March 2000

GENERAL ENGINEERING SCIENCE II

Attempt ALL questions

Marks for each part question are shown in brackets

1. *(a)* Define *latent heat of evaporation.* (2)

   (b) Describe how a mercury in glass thermometer is calibrated. (8)

2. A mass of 315 kg of oil is cooled in one hour from a temperature of 343 K to 30°C in a cooler consisting of a bank of tubes through which the hot oil passes. Cooling water circulates around the outside of the tubes.

   Calculate the mass of cooling water required per hour if the water temperature increases by 20°C. (8)

   Note: The specific heat capacity of the oil = 2.0 kJ/kgK
   The specific heat capacity of water = 4.2 kJ/kgK

3. *(a)* Define Charles' Law. (2)

   (b) A gas**,** initially at 1 bar, is heated from 20°C to 323 K in a 0.08 m^3 bottle.

   Determine the final pressure of the gas. (4)

4. A mass of methanol (CH_3OH) is completely burned in 50 kg of air to form carbon dioxide and steam. Determine the mass of methanol given that 20% excess air is supplied. (10)

   Note: Air contains 23% oxygen by mass.
   Relative atomic masses: hydrogen 1, carbon 12, oxygen 16.

5. A diesel engine develops 800 kW at the propeller of a vessel when using a fuel of 40MJ/kg at the rate of 170kg/hr. The manufacturer states that the indicated power output should be 950 kW.

   Calculate EACH of the following:

   (a) the mechanical efficiency of the engine given that the transmission losses are 5% of the propeller output; (3)

   (b) the brake thermal efficiency; (4)

   (c) the indicated thermal efficiency. (3)

6. *(a)* List FOUR desirable properties of a refrigerant. (4)

   (b) State why EACH of the properties in Q.6(a) is desirable. (4)

7. *(a)* With reference to their atomic structure, explain the difference between electrical conductors and insulators. (4)

(b) Give TWO examples for EACH of the following:

(i) good electrical conductors; (2)

(ii) good electrical insulators. (2)

8. An electric circuit uses resistors of 4Ω and 6Ω in parallel across a 24 V supply.

(a) Draw the circuit diagram using standard symbols. (2)

(b) Calculate EACH of the following:

(i) the current in each resistor; (4)

(ii) the power supplied to the circuit. (2)

9. An aluminium wire. 7.5 m long and 1 mm diameter, is connected in parallel with a copper wire 6 m long. When a current of 5 A is supplied to the combination, the current in the aluminium wire is 0.6 A.

Determine the diameter of the copper wire. (9)

Note: Resistivity of copper is 0.017 μΩm
Resistivity of aluminium is 0.028 μΩm

10. *(a)* Explain what is meant by *magnetic flux.* (2)

(b) Sketch diagrams to show how the magnetic flux would be distributed around:

(i) a horseshoe or U-shaped magnet; (3)

(ii) two bar magnets lying parallel to each other a short distance apart with their north poles facing opposite directions. (3)

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. Sketch a labelled diagram showing the construction of a moving coil meter. (9)