July 2004

GENERAL ENGINEERING SCIENCE II

Attempt ALL questions

Marks for each question are shown in brackets.

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

   (b) With reference to a marine boiler, state ONE example of EACH of the three modes in Ql(a). (3)

2. (a) Define the fixed points on the Celsius scale of temperature. (4)

   (b) Describe how a mercury in glass thermometer may be calibrated. (4)

3. A mass of 1.5kg of methane gas (CH4) is completely burned in 25% excess air.

   Calculate EACH of the following:

   (a) the stoichiometric oxygen required; (6)

   (b) the actual mass of air supplied. (4)

   Note: relative atomic masses: carbon = 12, hydrogen = 1 oxygen =16

   air contains 23% oxygen by mass

4. The initial pressure, temperature and volume of a mass of gas are 1.3 bar, 15°C and 1.6 litres respectively. The gas expands at constant temperature to a volume of 5.6 litres and then the temperature rises to 70°C at constant pressure.

   Calculate EACH of the following:

   (a) the final pressure of the gas in kN/m^2; (5)

   (b) the final volume of the gas in m^3 (5)

5. The area of an indicator diagram taken off one cylinder of a four cylinder, four stroke internal combustion engine is 385mm^2 and the length is 70mm. The bore of the engine is 250mm, the stroke is 300mm and the speed is 300 rev/min.

Assuming all of the cylinders develop equal power, calculate EACH of the following:

(a) the mean indicated pressure; (3)

(b) the indicated power of the engine. (6)

Note: spring constant is 1mm = 1 bar

6. With reference to a vapour compression refrigeration plant, state EACH of the following:

(a) the condition of the refrigerant at the FOUR main points in the cycle; (4)

(b) THREE desirable properties of a good refrigerant fluid. (3)

7. Resistances of 4 ohms, 6 ohms and 8 ohms are connected in series with a battery of internal resistance 2 ohms. The potential difference of the battery is 9 volts.

Calculate EACH of the following:

(a) the emf of the battery; (6)

(b) the volt drop across the 6 ohms resistor. (2)

8. (a) Define the resistivity of a material. (3)

(b) The resistance of 1.6km of copper wire of 0.5mm diameter is 170 ohms.

Calculate the resistance of 1km of iron wire of lmm diameter. (7)

Note: the resistivity of iron = 7 x *resistivity of copper*.

9. Describe, with the aid of a sketch, a lead acid battery. (6)

10. (a) State the units of EACH of the following:

(i) flux; (1)

(ii) flux density; (1)

(iii) magnetomotive force; (1)

(iv) inductance. (1)

(b) The active length of a conductor carrying a current of 40 amps at right angles to a magnetic field is 750mm. The force on the conductor is 24N.

Calculate the strength of the magnetic field. (4)

11. (a) Describe, with the aid of a labelled sketch, the operating principal of a solenoid. (6)

(b) State TWO marine plant systems where solenoids are used. (2)

12. Explain, with the aid of circuit diagrams, how a moving coil instrument can be adapted to measure EACH of the following:

(a) larger currents; (5)

(b) larger voltages. (5)