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:

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) 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)

$$\frac{\quad}{\quad} \quad \frac{\quad}{\quad} \quad 1$$

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

$$\frac{\quad}{\quad}$$

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)

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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)

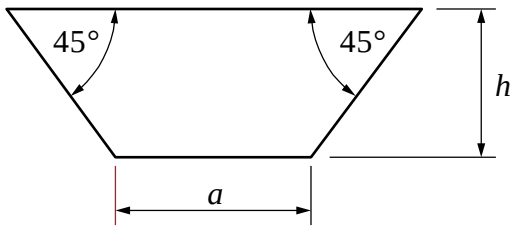

Fig Q7

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 and the lines .

Determine the volume of the container. (12)

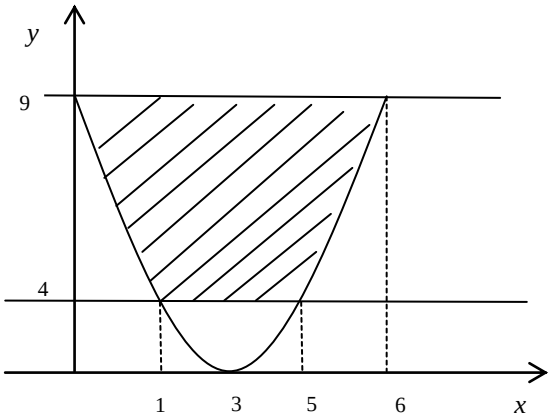

Fig Q8(a)

(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 m^3.

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)

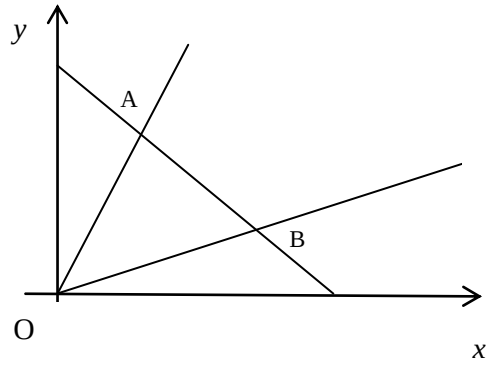

Fig Q9(b)