March 1999

GENERAL ENGINEERING SCIENCE II

Attempt ALL questions

Marks for each part question are shown in brackets

1 *(a)* State the fixed points of the Celsius scale of temperature. (2)

(b) Determine the heat required to raise a substance of mass 16 kg from 284 K to 90°C given that the specific heat capacity of the substance is 4.2kJ/kgK. (4)

2. The clearance between a piston and the wall of a 150 mm bore cylinder liner is 1mm at 10°C.

Calculate the temperature at which the piston will just seize in the liner. (8)

Note: Coefficient of linear expansion of the piston is 21 x 10^{-6}/°C.
Coefficient of linear expansion of the liner is 6 x 10^{-6}/°C.

3. *(a)* State the general equation for a perfect gas. (2)

(b) An air compressor delivers 0.2m^3/s of air at a pressure of 850kN/m^2 and 31°C into an air receiver.

Calculate the mass of air delivered. (4)

Note: The gas constant for air is 0.287kJ/kgK

4. Explain EACH of the following:

(a) the process of combustion; (3)

(b) stoichiometric conditions for combustion; (3)

(c) why excess air is supplied in a practical combustion process. (3)

5. The stroke to bore ratio for a six cylinder single-acting two-stroke diesel engine is 2.86:1. The mean area of the indicator diagrams taken at 80 rev/min is 1380 mm^2, the length is 80 mm and the spring scale is 100kN/mm. The shaft power is 15800kW and the mechanical efficiency is 86%. Determine the bore and stroke of the engine. (10)

6. *(a)* Draw a labelled line diagram of a simple refrigeration cycle. (2)

(b) State the condition of the refrigerant between each component in the cycle in Q.6(a). (8)

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7. *(a)* State THREE effects of an electric current. (3)

(b) Give ONE practical application for EACH effect in Q.7(a). (3)

8. An electric kettle is required to heat 0.5 kg of water from 10°C to its boiling point in 5 minutes.

The supply voltage is 230 V.

Calculate the resistance of the heating element, given that the efficiency of the kettle is 80%. (8)

Note: Specific heat capacity of water is 4.2kJ/kgK.

9. Two circuits, A and B, are connected in parallel to a 25V battery which has an internal resistance of 0.25Ω. Circuit A consists of two resistors, 6Ω and 4Ω, connected in series. Circuit B consists of two resistors, 10Ω and 5Ω, connected in series.

(a) Sketch the circuit diagram. (2)

(b) Calculate:

(i) the current flowing in each resistor, (4)

(ii) the potential difference across each resistor. (4)

10. *(a)* State Lenz's Law. (3)

(b) The axle of a vehicle is 1.5 m long. Calculate the induced emf in the axle when the vehicle is travelling at 140km/hr given that the vertical component of the Earth's magnetic flux density is 40 μT. (6)

11. *(a)* Explain the effect of rotating a wire coil at constant speed in a uniform magnetic field. (5)

(b) Describe the indication given on a centre-zero voltmeter connected across the ends of the coil in Q.11(a). (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:

(a) current; (5)

(b) voltage. (5)