July 2005

GENERAL ENGINEERING SCIENCE II

Attempt ALL questions

Marks for each question are shown in brackets.

1. (a) Define a fuel. (2)

   (b) List the types of fuel available. (3)

   (c) State TWO examples of EACH type of fuel listed in Q1 (b). (3)

2. A mass of 1kg of hydrogen occupies a volume of 11.2m^3 at a pressure and temperature of 1 bar and -3°C respectively. Calculate the value of the characteristic gas constant. (7)

3. A four cylinder, four-stroke engine has a bore of 76mm and a stroke of 125 mm. The brake power is 14.8kW at 1500 rev/min. The mechanical efficiency is 85% and the fuel consumption is 4.36kg of oil per hour.

   Calculate EACH of the following:

   (a) the indicated mean effective pressure in bar; (6)

   (b) the brake thermal efficiency; (3)

   (c) the brake specific fuel consumption. (2)

   Note: calorific value of the oil = 42MJ/kg

4. (a) Describe, with the aid of a sketch, a mercury in glass thermometer. (6)

   (b) State the factors that determine the range that a liquid in glass thermometer operates over. (3)

5. A steel component, of mass 10kg, is cooled from a temperature of 450°C by being completely immersed in a tank containing 4kg of oil at a temperature of 15°C.

   Calculate the final temperature of the oil and the steel component, assuming that the heat losses are negligible. (8)

   Note; specific heat capacity of steel = 0.48 kJ/kgK
   specific heat capacity of oil = 1.8 *kJ/kgK*

6. In a vapour compression refrigeration plant, state the primary function of EACH of the following:

(a) the condenser; (2)

(b) the expansion valve; (3)

(c) the evaporator. (2)

7. A battery consists of four cells in parallel each having an emf of 1.5V and an internal resistance of 0.6 Ω. Calculate EACH of the following:

(a) the current flowing if connected to a device of 2.6 Ω resistance; (5)

(b) the terminal voltage; (3)

(c) the current in one cell. (2)

8. (a) Derive the power formula in terms of voltage and resistance. (4)

(b) A ship's oil heater has a power rating of 2.88kW.

Calculate the electrical energy used in MJ when it is switched on for two hours. (3)

9: Describe, with the aid of a labelled sketch, the operation of a moving coil instrument. (10)

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

(b) A magnetic flux of 4mWb is produced by a current carrying coil having 2000 turns. The current direction is completely reversed in one-tenth of a second.

Calculate the average emf induced in the coil. (5)

11. A coil of copper wire at a temperature of 15°C has a resistance of 40Ω. Calculate the increase in the resistance when the temperature rises to 65°C, (7)

Note; the temperature coefficient of copper at 0°C = 0.00426/°C

12. (a) State the essential properties of EACH of the following:

(i) an electrical conductor; (2)

(ii) an electrical insulator. (2)

(b) State TWO examples of materials used in EACH case in Q 12(a). (4)