

**APPLIED MARINE ENGINEERING**

Attempt ALL questions

Marks for each part question are shown in brackets

1. With reference to carbon fibre used in marine construction:
  - (a) describe the properties that make it suitable for EACH of the following:
    - (i) hull construction; (2)
    - (ii) mast construction; (2)
  - (b) explain its undesirable properties for the applications in part (a); (3)
  - (c) explain the safety considerations necessary when working with carbon fibre. (3)
  
2. With reference to manufacturing components from aluminium:
  - (a) explain why it may be necessary to anneal aluminium; (2)
  - (b) describe the problems encountered when working with annealed aluminium; (4)
  - (c) describe how it could be annealed on board a vessel. (4)
  
3. Describe, with the aid of load extension graphs, EACH of the following engineering terms:
  - (a) limit of proportionality; (2)
  - (b) yield point; (2)
  - (c) Ultimate Tensile Strength; (2)
  - (d) 0.1% Proof Stress. (4)
  
4.
  - (a) Explain the process of *brazing* for the joining of metals and alloys. (4)
  - (b) State TWO methods by which a cracked aluminium alloy pump casting might be repaired. (2)
  - (c) List the FOUR functions that the flux performs in the brazing process. (4)
  
5.
  - (a) Describe the problems associated with two dissimilar metals in contact in the presence of sea water. (4)
  - (b) Describe THREE different methods that may be used to reduce the problems described in part (a). (6)

6. With reference to the cathodic protection of hull fittings:
- (a) explain how sacrificial anodes achieve this; (2)
  - (b) state where sacrificial anodes would be fitted and why; (4)
  - (c) describe an impressed current system, stating the principle on which it works. (4)
7. With reference to osmosis in glass reinforced plastic (GRP) hulls:
- (a) explain how osmosis may be detected in service; (2)
  - (b) explain why simply drying out the hull is not a cure for the effects of osmosis; (2)
  - (c) describe the FULL process for the treatment of a hull suffering from the effects of osmosis. (6)
8. Describe, with the aid of a sketch, a method of measuring and remotely indicating EACH of the following:
- (a) temperature; *Thermistor (Thermal resistor)* (4)
  - (b) rate of flow. *Turbine flowmeter* (6)
9. With reference to a main engine lubricating oil system, explain, with the aid of a sketch, the principle of a *closed loop* temperature control system. (10)
10. (a) Explain EACH of the following control terms:
- (i) proportional bandwidth; (2)
  - (ii) integral action; (2)
  - (iii) derivative action. (2)
- (b) Describe a 3-step method for tuning a PID controller. (4)