

GRADE: XII

SPLIT TEST 2

DATE: 12.12.22

MARKS: 70

PHYSICS (042)

TIME: 3.00Hrs

General Instructions:

Read the following instructions very carefully and strictly follow them:

- (1) There are 35 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 eighteen MCQ of 1 mark each, Section B contains seven questions of two marks each, Section C contains five questions of three marks each, section D contains three long questions of five marks each and Section E contains two case study based questions of 4 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. Electric field at a point varies as r^{-3} for
 - (a) Point charge
 - (b) Dipole
 - (c) Line charge
 - (d) Infinite plane sheet of charge
2. Which of the following is false for electric lines of force?
 - (a) They always start from positive charge and terminate on negative charges.
 - (b) They are always perpendicular to the surface of a charged conductor.
 - (c) They always form closed loops.
 - (d) They are parallel and equally spaced in a region of uniform electric field.
3. In a parallel plate capacitor, the capacitance increases from $4\mu\text{F}$ to $80\mu\text{F}$ on introducing a dielectric medium between the plates. What is the dielectric constant of the medium?
 - (a) 10
 - (b) 20
 - (c) 50
 - (d) 100

4. If a unit positive charge is taken from one point to another over an equipotential surface, then

- (a) Work is done on the charge. (b) Work is done by the charge.
(c) Work done is constant. (d) No work is done

5. Nichrome or Manganin is widely used in wire bound resistors because of their

- (a) Temperature independent resistivity
(b) Very weak temperature dependent resistivity
(c) Strong dependence of resistivity with temperature
(d) Mechanical strength

6. Two conducting wires X and Y of same diameter but different materials are joined in series across a battery. If the number density of electron in X is twice that in Y, find the ratio of drift velocity of electrons in two wires is

- (a)1:2 (b)1:1 (c)2:1 (d)3:2

7. A circular coil of wire n turns has a radius r and carries a current I . Its magnetic dipole moment is M . Now the coil is unwound and again rewound into a circular coil of half the initial radius and the same current is passed through it, then the dipole moment of this new coil is

- (a) $M/2$ (b) $M/4$ (c) M (d) $2M$

8. A capacitor has capacitance C and reactance X , If the capacitance and frequency become double, then reactance will be

- (a) $4X$ (b) $X/2$ (c) $X/4$ (d) $2X$

9. In a series LCR Series circuit, the voltages across Inductor, capacitor and Resistances are $20V, 20V$ and $40V$ respectively. The phase difference between the supplied voltage and current in the circuit is

- (a) 30° (b) 60° (c) 90° (d) 0°

10. What is the use of rays lying beyond X ray region in electromagnetic spectrum

- (a) Used to kill microbes
(b) Used to detect heat loss in insulated systems
(c) Used in standard broadcast radio and television
(d) Used In oncology, to kill cancerous

11. The electric field associated with an e.m wave in vacuum is given by

$E = 40 \cos (kz - 6 \times 10^8 t)$, where E, Z and t are in volt/m, metre and seconds respectively. The value of wave vector K is

(a) 2 m^{-1} (b) 0.5 m^{-1} (c) 6 m^{-1} (d) 3 m^{-1}

12. A force between two protons is same as the force between proton and neutron. The nature of the force is

(a) electrical force

(b) weak nuclear force

(c) gravitational force

(d) strong nuclear force

13. What are the processes that occur during formation of a p-n junction?

a) drift

b) diffusion

c) both (a) and (b)

d) None of these

14. The forbidden energy band gap in conductors, semiconductors and insulators are E_{G1} , E_{G2} and E_{G3} respectively. The relation among them is

(a) $E_{G1} = E_{G2} = E_{G3}$

(b) $E_{G1} < E_{G2} < E_{G3}$

(c) $E_{G1} > E_{G2} > E_{G3}$

(d) $E_{G1} < E_{G2} > E_{G3}$

15. Which of the following is true about photodiode?

(a) $E > hv$

(b) $E = hv$

(c) $E < hv$

(d) None of these

Q.No 16 to 18 contain statements one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

a) Both A and R are true and R is the correct explanation of A

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

16. **Assertion (A):** Isobars are the elements having same mass number but different atomic number.

Reason (R): Neutrons and protons are present inside nucleus.

17. **Assertion (A):** The electromagnetic wave is transverse in nature.

Reason (R): Electromagnetic wave propagates parallel to the direction of electric and magnetic fields.

18. **Assertion (A) :** Ohm's law is universally applicable for all conducting elements.

Reason (R) : All conducting elements show straight line graphic variation on (I–V) plot.

SECTION B

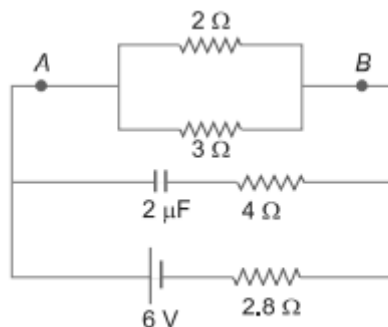
19. a) A charged metallic sphere A having charge q_A is brought in contact with an uncharged metallic sphere of same radius and then separated by a distance. What is the electrostatic force between them?

b) What is the ratio of electric field intensity at a point on the equatorial line to the field at a point on axial line when the points are at the same distance from the centre of the dipole?

20. a) A parallel plate capacitor C_1 having charge Q is connected, to an identical uncharged capacitor C_2 in series. What would be the charge accumulated on the capacitor C_2 ?

(b) Three identical capacitors each of capacitance $3 \mu\text{F}$ are connected, in turn, in series and in parallel combination to the common source of V volt. Find out the ratio of the energies stored in two configurations.

21. Calculate the steady current through the 2Ω resistor in the circuit shown below



22. Draw the magnetic field lines for a current carrying solenoid when a rod made of (a) copper, (b) aluminium and (c) iron are inserted within the solenoid

(OR)

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

Calculate

- (a) the number of turns in the secondary coil.
- (b) the current in the primary coil.
- (c) the voltage across the secondary coil.

23. (i) Arrange the following electromagnetic waves in the descending order of their wavelengths.

- (a) Microwaves (b) Infrared rays (c) Ultraviolet radiation (d) g-rays
- (ii) Write one use each of any two of them

24. a) Write two characteristic features of nuclear force which distinguish it from Coulomb's force.

b) Why do stable nuclei never have more protons than neutrons?

25. For an extrinsic semiconductor, indicate on the energy band diagram of the donor and acceptor levels?

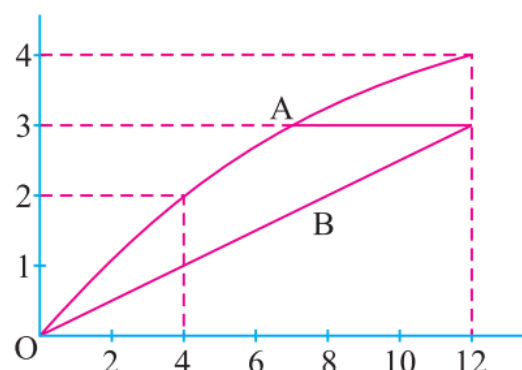
SECTION C

26. Using Gauss's theorem in electrostatics, deduce an expression for electric field intensity due to a charged spherical shell at a point (i) inside (ii) on its surface (iii) outside it. Graphically show the variation of electric field intensity with distance from the centre of shell.

27. The graph A and B shows how the current varies with applied potential difference across a filament lamp and nichrome wire respectively. Using the graph, find the ratio of the values of the resistance of filament lamp to the nichrome wire

(i) when potential difference across them is 12 V.

(ii) when potential difference across them is 4V. Give reason for the change in ratio of resistance in (i) and (ii).



28. An a.c. source generating a voltage $\varepsilon = \varepsilon_0 \sin \omega t$ is connected to a capacitor of capacitance C. Find the expression for the current I flowing through it. Plot a graph of ε and I versus t to show that the current is ahead of the voltage by $\pi/2$.

(OR)

A bar magnet of magnetic moment 1.5 JT^{-1} lies aligned with the direction of a uniform magnetic field of 0.22 T .

(a) What is the amount of work required by an external torque to turn the magnet so as to align its magnetic moment

(i) normal to the field direction? and

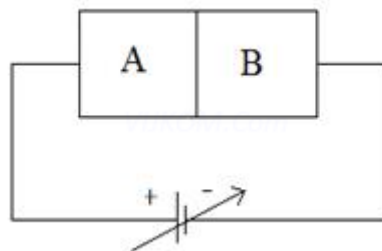
(ii) opposite to the field direction?

(b) What is the torque on the magnet in cases (i) and (ii)?

29. Draw a graph showing the variation of potential energy between a pair of nucleons as a function of their separation. Indicate the regions in which the nuclear force is (i) attractive, (ii) repulsive.

Write three important conclusions which you can draw regarding the nature of the nuclear forces.

30. Two semiconductor materials A and B shown in the figure are made by doping germanium crystal with arsenic and indium respectively. The two are joined end to end and connected to a battery as shown.



(a) Will the junction be forward biased or reverse biased? Justify

(b) Sketch a V-I graph for this arrangement and give the significance

SECTION D

31. (a) Draw equipotential surfaces for (i) an electric dipole and (ii) two identical negative charges placed near each other.

(b) In a parallel plate capacitor with air between the plates, each plate has an area of $6 \times 10^{-3} \text{ m}^2$ and the separation between the plates is 3 mm .

(i) Calculate the capacitance of the capacitor.

(ii) If the capacitor is connected to 100 V supply, what would be the charge on each plate?

(iii) How would charge on the plate be affected if a 3 mm thick mica sheet of $k=6$ is inserted between the plates while the voltage supply remains connected ?.

(OR)

(a) Three charges $-q$, Q and $-q$ are placed at equal distances on a straight line. If the potential energy of the system of these charges is zero, then what is the ratio $q:Q$?

(b)(i) Obtain the expression for the electric field intensity due to a uniformly charged sheet at a point distant r from the sheet.

(ii) Draw a graph showing the variation of electric field intensity E with r .

32. (a) Explain the term drift velocity of electrons in a conductor. Hence obtain the expression for the current through a conductor in terms of drift velocity.

(b) Derive the equation of the balanced state in a Wheatstone bridge using Kirchhoff's laws.

(OR)

(a) A power transmission line feeds input power at 2200 V to a step-down transformer with its primary windings having 3000 turns. Find the number of turns in the secondary to get the power output at 220 V.

(b) A step-up transformer converts a low voltage into high voltage. Does it not violate the principle of conservation of energy? Explain.

(c) Draw a labeled diagram of a step up transformer and state the principle of operation. Write any two sources of energy loss in a transformer.

33. (a) What is p-n junction diode?

(b) Define the term dynamic resistance for the junction. With the help of labelled diagram, explain the working of p-n junction as a full wave rectifier.

(OR)

a) What is meant by nuclear fission and fusion. Draw Binding Energy Vs Mass Number curve and explain four important features of this curve.

b) Find the binding energy and binding energy per nucleon (in MeV) of nucleus ${}_{83}\text{Bi}^{208}$. Given: mass of proton = 1.0078254 u. mass of neutron = 1.008665 u. Mass of ${}_{83}\text{Bi}^{208} = 208.980388\text{u}$.

SECTION E

34. P-N junction is a semiconductor diode. It is obtained by bringing p-type semiconductor in closecontact with n- type semiconductor. A thin layer is developed at the p-n junction which is devoid of any charge carrier but has immobile ions. It is called depletion layer. At the junction apotential barrier appears, which does not allow the movement of majority charge carriers across the junction in the absence of any biasing of the junction. p-n junction offers low resistance when forward biased and high resistance when reverse biased.

- i) Does current flow when diode is reverse biased?
- ii) What is meant by reverse bias?
- iii) What is the value of electric current in the middle of the depletion layer of reverse biased p-n junction? why?
- iv) Explain how a potential barrier is developed in a p-n junction diode.

35. By analogy to Gauss's law of electrostatics, we can write Gauss's law of magnetism as $\int \mathbf{B} \cdot d\mathbf{s} = 0$. We do not have an isolated magnetic pole in nature. At least none has been found to exist till date. The smallest unit of source of magnetic field is a magnetic dipole where the net magnetic pole is zero. Hence, the net magnetic pole enclosed by any closed surface is always zero. Correspondingly, the flux of the magnetic field through any close surface is zero

- i) Magnetic lines of force always forms closed loops. Comment.
- ii) A certain region is to be shielded from magnetic fields. Suggest a method.
- iii) State any two properties of magnetic field lines.
- iv) Write the Dimensional formula for Magnetic field and permeability of free space