March 2002

GENERAL ENGINEERING SCIENCE II

Attempt ALL questions

Marks for each part question are shown in brackets

1. The flow rate of jacket cooling water for an engine on test is 300 kg per hour. The inlet temperature of the cooling water is 15°C and the outlet temperature 51°C.

   Calculate the rate of heat energy transfer. (8)

   Specific heat capacity for the water is 4.2 kJ/kgK

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. For an internal combustion engine, describe the effect of supplying EACH of the following:

   (a) the stoichiometric air requirement; (3)

   (b) an inadequate quantity of air; (3)

   (c) an excess quantity of air. (3)

4. An oil engine developing an indicated power of 40 kW uses 10 kg of oil per hour. The brake power is 32 kW.

   Calculate EACH of the following:

   (a) the brake specific fuel consumption of the engine; (4)

   (b) the mechanical efficiency of the engine. (4)

5. In a refrigeration cycle, outline the primary function of EACH of the following:

   (a) the condenser; (3)

   (b) the regulator, (3)

   (c) the evaporator. (3)

6. A thermometer at a temperature of 15°C contains 360 mm^3 of mercury. The coefficient of cubical expansion of mercury is 1.82×10^{-4}/°C.

   Calculate the temperature required to increase the volume of the mercury to 372mm^3. (10)

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 0.1 ohm.

(a) Sketch the circuit diagram. (5)

(b) Calculate the current which flows. (5)

8. With respect to an electric circuit:

(a) explain the purpose of EACH of the following;

(i) a conductor; (2)

(ii) an insulator; (2)

(b) state TWO materials commonly used for EACH of the following:

(i) conductors; (2)
(ii) insulators. (2)

9. Sketch a lead-acid type storage battery, labelling the principal components. (8)

10. 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 rating of the circuit. (2)

11. *(a)* Define *flux density* with reference to a magnetic circuit in an iron core with cross-sectional area ***a*** and flux ϕ. (2)

(b) A rectangular coil wound with 80 turns of wire has a mean width of 40 mm and an effective length of 100 mm. The coil, carrying a current of 6 A, is placed in a uniform magnetic field of flux density 0.15T.

Calculate EACH of the following:

(i) the force acting on one side of the coil; (3)
(ii) the maximum torque on the coil. (3)

12. Explain, with the aid of circuit diagrams, how a moving coil instrument can be connected to an external resistance for the measurement of EACH of the following:

(a) voltage; (4)

(b) current. (4)