CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY – MARINE ENGINEER OFFICER

EXAMINATIONS ADMINISTERED BY THE
SCOTTISH QUALIFICATIONS AUTHORITY
ON BEHALF OF THE
MARITIME AND COASTGUARD AGENCY

STCW 95 SECOND ENGINEER REG. III/2 (UNLIMITED)

042-23 – MATHEMATICS

THURSDAY, 19 JULY 2012

1315 - 1615 hrs

Examination paper inserts:

Notes for the guidance of candidates:

1. Non-programmable calculators may be used.
2. All formulae used must be stated and the method of working and ALL intermediate steps must be made clear in the answer.

Materials to be supplied by examination centres:

Candidate's examination workbook
Graph Paper

MATHEMATICS

Attempt SIX questions only

All questions carry equal marks

Marks for each part question are shown in brackets

1. (a) An alloy is made by combining metal A with metal B so that the ratio of their volumes is 7:5. The relative density of metal A is 8.4 and that of metal B is 9.6.

   Determine the percentage mass of EACH of the metals in the alloy. (8)

   (b) A person spends £24750 in starting a business venture. This sum comprises the cost of buying the premises, the cost of repairs to the premises and the cost of equipment to be installed.
   The cost of repairs was 10% of the purchase price and the cost of equipment was 12.5% of the combined price of the purchase price and the cost of repairs.

   Calculate EACH of the following:

   (i) the purchase price; (6)

   (ii) the cost of repairs; (1)

   (iii) the cost of equipment. (1)

2. (a) Factorise fully EACH of the following:

   (i) (3)

   (ii) (3)

   (iii) (4)

   (b) Express the following function of x as a single fraction in its simplest form: (6)

3. (a) The voltage, V volts, and the current, I amps, of a non-linear resistor are related by the formula:

Calculate the positive value of V when $I = 0.85$ amps. (8)

(b) Determine the least positive values of A and B which satisfy the following system of equations:

(8)

4. (a) Solve for t in the following equation:

(6)

(b) Express the following in its simplest form:

(6)

(c) Make i the subject of the following equation:

(4)

5. The mass, M kg, which can safely be distributed uniformly on a girder of span L metres varies as indicated in Table Q5.

(a) Verify graphically that M and L are related according to the law: (10)

– where a and b are constants.

(b) Using the graph drawn in Q5(a), determine approximate values for a and b. (6)

M kg	184	140	103	56	40
L metres	1.6	2	2.5	3.5	4.0

Table Q5

Suggested scales : horizontal axis 2 cm = 2
vertical axis 2 cm = 20

6. (a) Two ships approach the same port. Their courses converge at an angle of 23°. At 1900 hours the two ships are 32 nautical miles apart and one ship is twice as far from the port as the other.

Calculate how far EACH ship is from the port at 1900 hours. (10)

(b) In a certain ammeter the current I amps is given by:

– – where θ radians is the deflection angle of the needle.

Calculate the value of θ in the range $0 \le \theta \le 2\pi$ radians when $I = 1.85$ amps. (6)

7. (a) An object moves along a straight line such that its position, s metres, from a fixed point after t seconds is given by:

Determine EACH of the following:

(i) the velocity of the object after 2 seconds; (4)

(ii) the time when the acceleration of the object is zero. (4)

(b) Differentiate EACH of the following functions:

(i) (4)

(ii) (4)

8. (a) Liquid flows into a tank at a variable rate q litres per minute according to the formula: where t is the time in minutes.

The volume of liquid in the tank after t minutes is given by:

Determine the volume of liquid in the tank after 20 minutes. (8)

(b) Evaluate (8)

9. A solid metal cylinder of diameter 20 cm and length 36 cm has six holes drilled through it as shown in Fig Q9. All six holes have a diameter of 3 cm and are drilled parallel to the axis of the cylinder.

Calculate EACH of the following:

(a) the total surface area of the original cylinder; (4)

(b) the percentage increase in the total surface area after the six holes have been drilled; (6)

(c) the percentage decrease in volume of the solid. (6)

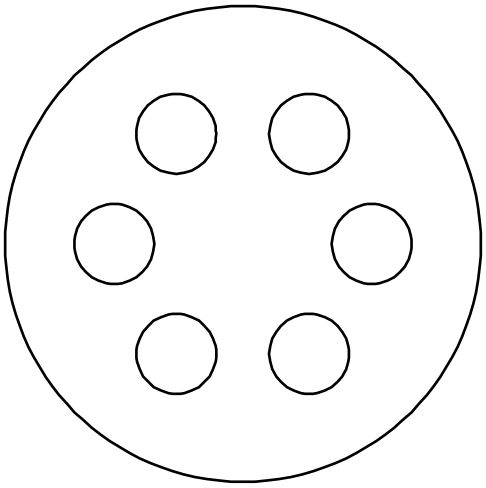

Fig Q9