SECOND PREBOARD EXAMINATION (2017-18)
CLASS: XII

Subject: PHYSICS **Date: 21.01.2018**
Time allowed: 3Hours Maximum Marks: 70

General Instructions:
1. **All** questions are **compulsory**.
2. Marks are indicated against each question.
3. Please check that this question paper contains 8 printed pages only.
4. Please check that this question paper contains 26 questions.
5. This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
6. 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.
7. 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.
8. You may use the following values of physical constants wherever necessary:

$\mu_\circ = 4\pi x10^{-7}$ TmA^{-1}

$1/4\pi\varepsilon_\circ = 9x10^{9}Nm^{2}C^{-2}$

$c = 3x10^{8}$ m/s

$e = 1.6x10^{-19}C$

$\varepsilon_\circ = 8.854x10^{-12}$ $C^{2}N^{-1}m^{-2}$

$m_e = 9.1x10^{-31}$ kg

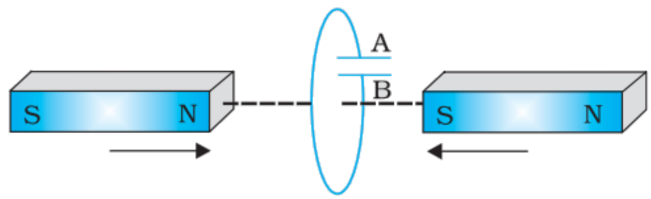
$h = 6.63$ X 10^{-34} Js

$R = 1.03x10^{7}m^{-1}$

SECTION A

1. Draw a sketch of equipotential surfaces due to a single charge (+q), depicting the electric field lines due to the charge. 1

2. Predict the polarity of the capacitor in the situation describes below and justify your answer: 1



3. A light bulb is rated at 100W for a 220 V a.c. supply. Find the peak voltage of the source. 1

4. Write the relationship between angle of incidence '*i*', angle of prism '*A*' and angle of minimum deviation for a triangular prism. 1

5. Carbon, Silicon and Germanium have same lattice structure. Why is C Insulator, while Si and Ge intrinsic semiconductors? 1

SECTION B

6. Prove that the current density of a metallic conductor is directly proportional to the drift speed of electrons through the conductor. 2

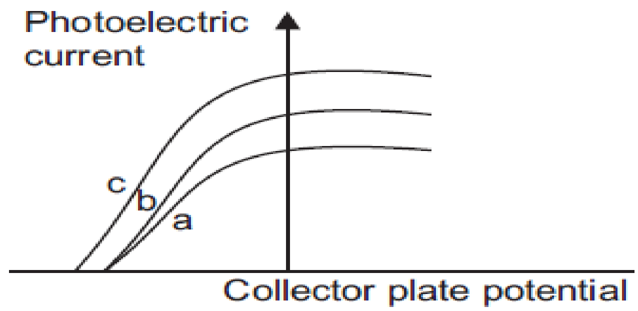
OR

Plot a graph showing the variation of resistivity with temperature for a metallic conductor. Explain such behaviour, using the mathematical expression of the resistivity of a material. 2

7. A galvanometer coil has a resistance of 15 Ω and the metre shows full scale deflection for a current of 4 mA. How will you convert the metre into an ammeter of range 0 to 6A? 2

8. Assume that light of wavelength 6000Å is coming from a star. What is the limit of resolution of a telescope whose objective has a diameter of 100 inch? (1inch = 2.54cm) 2

9. (a) State Heisenberg's uncertainty principle.
(b) The given graph shows three curves *a, b, c* showing the, variation of photo-electric current versus collector plate potential. Point out the two curves for which the incident radiations have same frequency but different intensities. 2



10. Calculate the (a) momentum, and (b) de Broglie wavelength of the electrons accelerated through a potential difference of 56 V. 2

SECTION C

11. (a) Derive an expression for the electric field $\vec{E}$ due to a dipole of length "2a' at a point distant r from the centre of the dipole on the axial line.
(b) Draw a graph of E versus r for r >> a. 3

12. Using Biot-Savart law, derive the expression for the magnetic field due to a circular coil carrying current at a point along its axis. 3

OR

Derive the expression for force per unit length between two long straight parallel current carrying conductors. Hence, define one ampere. 3

13.(a) Write two properties of a material suitable for making a permanent magnet.
(b) Give two points to distinguish between a paramagnetic and a diamagnetic substance. 3

14.(a) Define self-inductance. Write its S.I. units.
(b) Derive an expression for self-inductance of a long solenoid of length ***l***, cross-sectional area *A* having *N* number of turns. 3

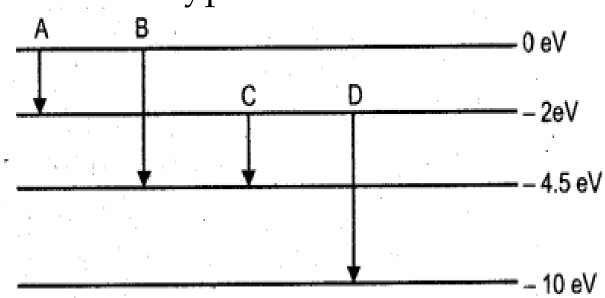
15. Justify the given statements:
(a) A step up transformer converts a low input voltage into a high output voltage, yet it does not violate law of conservation of energy.
(b) Choke coil is needed, in the use of fluorescent tubes with ac mains.
(c) At resonance, if quality factor (Q) is large, the circuit is more selective. 3

16. (a) Name the part of electromagnetic spectrum which is suitable for :
(i) Radar systems used in aircraft navigation
(ii) Treatment of cancer tumours.
(b) When an ideal capacitor is charged by a dc battery, no current flows. However, when an ac source is used, the current flows continuously. 3
How does one explain this, based on the concept of displacement current?

17. (a) Use the mirror equation to deduce that an object placed between f and $2f$ of a concave mirror produces a real image beyond $2f$.
(b) Double-convex lenses are to be manufactured from a glass of refractive index 1.55, with both faces of the same radius of curvature. What is the radius of curvature required if the focal length is to be 20cm? 3

18. For a single slit of width "a", the first minimum of the interference pattern of a monochromatic light of wavelength λ occurs at an angle of λ/a. At the same angle of λ/a, we get a maximum for two narrow slits separated by a distance "a". Justify and explain. 3

19. (a) The energy levels of a hypothetical atom are shown below.



Which of the shown transitions will result in the emission of a photon of wavelength 275 nm?
(b) The radius of the innermost electron orbit of a hydrogen atom is 5.3×10^{-11}m. What are the radii of the n = 2 and n =3 orbits? 3

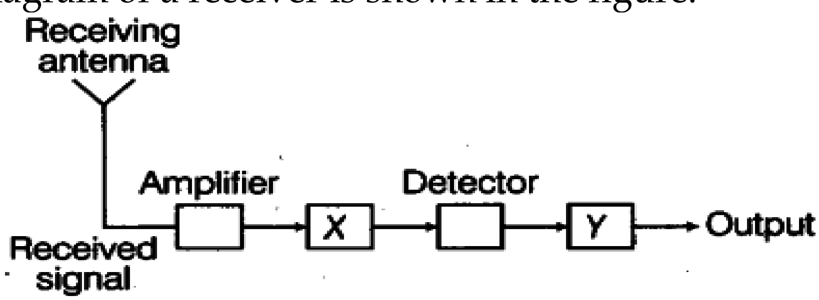
20. (a) Plot a graph showing the number (N) of undecayed nuclei as a function of time (t) for a given radioactive sample having half life $T_{1/2}$. Depict in the plot the number of undecayed nuclei at $t = 3T_{1/2}$
(b) A radioactive nucleus 'A' undergoes a series of decays according to the following scheme:

$$A \xrightarrow{\alpha} A_1 \xrightarrow{\beta^-} A_2 \xrightarrow{\alpha} A_3 \xrightarrow{\gamma} A_4$$

The mass number and atomic number of *A* are 180 and 72 respectively. What are these numbers for A_4? 3

21. Name the semiconductor device that can be used to regulate an unregulated dc power supply. With the help of *I-V* characteristics of this device, explain its application here. Support your answer with suitable circuit diagram 3

22. (a) A signal of 5 kHz frequency is amplitude modulated on a carrier wave of frequency 2 MHz. What are the frequencies of the side bands produced?
(b) Block diagram of a receiver is shown in the figure:



Identity 'X' and 'Y' and write their functions. 3

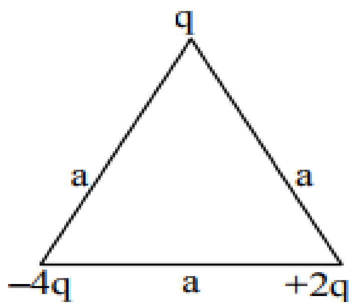
SECTION D

23. In Akash's classroom, one hot summer day, the fan was running very slowly. Due to which all the students in class were sweating and were restless. With the permission of the teacher, he went to the reception and requested for an electrician. The electrician came and changed the capacitor. Then the fan started operating to its full.
(a) What values are displayed by Akash?
(b) Which energy is stored in the capacitor and where?
(c) A slab of material of dielectric constant K has the same area as that of the plates of a parallel plate capacitor but has the thickness d/2, where d is the separation between the plates. Find out the expression for its capacitance when the slab is inserted between the plates of the capacitor. 4

SECTION E

24.(a) Obtain the expression for the potential energy of an electric dipole of dipole moment $\vec{p}$ placed in a uniform electric field $\vec{E}$

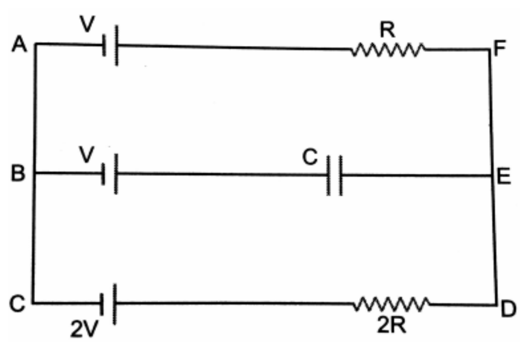
(b) Calculate the work done to dissociate the system of three charges placed at the vertices of an equilateral triangle of side 'a' as shown below. Here q = 1.6 x 10^{-10} C and a=10cm 5



OR

(a) With the help of the circuit diagram, explain how a potentiometer is used to compare the emf of two primary cells. Obtain the required expression used for comparing the emfs.

(b) In the given circuit in the steady state, obtain the expression for (a) the potential drop (b) the charge and (c) the energy stored in the capacitor C. 5



25.(a) The ratio of the intensities at minima to the maxima in the Young's double slit experiment is 9 : 25. Find the ratio of the widths of the two slits.

(b) Obtain lens makers formula using the expression

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

Here the ray of light propagating from a rarer medium of refractive index (n_1) to a denser medium of refractive index (n_2), is incident on the convex side of spherical refracting surface of radius of curvature R. 5

OR

(a) Using Huygen's principle, draw a diagram to show how a plane wave front incident at the interface of the two media gets refracted when it propagates from a rarer to a denser medium. Hence verify Snell's law of refraction.

(b) An astronomical telescope uses an objective lens of focal length 15 m and eye-lens of focal length 1 cm.

(i) What is the angular magnification of the telescope?

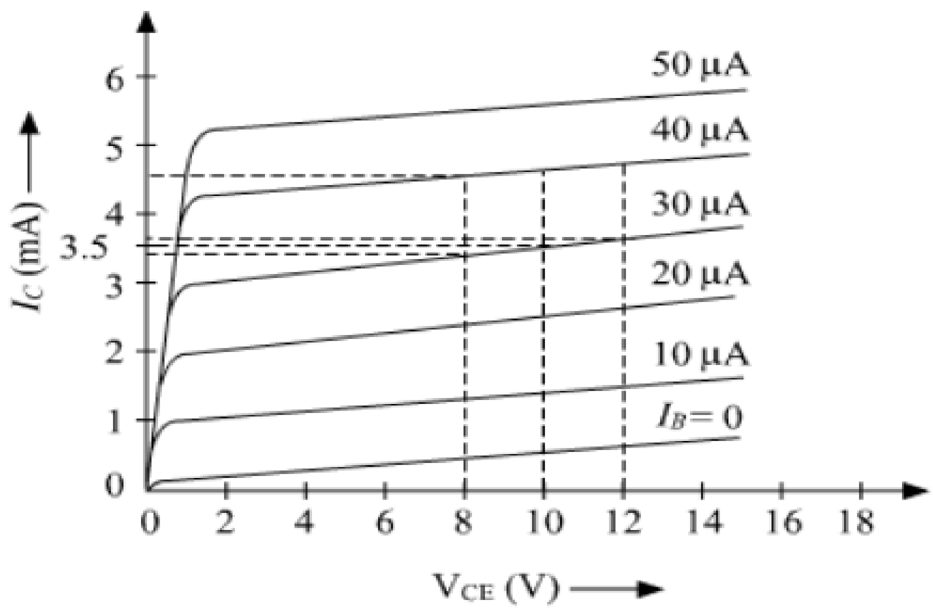
(ii) If this telescope is used to view moon, what is the diameter of the image of moon formed by the objective lens? (Diameter of moon =3.5×10^6 m and radius of lunar orbit =3.8×10^8 m). 5

26. (a) Output characteristics of an n-p-n transistor in CE configuration is shown in the figure. Determine:

(i) dynamic output resistance

(ii) dc current gain and

(iii) ac current gain at an operating point V_{CE} =10V, when I_B =30μA.



(b) Explain, with the help of a circuit diagram, the working of a photo-diode. State its application. 5

OR

(a) Explain the working of p-n junction diode as a Light Emitting Diode. Mention two important advantages of LEDs over conventional lamps.

What should be the order of band gap of an LED if it is required to emit light in the visible range?

(b) Draw the output waveform at X, using the given inputs A and B for the logic circuit shown below. Also, identify the logic operation performed by this circuit. 5