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 15 DECEMBER 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) Ports A and B are 36 nautical miles apart. A tanker leaves port A at 1130 hours travelling towards port B at a steady 16 knots. It stops for 2 hours 30 minutes for loading and returns at a steady speed of 12 knots. A second vessel leaves port B at 1610 hours and reaches port A 40 minutes before the tanker.

Determine EACH of the following:

(i) the time the tanker arrives back at port A; (4)

(ii) the speed of the second vessel. (4)

(b) The amount of energy stored in flywheels of similar shapes is directly proportional to the squares of their speeds and to the fifth power of their diameters. One flywheel has a diameter 1.72 times that of a smaller one and it runs at 85% of the speed of the smaller. The smaller flywheel stores 9.2 kJ of energy.

Calculate the amount of energy stored in the larger flywheel. (8)

2. (a) Solve for *a* in the following equation: (8)

(b) The vapour pressure in a certain inflammable gas is given by the formula:

where A and B are constants.

When p is 10.12, $T = 120° K$.
When p is 93.33, $T = 140° K$.

Determine the values of A and B correct to 3 significant figures. (8)

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3. (a)

Express y as a single fraction in its simplest form. (8)

(b) Determine the value of x, (for $x > 0$) which satisfies the following: (8)

4. (a) Solve for n in the following equation: (6)

(b) The time, t hours, to charge a certain battery to a level C (expressed as a decimal fraction of the battery's full charge) is given by :

Determine what percentage of the full charge would be achieved after charging the battery for 5 hours 15 minutes. (6)

(c)

Express R in terms of T, Q and s. (4)

5. The coefficient of friction, μ, between a pulley and a belt and the speed of the pulley, v m/s, are considered to be related according to where a and b are constants.

(a) Using the values of μ and v in Table Q5, draw a graph to confirm this relationship. (10)

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

μ	0.217	0.240	0.258	0.273	0.286
v m/s	2	4	6	8	10

Table Q5

Suggested scales: horizontal axis 2 cm = 0.2
vertical axis 2 cm = 0.01

6. In the diagram shown in Fig Q6, A and C represent the centres of two gear wheels.

An idler is to be placed at B.

Calculate the distances of x and y. (16)

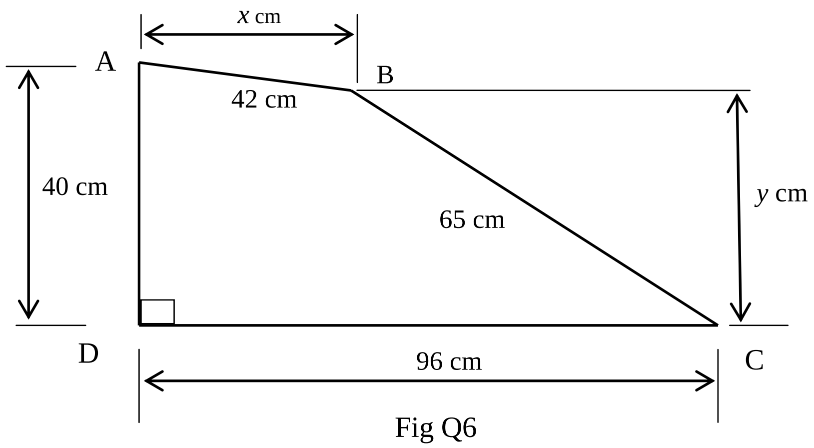

Fig Q6

7. (a) The cost, £C per 100 metres, of laying a cable of cross-section x cm^2 is found to correspond to the formula:

Calculate EACH of the following:

(i) the cross-sectional area such that the cost is a minimum; (6)

(ii) the minimum cost per 100 metres to lay the cable. (2)

(b) Determine the first differential coefficient of EACH of the following:

(i) (4)

(ii) (4)

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8. (a) Determine the shaded area enclosed by y = — and as shown in Fig Q8(a). (10)

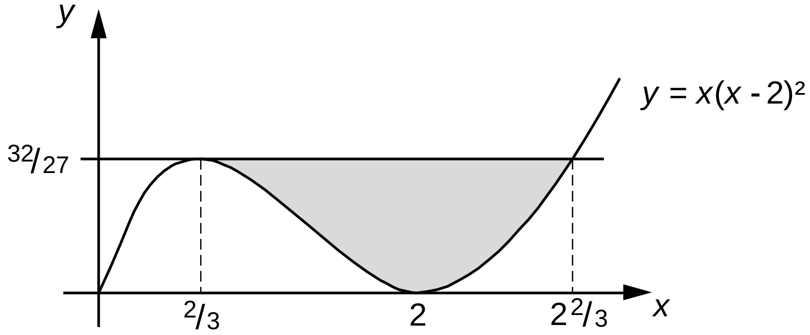

Fig 8(a)

(b) Evaluate (6)

9. The vertical height of a solid right circular cone is 50% greater than the diameter of its base. The <u>total</u> surface area of the cone is 500 cm^2.

Calculate EACH of the following:

(a) the diameter of the base of the cone; (12)

(b) the volume of the cone. (4)