

APPLIED MARINE ENGINEERING**Attempt ALL questions****Marks for each part question are shown in brackets**

1. (a) Construct a horizontal axis for carbon content of steel 0 to 2.5% using 0.1% increments. Place the following materials on this axis in their appropriate percentage carbon content bandwidth:
 - Mild Steel
 - Cast Iron
 - Wrought Iron
 - High Carbon Steel
 - Medium Carbon Steel(5)
- (b) Name a typical component that it would be used on a vessel for each of the metals detailed in part (a), stating the reason why it is best suited for this application. (5)
2. (a) Define the term *stainless steel*, making reference the percentage quantities of its TWO main constituents. (4)
- (b) With reference to EACH of the following grades of stainless steel, list ONE of its unique properties and a common use that utilises this property:
 - (i) ferritic; (2)
 - (ii) austenitic; (2)
 - (iii) martensitic. (2)
3. 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)
4. Explain EACH of the following engineering terms, stating ONE material that exhibits EACH property:
 - (a) brittleness; (2)
 - (b) ductility; (2)
 - (c) hardness; (2)
 - (d) malleability; (2)
 - (e) toughness. (2)

5. With reference to TIG welding:
- (a) describe the process; (3)
 - (b) explain why an ac current is preferred when welding aluminium; (2)
 - (c) explain the advantages compared to other methods. (5)
6. With reference to marine corrosion:
- (a) list EIGHT factors that influence the rate of corrosion for an unprotected metal surface; (4)
 - (b) explain the process of galvanic corrosion; (4)
 - (c) state TWO major factors influencing the severity of galvanic corrosion. (2)
7. With reference to glass reinforced plastic (GRP) hulls:
- (a) state THREE causes for EACH of the following defects to occur:
 - (i) de-lamination; (3)
 - (ii) osmotic blisters; (3)
 - (iii) stress cracking; (3)
 - (b) state the part of the underwater section of the hull on which osmotic blisters most commonly occur. (1)
8. List FIVE different methods of remotely monitoring the content level of a fuel oil service tank, explaining their operating principle. (10)
9. (a) Explain the limitation of a proportional controller. (2)
- (b) Explain, with the aid of diagrams, how the limitation explained in part (a) may be overcome. (8)
10. (a) Define EACH of the following terms:
- (i) cascade control; (4)
 - (ii) split range control. (3)
- (b) Describe possible problems associated with *split range control* used for the control of a main engine cooling system. (3)