2018

PHYSICS

(Theory)

Full Marks : 70

Pass Marks : 21

Time: Three hours

Attempt all questions.

The figures in the right margin indicate full marks for the questions.

*Question Nos. 1 to 10, are "Very Short Answer" type questions carrying 1 mark each.*

1. Draw electric field lines due to a positive charge.   1

2. State Faraday's laws of electromagnetic induction.   1

3. The instantaneous value of an alternating voltage in volts is given by
    $E = 311 \sin\left(100\pi t + \dfrac{\pi}{6}\right)$. Find the frequency of the supply voltage.   1

4. A voltage supply of 220V is fed to a step down transformer with its primary windings having 400 turns. What should be the number of turns in the secondary windings in order to get an output of 11 V.   1

5. Express the velocity of propagation of an electromagnetic wave in terms of the peak values of the electric and magnetic field.   1

6. What is the shape of the wavefront   1

    (a) near a point source of light

    (b) due to a distant light source.

7. A Photon of energy 4.8×10^{-19}J is incident on a caesium plate of work function 2·14ev. What will be the maximum kinetic energy of the emitted electron $\left(1eV = 1.16 \times 10^{-19}J\right)$.　　　　1

8. The base current and collector current of a transistor are respectively 40μ A and 2·4mA. Find the value of β.　　　　1

9. A TV tower has a height of 180m. Estimate the distance from the tower upto which TV signals can be received (Radius of the Earth $= 6400$ km).　　　　1

10. Why cannot television wave of 60MHz be transmitted via sky wave propagation.　　　　1

Question Nos. 11 to 20 are 'Short Answer Type-II' questions carrying 2 marks each.

11. Calculate the area of the plates needed to have a capacitance C=1 farad due to a parallel plate capacitor having plates separated by 1cm with air as di-electric $\left(\epsilon_0 = 8 \cdot 85 \times 10^{-12} C^2 N^{-1} m^{-2}\right)$.　　　　2

12. Define resistivity of the material of a conductor. Give its SI unit.　　　　2

13. A network of resistors is connected to a 16V battery as shown in the figure　　2
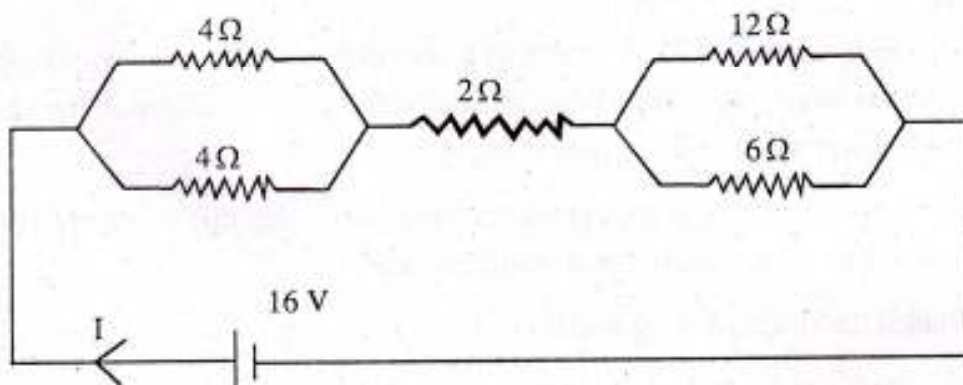
Calculate the current I drawn from the battery.

14. State Lenz's law. Give one example to illustrate this law. 2

15. Arrange the following electromagnetic waves in descending order of their frequencies

    (i) Micro waves

    (ii) γ-rays

    (iii) Radio-waves

    (iv) X-rays.

    (Write one use each of any two of them.) 2

16. What is total internal reflection ? Explain why diamonds have spectacular brilliance ? 2

17. The refractive index of a medium is $\sqrt{3}$. Calculate the angle of refraction for a ray of light in air incident on the medium at polarising angle. 2

18. Two monochromatic radiations of frequencies V_1 and V_2 $(V_1 > V_2)$ having the same intensity are in turn incident on a photo sensitive surface causing photoelectric emission. Curve A and B show the variations of photo electric current with accelerating potentials.

    2
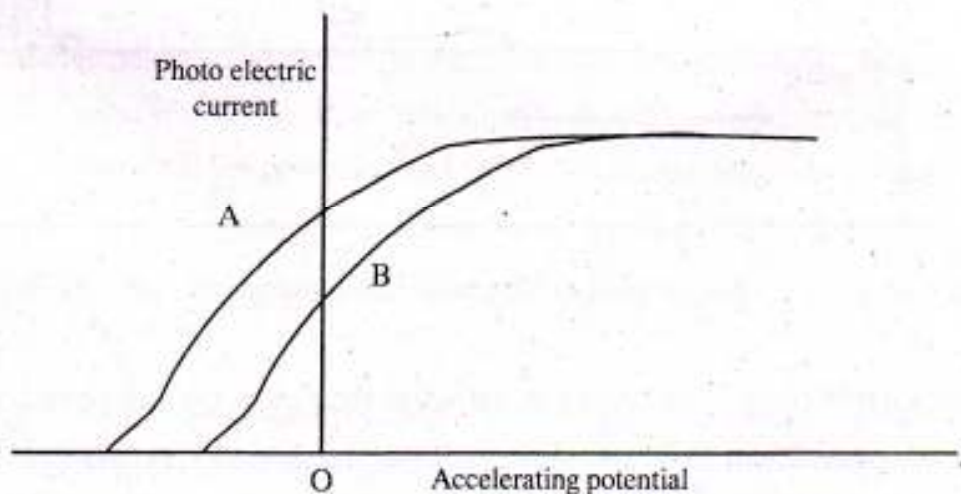
    Identify the curve representing the radiation having frequency υ_1 giving reason.

19. Calculate the binding energy of an alpha particle from the following data

   Mass of proton = 1·007825 amu

   Mass of neutron = 1·008665 amu

   Mass of helium nucleus = 4·002800 amu

   (Take 1 amu = 931·5 MeV)   2
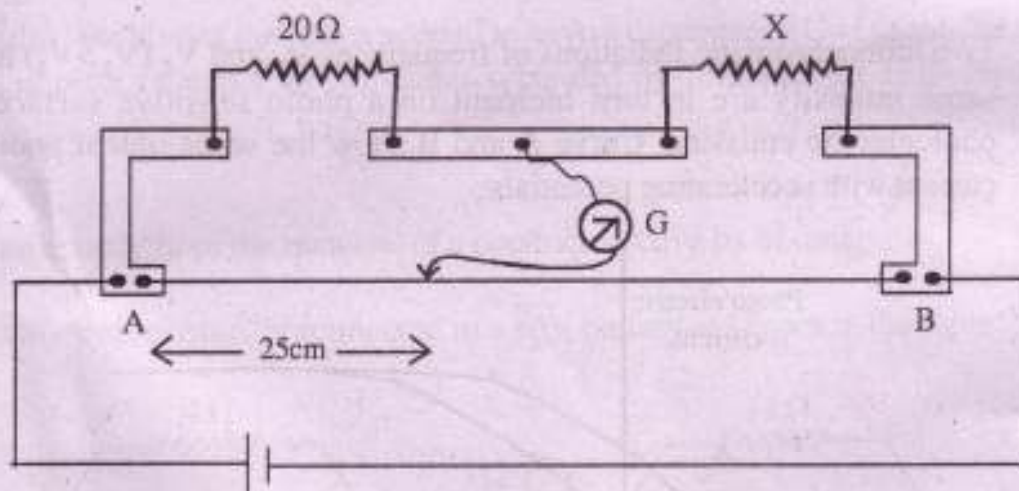
20. Draw the symbolic diagram each of two inputs OR gate and NOT gate.   2

   *Question Nos. 21 to 27 are 'Short Answer Type-I' questions carrying 3 marks each.*

21.

   In a metre bridge experiment, as shown in the figure, the null point is found at a distance 25cm from the point A. Find the value of the resistance X. At what distance from A will the null point be if the two resistances are interchanged.

                                                               3

22. A rectangular loop of wire ABCD of size $2 \cdot 5 \, cm \times 4cm$ carries a steady current 1A. A fixed long straight wire carrying a current 2A is placed in the same plane as the loop of wire at a distance 2cm from the side AB of the loop

Find the force on the loop

$\left(\dfrac{\mu_0}{4\pi} = 10^{-7} \, TmA^{-1} \right)$

I=2A

B   C

1A   1A 4cm

←2cm→

A   D

←— 2.5cm —→

3
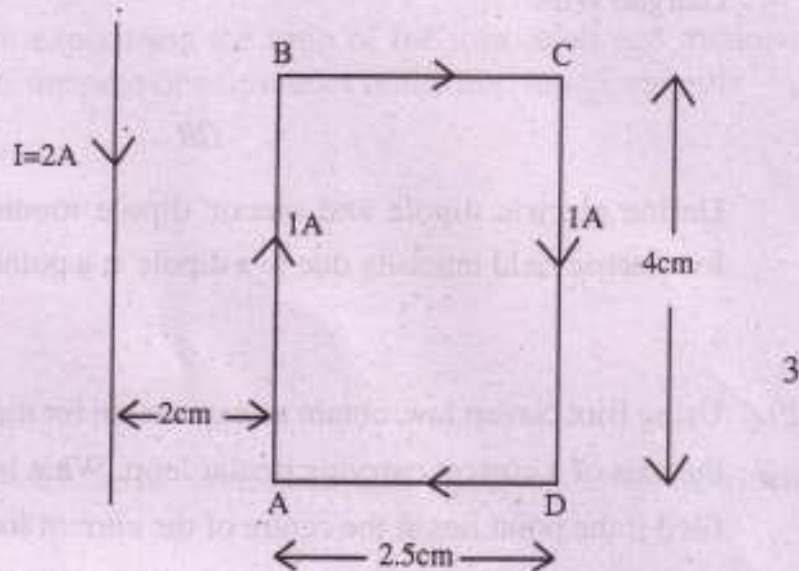
23. Draw an a.c. circuit having inductance only. Draw the variation of voltage and current with time. $1\frac{1}{2} + 1\frac{1}{2} = 3$

24. A person can see nearby objects clearly but cannot see objects clearly beyond 50cm from his eyes. What is the defect of vision for the person and what type of lens he should use. Find the power of lens to be used by the person to correct this defect.   1+2=3

25. Derive radio-active decay equation and hence define half life of a radio-active substance.   3

26. Explain briefly how a p–n junction diode can be designed to use as a photo-diode, light emitting diode and solar cell.   3

27. Describe briefly ground wave, sky wave and space wave propagations.   3

Question Nos. 28 to 30 are 'Long Answer Type' questions carrying 5 marks each.

28. Define electric flux. State Gauss's theorem in electrostatics and derive the expression for electric field intensity at a point due to an Infinitely Long Straight charged Wire.

$$1+1+3=5$$

OR

Define electric dipole and electic dipole moment. Derive the expression for electric field intensity due to a dipole at a point on its equatorial line.

$$1+1+3=5$$

29. Using Biot-Savart law, obtain an expression for the magnetic field at a point on the axis of a current carryig circular loop. What is the expression of magnetic filed if the point lies at the centre of the current loop?

$$4+1=5$$

OR

State Ampere circuital law. Using this law obtain an expression for the magnetic field due to a current carrying long Solenoid.

$$1+4=5$$

30. Derive the expression $\dfrac{\mu_2}{V}-\dfrac{\mu_1}{U}=\dfrac{\mu_2-\mu_1}{R}$ when refraction occures from rarer to denser medium at a convex spherical refracting surface. The symbols have their usual meanings.

5

OR

In Young's double slit experiment using a monochromatic light, prove that the distance between two consecutive bringes fringes is equal to the distance between two consecutive dark fringes.

5

Question Nos. *31 to 34* are *'Multiple Choice Type'* questions carrying *1 mark* each. Choose the correct answer out of the four alternatives and rewrite the correct answer.

31. In Young's double slit experiment the ratio of the maximum and minimum intensities is 36:1, then the ratio of amplitudes of the interfering waves is   1

    A.   9:1

    B.   6:1

    C.   7:5

    D.   3:7.

32. If an electron and a proton have the same de Broglie wavelength,then the kinetic energy of the electron is   1

    A.   zero

    B.   less than that of proton

    C.   more than that of proton

    D.   equal to that of proton

33. The half life of radon is 3·8 days. The time at the end of which $\left(\dfrac{1}{32}\right)^{th}$ of the radon sample will remain undecayed is   1

    A.   7·6 days

    B.   19 days

    C.   15·2 days

    D.   38 days.

34. The combination of gates given in the figure below
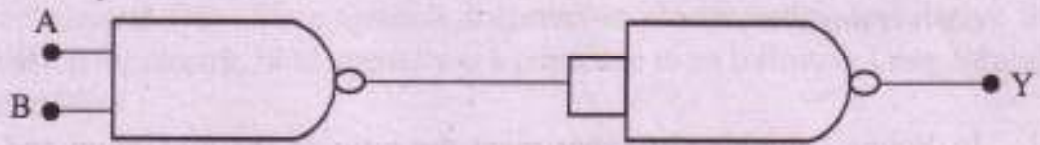
gives 1

A. NOR gate

B. OR gate

C. AND gate

D. NAND gate.

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