

**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, 20 OCTOBER 2011

1315 - 1615 hrs

Examination paper inserts:

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Notes for the guidance of candidates:

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| <ol style="list-style-type: none">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. |
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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) A manufacturer makes three types of paperclips, A, B and C. Each paperclip of type B weighs 20% more than type A and each of type C weighs 0.12 g more than type B.

The total mass of 12000 of type A, 8000 of type B and 5000 of type C is 11.64 kg.

Determine the mass of EACH of the three types of paperclip. (8)

- (b) Salesman A is paid a basic salary of £32000. He receives 25% commission on all sales above £50000. Salesman B, in another firm, is paid a basic salary of £35000 with 20% commission on all sales above £40000. In a particular year both make sales of £150000.

Calculate the salaries for both A and B for that year. (8)

2. (a) Solve for $x > 0$ in the following equation: (8)

$$\frac{1}{x} - \frac{1}{x+1} = 1$$

- (b) Transpose the terms in the following equation to make C the subject: (8)

$$\frac{1}{C} = \frac{1}{A} + \frac{1}{B}$$

3. (a) Solve the following system of equations for I_1 , I_2 and I_3 . (10)

(b) Given _____ and _____

Express _____ in terms of a and b in its simplest form. (6)

4. (a) Make t the subject of the following equation: (8)

(b) Evaluate without the use of a calculator: (8)

$$\frac{\frac{1}{2} - \frac{1}{3}}{\frac{1}{4} - \frac{1}{5}}$$

5. A frictional force F newtons in a lubricated system depends on the temperature T °C. The relationship between T and F is approximately of the form _____ where a and n are constants. Table Q5 gives various recorded values of T and F in an experiment.

(a) Verify graphically the relationship. (10)

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

T °C	10	20	30	40	50	60
F newtons	0.009	0.002	0.001	0.0005	0.0003	0.0002

Table Q5

Suggested scales: horizontal axis 2 cm = 0.2
vertical axis 2 cm = 0.2

6. (a) A patrol boat travelled 27 miles from port A on a course 031° and then 18 miles on a course 111° . After a brief stop it returns to port A by the shortest route.

Calculate EACH of the following:

- (i) the course that must be set in order to return to port A; (6)

- (ii) the return distance to port A. (4)

- (b) An alternating voltage, v volts, is given by the formula:

where t is the time in seconds. ($t > 0$)

- Calculate the least value of t when $v = 20$ volts. (6)

7. Fig Q7 shows the uniform cross section of an open drain designed for the flow of water.

The cross sectional area is 80 m^2 . The resistance to the flow of water along the channel is least when the wetted surface area is least.

- (a) Show that the dimension — (4)

- (b) Calculate the value of h such that the resistance is a minimum. (12)

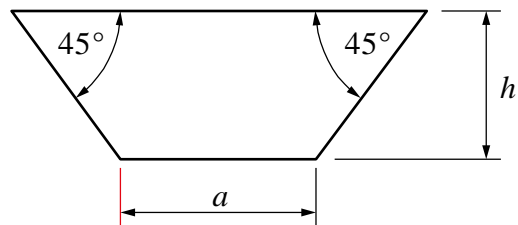


Fig Q7

8. (a) The shaded area in Fig Q8(a) represents the uniform cross section of a container six metres long. All the dimensions are in metres. The area is enclosed by the parabola with equation $y = x^2 - 6x + 9$ and the lines $y = 9$ and $y = 4$.

Determine the volume of the container.

(12)

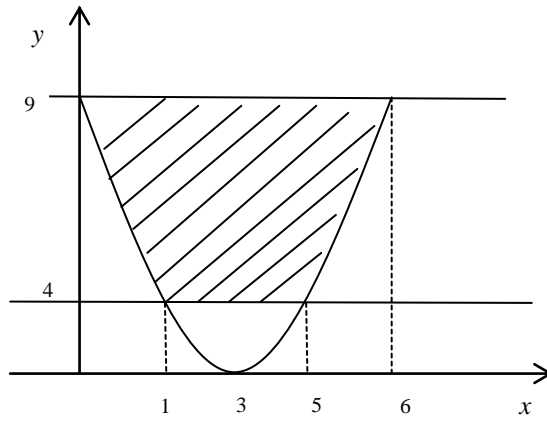


Fig Q8(a)

- (b) Evaluate

(4)

9. (a) A piece of lead pipe 350mm long has an internal diameter of 40mm and a wall thickness of 5mm. It is melted down and recast into a solid hemisphere. The density of the lead is 11340 kg per m³.

Determine EACH of the following:

- (i) the diameter of the hemisphere; (5)
(ii) the mass of the hemisphere. (1)

- (b) Fig Q 9(b) shows the graphs of the functions —

Determine EACH of the following

- (i) the co-ordinates of points A and B; (4)
(ii) the area of triangle AOB. (6)

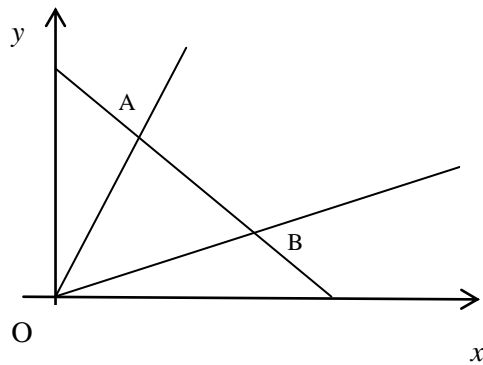


Fig Q9(b)