

**2019  
PHYSICS**

Total marks : 70

Time : 3 hours

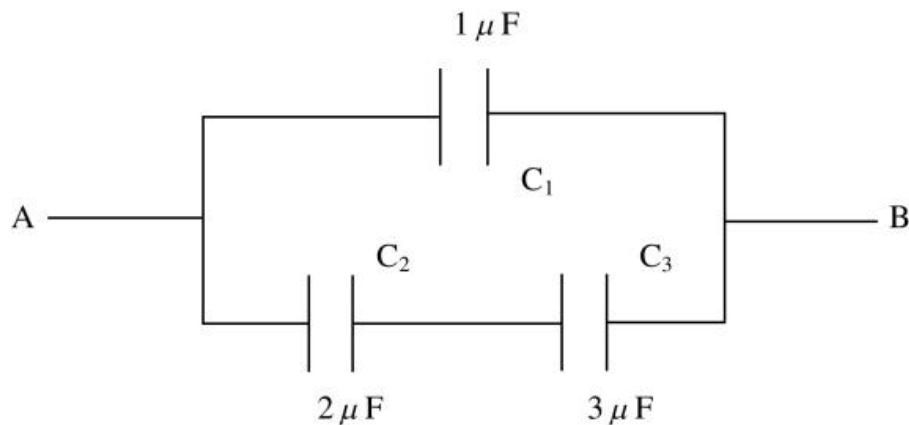
**General instructions:**

- i) *Approximately 15 minutes is allotted to read the question paper and revise the answers.*
- ii) *The question paper consists of 30 questions. All questions are compulsory.*
- iii) *Marks are indicated against each question.*
- iv) *Internal choice has been provided in some questions.*

**N.B:** *Check that all pages of the question paper is complete as indicated on the top left side.*

1. A charge  $q$  is enclosed by a Gaussian spherical surface of radius  $R$ . If the radius is doubled, then the outward electric flux will **1**
  - (a) be doubled
  - (b) increase four times
  - (c) be reduced to half
  - (d) remain the same
  
2. If an ammeter is to be used in place of a voltmeter, then you must connect with the ammeter of a **1**
  - (a) low resistance in parallel
  - (b) high resistance in parallel
  - (c) high resistance in series
  - (d) low resistance in series.
  
3. A circuit has a resistance of  $12\Omega$  and an impedance of  $15\Omega$ . The power factor of the circuit will be **1**
  - (a) 0.8
  - (b) 0.4
  - (c) 1.25
  - (d) 0.125
  
4. The stopping potential doubles when the frequency of the incident light changes from  $\nu$  to  $\frac{3}{2}\nu$ . The work function of the metal must be **1**
  - (a)  $\frac{1}{2}h\nu$
  - (b)  $h\nu$
  - (c)  $2h\nu$
  - (d) none of these.
  
5. The mobile telephones operate typically in the range of **1**
  - (a) 100 – 200 MHz
  - (b) 800 – 950 MHz
  - (c) 1000 – 2000 MHz
  - (d) 88 – 108 MHz.
  
6. Name any one application of electrical resonance phenomena. **1**

- 7. What is the source of an electromagnetic wave? 1
- 8. State Huygen's principle of diffraction of light. 1
- 9. Two nuclei have mass numbers in the ratio 1:8. What is the ratio of their nuclear radii? 1
- 10. What is Global Positioning System? 1
- 11. State Coulomb's law of electrostatic. Show that the electrostatic forces between two static charges separated by a distance follow Newton's third law of motion. 2
- 12. **a.** Two charges of + 5nC and -2nC are placed at points (5cm, 0,0) and (23cm, 0,0) in a region of space where there is no other external electric field. Calculate potential energy of this charge system. 2  
**Or**  
**b.** Three capacitors are connected as shown in the following figure. Calculate the resultant capacitance. If the combination is connected across a 30V DC battery, find the total charge drawn by the arrangement.



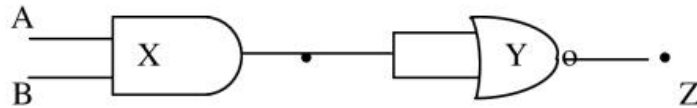
- 13. Derive an expression for the resistivity of a conductor in terms of number density of free electrons and relaxation time. 2
- 14. Deduce an expression for the magnetic dipole moment of an electron orbiting around the central nucleus. 2
- 15. **a.** What are electromagnetic waves? Write the equations for associated electric and magnetic fields clearly mentioning their directions. 2  
**Or**  
**b.** Write any four properties of electromagnetic waves.

16. a. Draw the graph showing the variation of current with voltage for a p-n junction diode, when the diode is (i) forward biased and (ii) reverse biased.

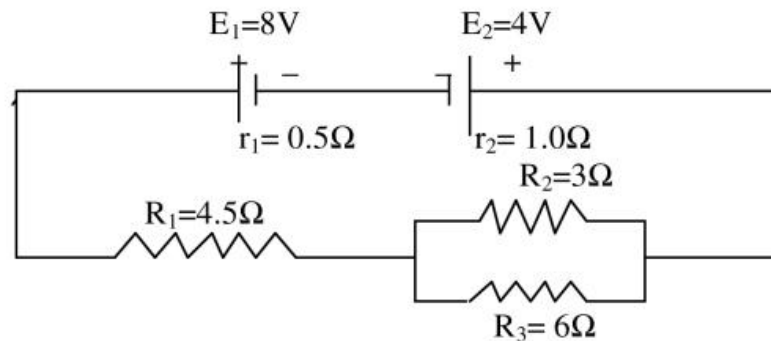
Or

2

- b. Identify the logic gates X and Y in the following figure. Write down the truth table for output Z for all possible inputs A and B.



17. Prove that total electrostatic potential energy stored in a capacitor is  $\frac{1}{2}CV^2$ . Hence, derive an expression for the energy density of an electric field. 3
18. Draw a circuit diagram of a Wheatstone bridge. Using Kirchhoff's rules, obtain the balance condition for the network. 3
19. a. In the arrangement of cells and resistors shown in the figure, calculate the current in each resistor.



Or

3

- b. A heater coil is rated 100W, 200V. It is cut into two identical parts. Both parts are connected together in parallel to the same source of 200V. Calculate the energy liberated per second in the new combination.
20. A rectangular coil of 500 turns, each of area  $200\text{cm}^2$ , rotates in a uniform magnetic field of  $0.28\text{ Wbm}^{-2}$ . The rotation axis of the coil is perpendicular to the field and frequency of rotation is 50 cps. Calculate the peak emf induced between the ends of the coil. If the coil has a resistance of  $24\Omega$ , what is the peak current flowing in the circuit? 3

21. **a.** A metallic rod of length  $l$  is rotated at constant angular speed  $\omega$  normal to a uniform magnetic field  $B$ . Derive an expression for the emf induced in the rod. **3**
- Or**
- b.** Define the term 'rms value of an AC'. Obtain a relation between the rms value and the peak value of AC. **3**
22. A ray of light is incident on one face of a prism and emerges out from the other face. Draw a ray diagram and derive an expression for refractive index of the material of the prism. **3**
23. In a Young's double slit interference experiment, the ratio of intensity at the maxima and minima in the interference pattern is  $\frac{25}{9}$ . What will be the ratio of amplitudes of light emitted by the two slits? **3**
24. **a.** What is photo electric effect? State the laws of photo-electric emission. **3**
- Or**
- b.** Show that de-Broglie wavelength of electron when accelerated through a potential difference  $V$  is given by the relation -  

$$\lambda = \frac{12.27}{\sqrt{V}} \text{ \AA}, \text{ where } V \text{ is in volt.}$$
25. Calculate the wavelength of first spectral line of Balmer series for hydrogen. Given that Rydberg constant,  $R = 1.097 \times 10^7 \text{ m}^{-1}$  **3**
26. **a.** Derive an expression for the total energy of an electron in any orbit of a hydrogen atom in accordance with Bohr's atomic model. **3**
- Or**
- b.** State the radio-active decay law. Deduce the relation  $N = N_0 e^{-\lambda t}$ , where the symbols have their usual meanings
27. Explain any two factors which justify the need for modulating a signal. **3**
28. **a.** State Biot-Savart law. Use this law to obtain the expression for the magnetic field on the axis of a circular current loop. **5**
- Or**
- b.** With the help of a diagram, explain the principle and working of a cyclotron. Show that cyclotron frequency does not depend on the speed of the particles.

29. a. Derive the lens maker's formula for a thin double convex lens. Why is it called so?

**Or**

**5**

- b. Draw a neat ray diagram to show the image formation in a compound microscope. Define its magnifying power and derive an expression for it, when the final image is at near point of eye.

30. a. State the principle of working of p-n diode as a rectifier. With the help of circuit diagram, explain the use of p-n junction diodes as a full wave rectifier. Draw input and output wave forms.

**Or**

**5**

- b. Explain with the help of a labelled circuit diagram, how an n-p-n transistor can be used as an amplifier in common emitter configuration. Also, explain how input and output voltages are out of phase by  $180^\circ$  for a common emitter transistor amplifier.

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