Dec 2005

GENERAL ENGINEERING SCIENCE II

Attempt ALL questions

Marks for each question are shown in brackets.

1. (a) Define the specific heat capacity of a fluid. (2)

(b) Water flows through a heater at the rate of 2700 litre/h. It enters the heater at a temperature of 16°C and leaves at a temperature of 83°C.

Calculate the rate at which heat energy is transferred to the water in kW. (5)

Note: specific heat capacity of water = 4.184 kJ/kgK
1 m^3 of water has a mass of 1 tonne

2. (a) State the THREE modes of heat transfer. (3)

(b) Describe EACH of the modes stated in Q2(a). (6)

3. A steel ball has a diameter of 50.25mm at a temperature of 500°C.

Calculate the temperature at which the ball will just drop through a hole of 50mm. (6)

Note: coefficient of linear expansion of steel = 0.000012/ °C

4. (a) Define Boyle's Law for a perfect gas. (2)

(b) A hot air balloon contains 1200 litres of a perfect gas at a pressure and temperature of 1.5 bar and 14°C respectively. The temperature of the gas rises to 62°C at constant pressure.

Calculate EACH of the following:

(i) the increase in the volume of the balloon in m^3; (4)

(ii) the mass of gas in the balloon. (4)

Note: for the gas R = 0.25kJ/kgK

5. (a) Define EACH of the following:

(i) the higher calorific value of a fuel; (3)

(ii) the lower calorific value of a fuel. (3)

(b) State the TWO main elements of a ship's fuel. (2)

6. A six cylinder two-stroke single acting diesel engine has a bore of 900mm, a stroke of 1300mm and runs at 120 rev/min. The effective brake torque is 700kNm, the mechanical efficiency is 94% and the brake specific fuel consumption is 0.24kg/kWh.

Calculate EACH of the following:

(a) the brake power; (3)

(b) the indicated power; (3)

(c) the indicated mean effective pressure in bar. (4)

7. (a) With reference to an electric circuit, define EACH of the following terms:

(i) a conductor; (2)

(ii) an insulator. (2)

(b) State TWO materials commonly used for electrical conductors and TWO commonly used as electrical insulators. (4)

8. Calculate EACH of the following for a 100W, 250V electric filament lamp:

(a) the operating resistance; (4)

(b) the operating current. (3)

9. A two-core cable is 500m long and is fed at one end from a 250V supply.

Load currents are taken at points along the cable as follows:

10A at point A, 100m from the supply end
15 A at point B, 200m from the supply end
20A at point C, 500m from the supply end

(a) Draw a circuit diagram of this arrangement and show the current in EACH section of the cable. (4)

(b) Calculate the voltage at EACH load point. (6)

Note: resistance of cable is 0.02 ohm per 100m.

10. A coil of copper wire at 15°C takes a current of 2.5A from a 100V supply. After a period of time the current falls to 2A for the same supply voltage.

Calculate the temperature rise of the coil. (10)

Note: temperature coefficient of resistance of copper - 0.00426/°C at 0°C

11. A conductor of 12.5mm diameter has an effective length of 600mm when carrying a current of 25 A at right angles to a magnetic field. The force on the conductor is 24N.

Calculate EACH of the following:

(a) the flux density; (3)

(b) the magnetic flux. (3)

12. Sketch diagrams showing how magnetic flux would be distributed around EACH of the following:

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

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

(c) two bar magnets lying parallel to each other, a short distance apart, with their north poles facing the same direction. (3)