GENERAL ENGINEERING SCIENCE II

Attempt ALL questions

Marks for each part question are shown in brackets

1. *(a)* Define *specific heat capacity* of a substance. (3)

   (b) A mass of 100kg of a substance has its temperature raised by 200°C. The specific heat capacity of the substance is 410J/kgK.

   Determine the quantity of heat that was supplied to the substance. (5)

2. *(a)* State *Boyle's Law* for a perfect gas. (3)

   (b) The pressure of a certain gas is 5 bar when contained in a pressure vessel having a volume of $0.02m^3$. The gas is expanded to $0.2m^3$ while its temperature is kept constant.

   Calculate the final pressure of the gas. (5)

3. An engine developing 30kW of brake power consumes 11.1 kg of fuel oil per hour. The mechanical efficiency of the engine is 68 percent.

   Calculate:

   (a) the indicated power; (4)

   (b) the brake specific fuel consumption. (4)

4 A 3 kg mass of carbon is completely burnt with 20 percent excess air.

   (a) State the combustion equation, (2)

   (b) Determine the actual mass of air supplied for the process. (8)

   Relative atomic masses: hydrogen = 1; carbon=12; oxygen = 16;
   Air contains 23 percent oxygen by mass.

5 Explain why thermal insulation of marine plant is necessary and beneficial. (6)

6 List, with reasons, FOUR desirable properties of a refrigerant. (8)

7. *(a)* With the aid of a labelled sketch, describe the operation of a *thermocouple.* (8)

   (b) State TWO applications of a thermocouple. (2)

8 A wire, 50cm long with a resistivity of 120μΩmm, is to carry a current of 2.5 A with a voltage drop of 6.75V between its ends.

   Calculate the diameter of the wire. (8)

9. The resistance of a coil of wire at the start of a heat test is 250 Ω. and its temperature is 15°C. On completion of the test the resistance is measured at 275 Ω. The temperature coefficient of resistance (α_0) at 0°C of the wire is 0.005 Ω/Ω. /°C.

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

10. An electrical appliance has a resistance of 40Ω and is supplied with 245V.

Calculate:

(a) the current flowing; (4)

(b) the power rating in kW, (4)

11. *(a)* State *Faraday's Law* of electromagnetic induction. (3)

(b) The flux linking a coil of 80 turns changes at the rate of 62.5 mWb per second. Calculate the value of the induced emf. (3)

12. *(a) Define flux density* with reference to a magnetic circuit with cross-sectional area '**a**' and flux '**Φ**'. (4)

(b) State the units of EACH of the following:

(i) flux; (2)

(ii)flux density; (2)

(iii) magnetomotive force. (2)