July 1997

GENERAL ENGINEERING SCIENCE II

Attempt ALL questions

Marks for each part question are shown in brackets

1. A mass of 315 kg of oil is cooled in one hour from a temperature of 70°C 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 =2.0kJ/kgK.
   The specific, heat capacity of water =4.2kJ/kgK.

2. A quantity of gas occupies a volume of 0.4 m^3 at a pressure of 2 bar and a temperature of 20°C. Determine the temperature of the gas after it is compressed to a volume of 0.15 m^3 at a pressure of 7.28 bar. (6)

3. A thermometer at a temperature of 10°C contains 450 mm^3 of a liquid. The coefficient of cubical expansion of the liquid is 1.802 x 10^{-6}/deg.C.

   Determine the temperature required to increase the volume of the liquid to 465 mm^3. (8)

4. With respect to the combustion process, explain:

   (a) the term *excess air,* (3)

   (b) why it is usual to supply excess air; (4)

   (c) the consequences of supplying insufficient air. (3)

5. The indicated power of an engine consuming 1.317 kg of fuel oil per hour of calorific value 41 MJ/kg is 6.25 kW. The mechanical efficiency of the engine is 80 percent.

   Calculate:

   (a) the brake power; (3)

   (b) the brake thermal efficiency. (5)

6. A simple 'U' tube manometer containing water reads 105.6 mm when connected to a gas supply point. A local barometer reads 750mmHg.

   Determine the absolute pressure of the gas in kN/m^2. (10)

   Note: Density of water =1000 kg/m^3; relative density of mercury = 13.6;
   The acceleration due to gravity=9.81m/s^2

7. *(a)* (i) Sketch a solenoid showing the constructional features. (4)

(ii) Sketch the electromagnetic field lines on your solenoid diagram, showing the North and South poles relative to- the direction of current. (2)

(b) State ONE practical application for a solenoid. (2)

8. *(a)* With regard to electric circuits, explain the purpose of:

(i) a conductor; (2)

(ii) an insulator. (2)

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

9. *(a)* Sketch and label the basic construction of:

(i) a primary cell; (3)

(ii) a secondary cell. (3)

(b) Explain the difference in operation between the two cell types in Q.9(a). (4)

10. A test instrument has a coil resistance of 2.5 Ω and a full-scale deflection with 20 mA. Sketch and label simple circuit diagrams to show how the instrument can be arranged to indicate:

(a) a maximum current of 3 A; (5)

(b) a maximum voltage of 20 V. (5)

11. For the circuit diagram shown in Fig. Q.1l, calculate:

(a) the pd across the 7 Ω resistance; (4)

(b) the current through each resistor. (4)

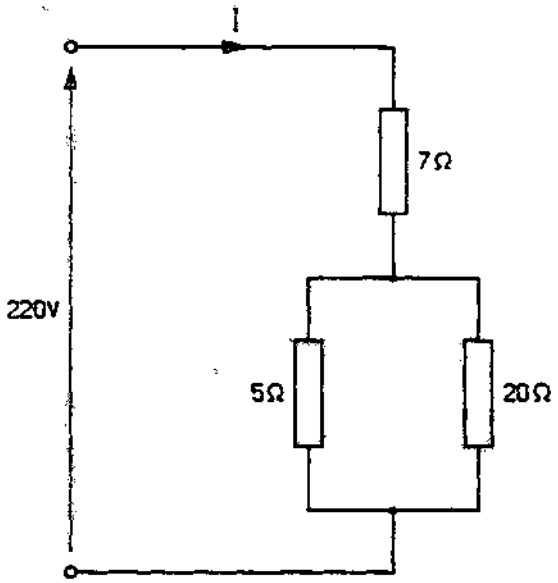

Fig. Q.11

12. A coil of 200 turns with a coil side of active length 200 mm between the poles of an electromagnet has uniform flux density 0.015 T. For a conductor speed of 10m/s, determine the maximum emf generated in the coil. (6)