

A. All **Questions** are compulsory. There are **26 Questions** in all.
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B. This **Question Paper** has **Five** sections: **Section A, Section B, Section C, Section D** and **Section E**.

C. **Section A** contains **Five** questions of **One Mark** each.

D. **Section B** contains **Five** questions of **Two Marks** each.

E. **Section C** contains **Twelve** questions of **Three Marks** each.

F. **Section D** contains **One Value Based Question** of **Four Marks**

G. **Section E** contains **Three** questions of **Five Marks** each.

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.

Section A

1

What is the work done in moving a test charge q through a distance of 1 cm along the equatorial axis of an electric dipole?

[1]

2

Show on a graph, the variation of resistivity with temperature for a typical semiconductor.

[1]

3

Using the concept of force between two infinitely long parallel current carrying conductors, define one ampere of current.

[1]

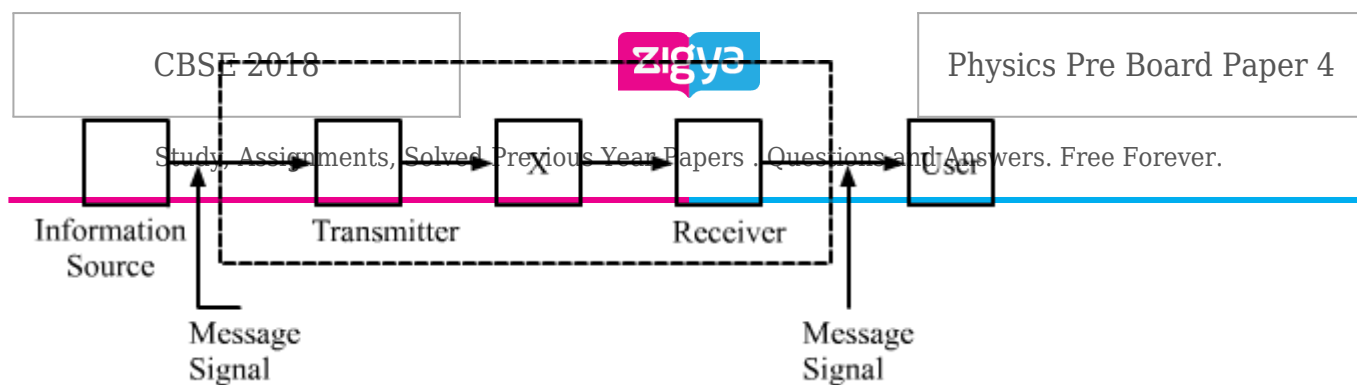
4

Which of the following waves can be polarized (i) Heat waves (ii) Sound waves?

[1]

5

The figure given below shows the block diagram of a generalized communication system. Identify the element labelled 'X' and write its function.



[1]

Section B

6

If the length of a conductor wire is doubled by stretching it, keeping the p.d. across it constant, by what factor does the drift velocity of electrons change?

[2]

7

The equivalent wavelength of a moving electron has the same value as that of a photon of energy 6×10^{-17} J. Calculate the momentum of the electron.

[2]

OR

Plot a graph showing variation of de Broglie wavelength λ versus $\frac{1}{\sqrt{V}}$, where V is the accelerating potential for two particles A and B, carrying the same charge but different masses m_1 and m_2 ($m_1 > m_2$). Which one of the two represents a particle of smaller mass and why?

[2]

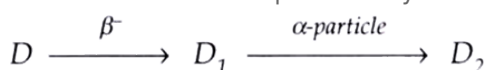
8

What is sky wave communication? Why is this mode of propagation restricted to the frequencies only up to few MHz?

[2]

9

The radioactive isotope D decays according to the sequence.



If the mass number and atomic number of D_2 are 176 and 71 respectively, what is (i) the mass number, (ii) atomic number of D?

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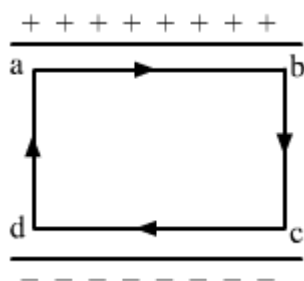
What is the length of a telescope in a normal adjustment?

[2]

Section C

11

- (a) Obtain the expression for the energy stored per unit volume in a charged parallel plate capacitor.
 (b) The electric field inside a parallel plate capacitor is E . Find the amount of work done in moving a charge q over a closed loop $a \rightarrow b \rightarrow c \rightarrow d \rightarrow a$.



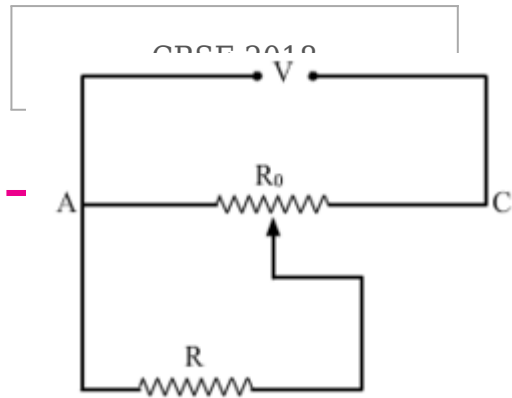
[3]

12

- (a) Why are the connections between the resistors in a meter bridge made of thick copper strips ?
 (b) Why is it generally preferred to obtain the balance point in the middle of the meter bridge wire?
 (c) Which material is used for the meter bridge wire and why?

OR

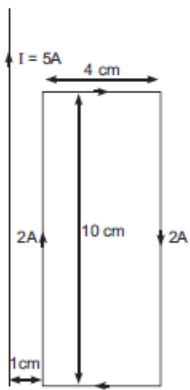
A resistance of R draws current from a potentiometer as shown in the figure. The potentiometer has a total resistance R_0 . A voltage V is supplied to the potentiometer. Derive an expression for the voltage across R when the sliding contact is in the middle of the potentiometer.



[3]

13

A rectangular loop of wire of size 4 cm × 10 cm carries a steady current of 2A. A straight long wire carrying 5A current is kept near the loop as shown.



If the loop and the wire are coplanar, find

- the torque acting on the loop and
- the magnitude and direction of the force on the loop due to the current carrying wire.

[3]

14

Name the electromagnetic waves used for the following and arrange them in increasing order of their penetrating power.

- Water purification
- Rewrite sensing
- Treatment of cancer.

[3]

15

Use Biot-Savart law to derive the expression for the magnetic field on the axis of a current carrying circular loop of radius R.

Draw the magnetic field lines due to a circular wire carrying current I.

[3]

16

A convex lens of focal length 20 cm and a concave lens of focal length 30 cm are placed in contact. A point object lies 60 cm in front of the convex lens. Draw a ray diagram to show the formation of the image by the combination. Determine the nature and position of the image formed.

[3]

17

A proton and an α -particle have the same de-Broglie wavelength. Determine the ratio of (i) their accelerating potentials (ii) their speeds.

[3]

18

In Young's double-slit experiment how many maximas can be obtained on a screen (including the central maximum) on both sides of the central fringe if $\lambda = 2000 \text{ \AA}$ and $d = 7000 \text{ \AA}$. Given that perpendicular distance of a screen from the mid-point of two slits is 3.5 cm.

[3]

19

The ground state energy of hydrogen atom is -13.6 eV . If an electron makes a transition from an energy level -0.85 eV to -3.4 eV , calculate the wavelength of the spectral line emitted. To which series of hydrogen spectrum does this wavelength belong?

[3]

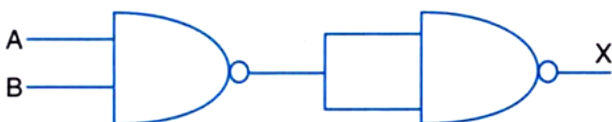
OR

Show that the decay rate 'R' of a sample of a radionuclide is related to the number of radioactive nuclei 'N' at the same instant by the expression $R = \lambda N$.

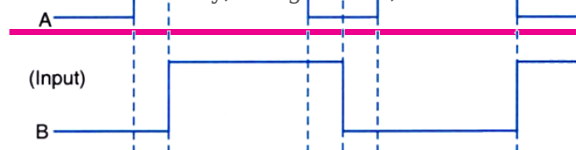
[3]

20

Draw the output wave form at X, using the given inputs A, B for the logic circuit shown below. Also identify the gate.



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[3]

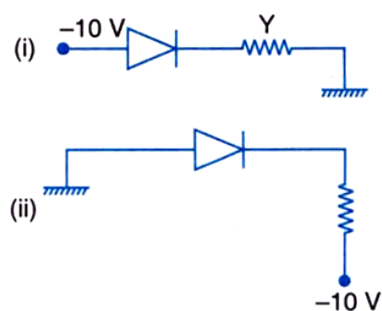
21

The emitter in a photoelectric tube has a threshold wavelength of $6000 \text{ \AA}$. Determine the wavelength of the light incident on the tube if the stopping potential for this light is 2.5 V .

[3]

22

Explain, with the help of a circuit diagram, how the thickness of depletion layer in a p-n junction diode changes when it is forward biased. In the following circuit which one of the two diodes is forward biased and which is reverse biased?



[3]

Section D

23

When Sunita, a class XII student, came to know that her parents are planning to rent out the top floor of their house to a mobile company she protested. She tried hard to convince her parents that this move would be a health hazard.

Ultimately her parents agreed:

- (1) In what way can the setting up of transmission tower by a mobile company in a residential colony prove to be injurious to health?
- (2) By objecting to this move of her parents, what value did Sunita display?
- (3) Estimate the range of E.M waves which can be transmitted by an antenna of height 20 m . (Given radius of the earth = 6400 km)

[4]

24

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Using Gauss' laws deduce the expression for the electric field due to a uniformly charged spherical conducting shell of radius R at a point (i) outside and (ii) inside the shell.

Plot a graph showing variation of electric field as a function of $r > R$ and $r < R$. (r being the distance from the centre of the shell).

[5]

OR

(a) Define electric flux. Write its S.I. units.

(b) Using Gauss's law, prove that the electric field at a point due to a uniformly charged infinite plane sheet is independent of the distance from it.

(c) How is the field directed if (i) the sheet is positively charged, (ii) negatively charged?

[5]

25

A voltage $V = V_0 \sin \omega t$ is applied to a series LCR circuit. Derive the expression for the average power dissipated over a cycle.

Under what condition (i) no power is dissipated even though the current flows through the circuit, (ii) maximum power is dissipated in the circuit?

[5]

OR

(i) Write the function of a transformer. State its principle of working with the help of a diagram. Mention various energy losses in this device.

(ii) The primary coil of an ideal step-up transformer has 100 turns and the transformation ratio is also 100. The input voltage and power are 220 V and 1100 W, respectively. Calculate the:

a) number of turns in secondary

b) current in primary

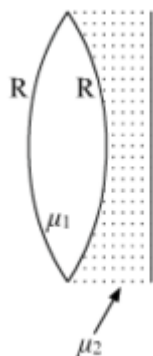
c) voltage across secondary

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e) power in secondary

[5]

26

A biconvex lens with its two faces of equal radius of curvature R is made of a transparent medium of refractive index μ_1 . It is kept in contact with a medium of refractive index μ_2 as shown in the figure.



- Find the equivalent focal length of the combination.
- Obtain the condition when this combination acts as a diverging lens.
- Draw the ray diagram for the case $\mu_1 > (\mu_2 + 1)/2$, when the object is kept far away from the lens. Point out the nature of the image formed by the system.

[5]

OR

- Use Huygens' principle to show the propagation of a plane wavefront from a denser medium to a rarer medium. Hence find the ratio of the speeds of wavefront in the two media.
- (i) Why does an unpolarized light incident on a polaroid get linearly polarized ?
(ii) Derive the expression of Brewster's law when unpolarized light passing from a rarer to a denser medium gets polarized on reflection at the interface.

[5]