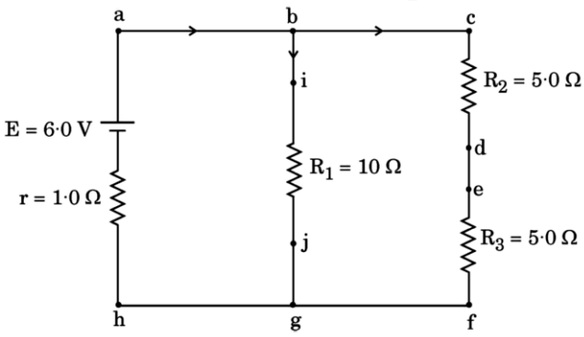
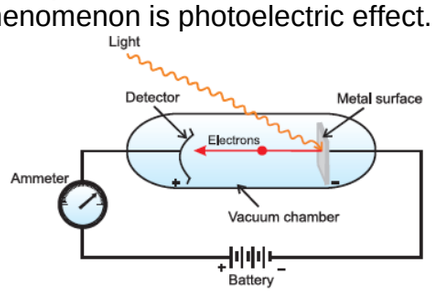
(4) There is no overall choice. However, an internal choice has been provided in section B, C, D and E. You have to attempt only one of the choices in such questions.

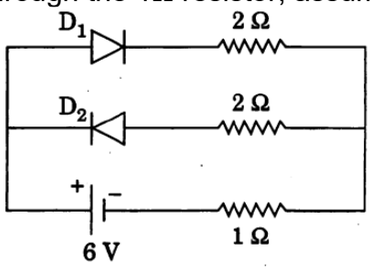
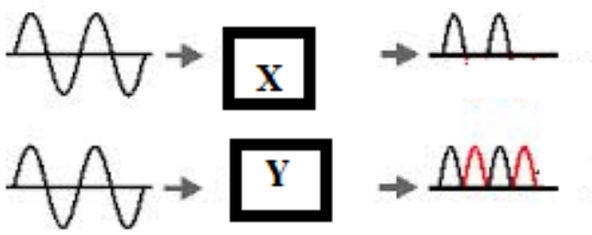
SECTION A

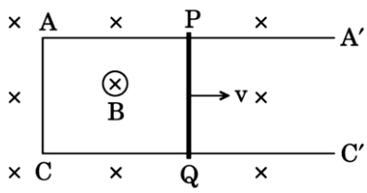
1.	A charge Q is uniformly distributed over the surface of a spherical shell of radius R. The work done in bringing a test charge Q_0 from its centre to its surface is (a) $\frac{QQ_0}{4\pi\varepsilon_0 R}$ (b) $\frac{QQ_0}{4\pi\varepsilon_0 2R}$ (c) $\frac{QQ_0}{\varepsilon_0 R}$ (d) zero	(1)
2.	A charged particle is placed between the placed of a charged parallel plate capacitor experiences a force F. If one of the plates is removed, the force on the particle will be (a) 2F (b) F (c) F/2 (d) zero	(1)
3.	An electric dipole in a non-uniform electric field will experience (a) only force (b) only torque (c) both force and torque (d) neither force nor torque	(1)
4.	The electric field at a point on the axis of a short electric dipole at a distance r from the midpoint of the dipole is proportional to (a) $\frac{1}{r^4}$ (b) $\frac{1}{r^{3/2}}$ (c) $\frac{1}{r^3}$ (d) $\frac{1}{r^2}$	(1)
5.	A constant voltage is applied between the two ends of a uniform metallic wire, heat 'H' is developed in it. If another wire of the same material, double the radius and twice the length as compared to original wire is used then the heat developed in it will be (a) H/2 (b) H (c) 2H (d) 4H	(1)
6.	Relative permeability of a material is 0.9. The material is (a) diamagnetic (b) paramagnetic (c) ferromagnetic (d) diamagnetic or paramagnetic	(1)
7.	Two concentric and coplanar circular coils A and B have their radii in the ratio 2:3. If loop A carries a current of 6A in the clockwise direction, for magnetic field at the centre to be zero, loop B must carry _____ current in the _____ direction. a) 6A; anticlockwise (b) 3A; anticlockwise (c) 9A; anticlockwise (d) 9A; clockwise	(1)
8.	Alternating emf E= 220sin100πt is applied to a circuit containing an ideal inductor of L=2/π H. Instantaneous value of current is (a) 1.1cos100πt (b) -1.1cos100πt (c) 1.1sin100πt (d) -1.1sin100πt	(1)
9.	In photoelectric experiment, if the ratio of the frequency of the incident radiation for the same intensity on a photosensitive surface is 1:2:3, the ratio of photoelectric current is (a) 1:2:3 (b) √1:√2:√3 (c) 1:4:9 (d) 1:1:1	(1)

10.	Radius of ^{27}Al is 3.6 fm. Radius of ^{125}Fe is (a) 3 fm (b) 6 fm (c) 9 fm (d) 12fm	(1)
11.	A glass slab of refractive index 1.5 is placed on a cross marked on paper. The cross appears to be raised by 1cm. The thickness of the slab is (a) 2cm (b) 4cm (c) 3cm (d) 6cm	(1)
12.	Which of the diodes is forward biased? 	(1)
13.	**Assertion (A):** When a light wave travels from a rarer to a denser medium, its speed decreases. The reduction in speed implies a reduction in energy carried by the light wave. **Reason (R):** The energy of a wave is proportional to velocity of wave. (a) Both A and R are true and R is the correct explanation (b) Both A and R are true but R is NOT the correct explanation of A (c) A is true but R is false (d) A is false and R is also false	(1)
14.	**Assertion (A):** Increasing the current sensitivity by increasing the number of turns may not necessarily increase the voltage sensitivity. **Reason (R):** The resistance of the coil of the galvanometer increases with the number of turns (a) Both A and R are true and R is the correct explanation (b) Both A and R are true but R is NOT the correct explanation of A (c) A is true but R is false (d) A is false and R is also false	(1)
15.	**Assertion (A):** The refractive index of diamond is $\sqrt{6}$ and of liquid is $\sqrt{3}$. If light travels from diamond into the liquid, it will be totally internally reflected when angle of incidence is 300. **Reason (R):** For total internal reflection, light should travel from rarer to denser medium. (a) Both A and R are true and R is the correct explanation (b) Both A and R are true but R is NOT the correct explanation of A (c) A is true but R is false (d) A is false and R is also false	(1)
16.	**Assertion (A):** Pure semiconductors have negative temperature coefficient of resistance. **Reason (R):** On increasing the temperature, more charge carriers are produced and hence resistance decreases. (a) Both A and R are true and R is the correct explanation (b) Both A and R are true but R is NOT the correct explanation of A (c) A is true but R is false (d) A is false and R is also false	(1)
	SECTION B	
17.	Two coherent sources superpose and produce interference pattern on a screen in Young's double slit experiment. At a point where the path difference is $\lambda/6$, find i) phase difference ii) resultant intensity at the point if intensity of central maxima is I_0.	(2)

18.	Derive the expression for electric field intensity $\vec{E}$ at a point on the equatorial line of an electric dipole**.**	(2)
19.	A battery of emf 12V and internal resistance 4Ω is connected to an external resistance R. If the current in R is 0.5A, calculate the value of R and the terminal voltage of the battery.	(2)
	OR	
19.	Calculate the value of R in the circuit shown so that current in the circuit is 0.2A. 	(2)
20.	Using Huygen's principle, prove Snell's law.	(2)
21.	A short bar magnet placed with its axis at 30^0 with an external field of 800 G experiences a torque of 0.016 Nm. (a) What is the magnetic moment of the magnet? (b) What is the work done in moving it from its most stable to most unstable position? ($1G = 10^{-4}$ T)	(2)
	SECTION C	
22.	a) Write the expression for speed of light in a material medium in terms of permittivity and permeability. b) Name the electromagnetic wave used in i) RADAR ii) earth satellites to observe growth of crops.	(3)
23.	Hydrogen atoms are excited by an electron beam of energy 12.5eV. Find i) highest energy level up to which the hydrogen atoms will be excited ii) Longest wavelength of the Lyman series for these hydrogen atoms.	(3)
24.	To convert a galvanometer to a voltmeter of ranges 2V, V and V/2 volt, resistances R_1, R_2 and R_3 are required to be connected in series with the galvanometer. Obtain the relation between R_1, R_2 and R_3.	(3)
25. a) b)	Write two characteristics of nuclear force. Draw a plot of the potential energy of a pair of nucleons as a function of their separation.	(3)
26.	The focal lengths of the objective and eyepiece of a compound microscope are 1.25cm and 5cm respectively. Find the position of the object relative to the objective in order to obtain an angular magnification of 30 when the final image is formed at near point. Also find the distance between the lenses.	(3)
27.	Determine the electrostatic potential energy of a system consisting of two charges 7μC and –2μC (and with no external field) placed at (–9 cm, 0, 0) and (9 cm, 0, 0) respectively. a) How much work is required to separate the two charges infinitely away from each other? b) Suppose that the same system of charges is now placed in an external electric field $E = A (1/r^2)$; $A = 9 \times 10^5$ NC^{-1} m^2. What would the electrostatic energy of the configuration be?	(3)

28.	The variation of inductive reactance (X_L) of an inductor with the frequency (f) of the ac source of 100 V and variable frequency is shown.  (i) Calculate the self-inductance of the inductor. (ii) When this inductor is used in series with a capacitor of unknown value and a resistor of 10 Ω at 300 s^{-1}, maximum power dissipation occurs in the circuit. Calculate the capacitance of the capacitor.	(3)
	OR	
28.	An ideal inductor of $\frac{5}{\pi}$ H inductance is connected to a 200 V, 50 Hz ac supply. (i) Calculate the rms and peak value of current in the inductor. (ii) What is the phase difference between current through the inductor and the applied voltage? How will it change if a small resistance is connected in series with this inductor in the circuit?	(3)
	SECTION D	
29.	**<u>Kirchhoff's laws</u>** The following figure shows a circuit diagram. We can find the currents through and potential differences across different resistors using Kirchhoff's rules.  Answer the following questions based on the above: (a) Which points are at the same potential in the circuit? (b) What is the current through arm bg? (c) Find the potential difference across resistance R_3. **OR** (c) What is the power dissipated in resistance R_2 ?	(1) (1) (2) (2)
30.	**CASE STUDY – Photoelectric Effect** When ultraviolet light falls on certain metals like zinc, cadmium and magnesium etc. electron emission take place from the surface. Alkali metals emit electrons even with visible light. After the discovery of electrons in 1897, these electrons were termed as photoelectrons and the phenomenon is photoelectric effect.  	

	a) Alkali metals show photoelectric effect with visible light but Zn, Mg and Cd respond to uv light. Why? (i) Alkali metals have less threshold wavelength. (ii) Zn, Cd and Mg have greater threshold wavelength. (iii) Alkali metals have greater threshold frequency. (iv) Zn, Cd and Mg have greater threshold frequency.	(1)
	b) Maximum kinetic energy of the emitted photoelectrons is 5eV. What is its stopping potential?	(1)
	c) By how much would the stopping potential of a given photosensitive surface go up if the incident radiation is increased from $4x10^{15}$ Hz to $8x10^{15}$ Hz?	(2)
	OR	
	c) The threshold frequency for a given metal is f_0. If light of frequency $2f_0$ is incident on it, velocity of the emitted photoelectrons is v_1 and for frequency $5f_0$, velocity is v_2. Find ratio of velocities.	(2)
	SECTION E	
31.	a) The ratio of the number density of free electrons to holes, (n_e/n_h), for three different materials A, B, C are equal to one, less than one and more than one respectively. Name the type of semiconductor and draw energy band diagrams for A, B & C.	(3)
	b) Find the current flowing through the 1Ω resistor, assuming the diodes are ideal.  	(2)
	OR	
31.	a) An ac signal is fed into two circuits X and Y and the corresponding output in the two cases have the waveforms shown below. Name the circuits X and Y. Also draw their circuit diagram.  	(3)
	b) If the frequency of the input signal is 50Hz, what will be the frequency of the output signal in X & Y**.**	(2)
32.	a) Derive mirror formula for a convex mirror. b) Two objects P and Q when placed at different positions in front of a concave mirror of focal length 20 cm, form real images of equal size. Size of object P is three times size of object Q. If the distance of P is 50 cm from the mirror, find the distance of Q from the mirror.	(3) (2)
	OR	
32.	a) Two thin convex lenses are placed coaxially in contact. Obtain the expression for focal length of the combination in terms of the focal length of the two lenses. b) A converging lens of refractive index 1.5 has power of 10D. When it is immersed in a liquid it behaves as a diverging lens of focal length 50cm. Find the refractive index of the liquid.	(3) (2)

33.	a) With the help of a labelled diagram, explain the working of a step-down transformer. Give reasons for the following i) The core of the transformer is laminated ii) Thick copper wires are used in the windings	(3)
	b) A conducting rod PQ of length 20 cm and resistance 0·1 Ω rests on two smooth parallel rails of negligible resistance AA' and CC'. It can slide on the rails and the arrangement is positioned between the poles of a permanent magnet producing uniform magnetic field B = 0·4 T. The rails, the rod and the magnetic field are in three mutually perpendicular directions as shown in the figure. If the ends A and C of the rails are short circuited, find the (i) induced emf if the rod moves with uniform velocity v = 10 cm/s, and (ii) induced current  	(2)
	OR	
33.	a) Draw a labelled diagram of an ac generator. Obtain the expression for induced emf.	(3)
	b) A horizontal straight wire 10 m long extending from east to west is falling with a speed of 5.0 m s^{-1}, at right angles to the horizontal component of the earth's magnetic field, 0.30 × 10^{-4} Wb m^{-2}. i) What is the instantaneous value of the emf induced in the wire? ii) Which end of the wire is at a higher potential?	(2)