AKR/48/16

2016-17

PHYSICS

SECOND PAPER

Full Marks : 200

Time : 3 hours

The figures in the margin indicate full marks for the questions

GROUP—A

Answer any *four* questions from the following :

1. *(a)* State and establish Gauss theorem in electrostatics. Derive an expression for the energy stored in an electric field. 2+4+4=10

   (b) Establish Coulomb's law using Gauss theorem. Find the field due to two concentric charged spherical conductors. 5+5=10

2. *(a)* How can dielectric constant be determined in the form of a solid slab? 10

   (b) Describe the attracted disc electrometer to determine unknown potential difference. 10

3. *(a)* Derive the expressions for the force and torque on a current loop in a uniform magnetic field. 10

(b) What is magnetic shell? Find an expression for the potential at a point due to a thin magnetic shell. 2+8=10

4. *(a)* What is hysteresis loop? How are the values of remanence and coercivity determined from such a loop? 2+8=10

(b) Define magnetic permeability and susceptibility. Obtain a relation between them. Discuss in an elementary manner, the atomic origins of dia-, para- and ferromagnetism. 5+5=10

5. *(a)* What are Peltier effect and Thomson effect? How would you demonstrate experimentally Peltier and Thomson effects? 2+8=10

(b) What is thermoelectric power? Prove that the Peltier coefficient for a pair of metals is product of the absolute temperature and the thermoelectric power. 2+8=10

(Continued)

6. *(a)* Describe the necessary theory, construction and working of a Helmholtz galvanometer. 10

(b) Distinguish between mean value and root-mean-square value of an alternating current. Derive an expression for the r.m.s. value of alternating current. 4+6=10

Answer any *three* questions from the following :

7. Define coefficient of self-induction of a coil. Deduce a mathematical expression for the self-induction of a solenoid. 2+6=8

8. What is resonance in an LCR series circuit? Find an expression for the resonance frequency. What is the value of impedance at resonance? 2+6=8

9. State Kirchhoff's law of current in an electrical network. Deduce the condition of a balanced Wheatstone bridge applying Kirchhoff's law. 2+6=8

10. Discuss the working principle of a simple d.c. motor and find its efficiency. 8

11. Explain the reason of designing transformers with laminated insulated slabs of materials (metals) instead of solid metals. Prove it mathematically. 8

GROUP—B

Answer any *four* questions from the following :

12. *(a)* Describe the Millikan's method of finding the electron charge. Why is oil used in drop? 8+2=10

(b) How can the unknown mass of a charged particle be determined by Bainbridge mass spectrograph? 10

13. *(a)* Explain the emission of continuous X-ray spectrum. 10

(b) What is the difference between continuous and characteristic X-ray spectrums? Explain how the characteristic X-ray spectrum depends upon the nature of target material. 3+7=10

14. *(a)* What do you understand by mass defect and binding energy of a nucleus? Draw a curve showing the variation of binding energy per nucleon. 6+4=10

(Continued)

(b) What is radioisotope? Write its applications. Half-life of Na is 15 hours. How long does it take for 87·5% of the isotope to decay? 6+4=10

15. (a) Explain with circuit diagram, triode as an amplifier and find the expression for voltage gain. 10

(b) What is radio broadcasting? How does radio station work? 10

16. (a) Explain how Bohr's theory accounts for the observed spectrum of hydrogen. 10

(b) Write a short note on G. M. Counter. 10

17. (a) Derive the expression for total energy of an electron revolving around the nucleons of hydrogen atom. 10

(b) Discuss the neutrino theory of β-dacay. How does it explain the continuous energy spectrum of β-decay? 10

Answer any *two* questions from the following :

18. Define thermoionic emission and work function. Write Richardson's equation. What is the conclusion that can be drawn from this equation? 4+4=8

19. Distinguish between nuclear fission and nuclear fusion. Explain the principle for the construction of atomic reactor. 4+4=8

20. What is cosmic ray shower? How are cosmic rays affected by latitude and altitude? 4+4=8

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