May 2017

APPLIED PHYSICS

Time Allowed: 2 Hours *Full Marks: 35*

Answer to Question No.1 is compulsory and to be answered first.
This answer is to be made in separate loose script(s) provided for the purpose.
Maximum time allowed is 30 minutes, after which the loose answer scripts will be collected and fresh answer scripts for answering the remaining part of the question will be provided.
On early submission of answer scripts of Question No.1,
a student will get the remaining script earlier.
Answer questions from Group-A & B, as directed.

1. Answer the following questions: 10x1

i) A particle is moving along a straight path with constant acceleration of 4.0 m/s^2. If the initial velocity of the particle be 20 m/s, the distance travelled by it in the 5^{th} second is – (a) 150 m, (b) 40 m, (c) 38 m, (d) none of these.

ii) Impulse of a force acting on a body is equal to – (a) Change in momentum of the body, (b) rate of change of momentum of the body, (c) change in kinetic energy of the body, (d) none of these.

iii) A body of mass 4.0 kg is hanged at the lower end of a spring balance whose upper end is fixed at the ceiling of a lift. If the lift moves up with an acceleration of 6.0 m/s^2, the reading of the spring balance is (Take $g = 9.8\ m/s^2$) – (a) 15.2 N, (b) 24.0 N, (c) 39.2 N, (d) 63.2 N.

iv) Which of the following remains constant for a particle executing uniform circular motion? – (a) Linear speed, (b) Linear velocity, (c) Linear acceleration, (d) None of these.

v) A vehicle of mass 1000 kg is moving on a rough horizontal road with a constant velocity of 40 m/s. If the frictional force be 200 N, the power delivered by the engine of the vehicle is – (a) 2.0×10^5 W, (b) 4.0×10^4 W, (c) 8.0×10^3 W, (d) 5.0×10^3 W.

vi) The ratio of resistances of two bulbs of powers 40 W and 60 W, designed to operate at 110 V and 220 V respectively, is – (a) 3:8, (b) 3:4, (c) 3:2, (d) 3:1.

vii) A straight conductor of length 50 cm is placed in a uniform magnetic field of 1.5 T with its length parallel to the direction of the field. If the current through the conductor be 1.0 A, the force on the conductor is – (a) 0.75 N, (b) 7.5 N, (c) 75.0 N, (d) zero.

viii) The SI unit of magnetic flux density is – (a) tesla, (b) oersted, (c) gauss, (d) none of these.

ix) If a very small amount of boron is added to a pure germanium crystal at room temperature, it becomes – (a) an n-type semiconductor, (b) a p-type semiconductor, (c) an insulator, (d) a good conductor.

x) Which of the following statement is true? – (a) Frequency of X-rays is slightly less than that of visible light, (b) Frequency of X-rays is much less than that of visible light, (c) Frequency of X-rays is greater than that of visible light, (d) Frequency of X-rays is equal to that of visible light.

Group-A

Answer any three questions.

2. a) A particle is moving along a straight path with uniform acceleration a. Its initial velocity is u and final velocity after time t is v. Write down the relation between u, v, a and t and draw the v-t curve.
b) Define unit of force from Newton's second law.
c) A constant force of 6.0 N acts on a body for 4.0 seconds. Draw the force vs time graph and calculate the change in momentum of the body from the graph. 2+1+2

3. a) Define centripetal force. Write down its formula.
   b) Define the terms angular momentum and moment of a force (torque). Write down the relation between them. State the principle of conservation of angular momentum. 2+3

4. a) Derive the expression for kinetic energy of an object of mass m moving along a straight path with speed V.
   b) An electric pump can lift 600 litre of water from a depth of 10 m to a height of 30 m above the ground in 5 minutes. If the power of the pump be 1.2 hp, calculate its efficiency. (Given $g = 10\ m/s^2$). 2+3

5. a) What is a non-ohomic conductor? Give an example of it.
   b) The resistance of a 20 mV voltmeter is 1000 ohm. How can you convert this voltmeter into an ammeter which can measure up to 2.0 A. Draw the necessary circuit diagram. 2+3

6. a) Write down the expression of the thermo-emf (E) developed in a thermocouple in terms of the temperature difference (θ) between its junctions. Draw E vs θ curve and show the positions of neutral temperature and inversion temperature.
   b) Write down two important differences between Joule effect and Peltier effect. 3+2

Group-B

Answer any two questions.

7. a) State Biot-Savart's law for the magnetic field due to a small current element.
   b) Write down the expression for the magnetic field developed inside a long solenoid carrying a current.
   c) Which rule gives the direction of the force on a current carrying conductor when placed in a magnetic field? State it. 2+1+2

8. a) State the laws of electromagnetic induction.
   b) Define coefficient of mutual inductance of a pair of coils. Write down its SI unit. 3+2

9. a) Draw the necessary circuit diagram for studying the forward bias characteristic curve of a p-n junction diode. Also draw the characteristic curve.
   b) Write down two important differences between n-type and p-type semiconductor. 3+2

10. a) Write down two important applications of X-rays.
    b) Write short notes on – (i) spontaneous emission, and (ii) stimulated emission. 2+3