Dec 2002

GENERAL ENGINEERING SCIENCE II

Attempt ALL questions

Marks for each part question are shown in brackets

1. During a heat treatment process, a steel connecting rod of mass 20 kg is cooled from 600°C to 70°C by immersion in a tank of quenching oil. In cooling the rod, the oil temperature increases by 50°C.

   Calculate the mass of oil in the tank. (10)

   Note: Specific Heat Capacities: Quenching oil: 1.9kJ/kg K
   Steel: 0.49kJ/kg K

2. An engine cylinder has a volume of 2.3 m^3 and contains gas at a pressure of 1.55 bar and a temperature of 20°C.

   Calculate the mass of the gas in the cylinder. (6)

   Note: R for the gas = 0.256kJ/kgK

3. *(a)* State what is meant by *combustion.* (1)

   (b) List THREE conditions necessary for combustion to occur. (3)

   (c) Calculate the mass of air needed to completely burn EACH of the following:

   (i) 0.8 kg Carbon; (3)
   (ii) 0.15 kg Hydrogen. (3)

   Note: Relative atomic masses: Oxygen 16; Hydrogen 1; Carbon 12. Air contains 23% oxygen by mass.

4. The following results were obtained during an engine trial on a single acting, single cylinder two stroke engine:

Bore	150 mm
Stroke	200 mm
Engine speed	220 RPM
Indicator diagram mean height	11.5 mm
Engine indicator spring rating	50kN/m^2 per mm

   Calculate EACH of the following:

   (a) the indicated mean effective pressure; (2)

   (b) the indicated power. (6)

5. *(a)* State the meaning of EACH of the following terms:

(i) *Sensible heat;* (2)
(ii) *Enthalpy of evaporation/fusion.* (2)

(b) A mass of 5 kg of ice at 0°C is heated until it is converted into liquid at 10°C.

Calculate the heat energy required to produce this change. (6)

Note: Specific heat capacity of water is 4.19kJ/kgK

The enthalpy of fusion for water is 330kJ/kgK.

6. State SIX desirable properties of a refrigerant fluid. (6)

7. A 5.8 ohm resistor is connected in series with a 4.1 ohm resistor across a battery of electromotive force 12 volts and internal resistance of 0.1 ohm.

(a) Sketch the circuit diagram. (4)

(b) Calculate the current which flows in the circuit, (4)

8. The resistance of a coil of wire at the start of a heat test is 300 Ω. when its temperature is 20°C. At the completion of the test the resistance is 340 Ω.

Calculate the temperature of the coil at the completion of the test. (10)

Note: The temperature coefficient of resistance of the wire at 0°C (a_0) is 0.005 Ω/Ω/°C.

9. *(a)* With reference to an electric cell, explain the term *internal resistance*, stating the effect it has on the terminal voltage of the cell. (5)

(b) The e.m.f. of a cell is 1.5 V and its terminal voltage is 1.3 V when a current of 0.7 A is flowing.

Calculate the internal resistance of the cell. (5)

10. *(a)* State the meaning of the term *magnetic flux.* (2)

(b) An electric conductor of length 45m is moved at a velocity of 9m/s at 90° to a uniform magnetic field. An e.m.f. of 0.12 V is induced in the conductor.

Calculate the density of the magnetic field. (4)

11. *(a)* Describe, with the aid of a sketch, how torque is produced on the armature of a d.c. motor. (6)

(b) Explain the function of the commutator in a d.c. motor. (3)

12. A moving, coil test meter has a resistance of 14 Ω, and takes a current of 50 mA to produce full scale deflection.

(a) Explain, with the aid of circuit diagrams, how it can be adapted to measure a larger voltage value. (4)

(b) Calculate the values of additional resistance to extend its voltage measurement range to 12 V. (3)