

March 2001

GENERAL ENGINEERING SCIENCE II

Attempt ALL questions

Marks for each part question are shown in brackets

1. (a) State the condition that determines whether heat energy transfer by conduction will take place. (2)
(b) Explain the physical processes occurring when heat energy-transfer takes place by:
 - (i) conduction in a solid; (3)
 - (ii) convection in a fluid. (3)

2. (a) State Charles' Law for a perfect gas. (2)
(b) Express Charles' Law as an equation, and state the units used. (2)
(c) A perfect gas has a specific volume of $0.75 \text{ m}^3/\text{kg}$ at a temperature of 25°C .
Calculate the new value of specific volume when the temperature is raised to 155°C while the pressure remains constant. (6)

3. With reference to diesel engine operation:
 - (a) explain the meaning of the term *excess air supply*, (2)
 - (b) describe the effects on combustion when supplied with EACH of the following:
 - (i) excess air; (3)
 - (ii) insufficient air.' (3)

4. A refrigeration plant requires a working fluid in order to function.
State EACH of the following:
 - (a) FOUR desirable qualities of an effective refrigerant fluid; (4)
 - (b) why each of the qualities in Q.4(a) is desirable. (4)

5. The stroke to bore ratio for a six cylinder, single-acting, two stroke, diesel engine is 2.86:1. When the engine is running at 80 rev/mm the mean area of the indicator diagrams is 1380 mm^2 , with a length of 80mm when using, a spring scale of $100 \text{ kN/m}^2/\text{mm}$. The shaft power is 15,800 kW and the mechanical efficiency is 86%.

Determine the bore and stroke of the engine. (10)

6. A 230 V electric kettle is required to heat 0.5 kg of water from 10°C to its boiling point in 5 minutes. Calculate the resistance of the heating element given that the efficiency of the kettle is 80% (8)

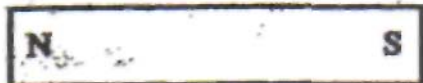
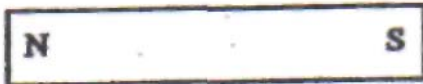
Note: Specific heat capacity of water is 4.2 kJ/kgK

7. (a) (i) Sketch a solenoid showing the constructional features (4)
(ii) Sketch the electromagnetic field lines on your solenoid and 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 2.5Ω 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. (a) Describe the effect that a ferro-magnetic material has when placed within a magnetic flux, stating the reason for this effect. (2)
(b) Sketch the general distribution of magnetic flux for the three arrangements of magnets shown in Worksheet Q.11. (6)
12. With reference to a moving coil ammeter
(a) sketch and label the main components; (5)
(b) explain the principle of operation. (3)

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Worksheet Q.11

This worksheet is to be returned with your answer book



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