

**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, 18 JULY 2013

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 garage services three cars A, B and C. The cost for A is $1\frac{2}{3}$ the cost for B. The cost for C is 80% of the cost for B. The total cost for servicing all three cars is £1040.

Calculate the cost for servicing EACH car. (6)

- (b) A ship's speed is increased by 20% above normal for 8 hours, reduced by 15% below normal for 10 hours and is normal for the remaining 6 hours of the day. The fuel consumption per unit time is directly proportional to the cube of the ship's speed, V .

Calculate the percentage increase in the fuel consumption above the normal for the day in question. (10)

2. (a) Calculate the values of the currents in an electrical network which satisfy EACH of the following equations: (10)

$$\begin{aligned}I_1 + I_2 + 3I_3 &= 9.8 \\2I_1 + I_2 - 8I_3 &= 0.5 \\I_2 - I_1 + 3I_3 &= 4.2\end{aligned}$$

- (b) Factorise EACH of the following:

(i) $2ax - 3ay + 4bx - 6by - 2cx + 3cy$; (3)

(ii) $64a^2x^2 - 100b^2y^2$. (3)

3. (a) Solve for a in the following equation:

$$\frac{a}{a+1} - \frac{a+1}{3a-1} = \frac{1}{4} \quad (8)$$

- (b) Transpose the terms in the following formula in order to make n the subject:

$$P = \frac{fA}{1 + b\left(\frac{m}{n}\right)^2} \quad (8)$$

4. (a) Determine the value of x , for $x > 0$, which satisfies EACH of the following equations:

(i) $\ln(5 - 2x^3) = -0.8$ (4)

(ii) $x^{7.5} = (2x)^3$ (4)

(b) The pressure in a particular life raft falls according to the formula:

$P_t = P_0 e^{-kt}$ where P_0 is the initial pressure at time t hours and k is a constant.

(i) When $t = 0$ the pressure is 80 units and 12 hours later it is 60 units.

Calculate the value of k to two significant figures. (4)

(ii) When the pressure falls below 40 units the raft is unsafe.

Calculate the length of time the raft is safe to use. (4)

5. It is considered that the variables T and H are connected by the relationship:

$T = aH\sqrt{H} + b$ where a and b are constants.

(a) Using the values of T and H in Table Q5, draw a graph to verify the relationship. (10)

Suggested scales: horizontal axis 2 cm = 10
vertical axis 2 cm = 20

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

H	6	8	10	12	14
T	85.4	125.1	170.1	219.9	273.9

Table Q5

6. (a) Fig Q6(a) represents a roof truss.

$AB = DE = 2.5$ metres. $BC = CD = 3.2$ metres $AF = FE = 4$ metres.
 Angle $BAE =$ Angle $DEA = 65^\circ$.

Calculate EACH of the following:

(i) BF ; (4)

(ii) CF . (8)

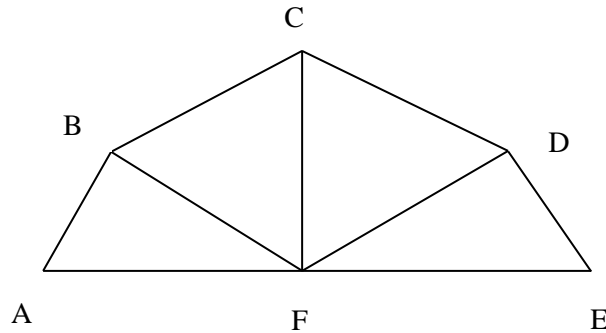


Fig Q6(a)

- (b) Given $0.4WL \sin \theta = WL \cos \theta$

Calculate the values of θ in the range $0 \leq \theta \leq 2\pi$. (4)

7. (a) Given $T = 1 + \frac{x}{4} + \frac{3375}{x^2}$

Calculate EACH of the following:

(i) the value of x such that T is a minimum; (8)

(ii) the minimum value of T . (2)

- (b) Determine the first derivative of the following function:

$$y = 8 - \sqrt{x} + x^{1.2} - 12 \sin x - 6 \cos x - e^x + \frac{1}{x} \quad (6)$$

8. (a) Fig Q8(a) shows the area included between the function $y = x^2(3 - x) + 5$, the x and y axes and the ordinate $x = 3$.

Calculate the shaded area.

(8)

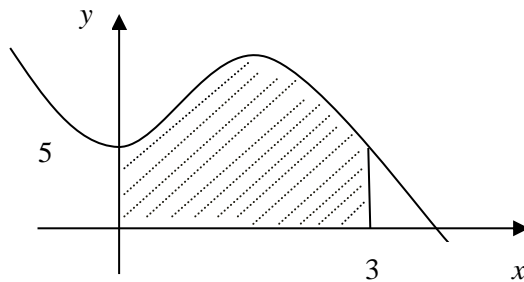


Fig Q8(a)

- (b) Integrate EACH of the following functions with respect to r :

(i) $r + 5\sqrt{r} - \frac{2}{r^2} + 7r^{2/3}$ (4)

(ii) $\pi - 2\pi \sin r + 4\pi \cos r$ (4)

9. (a) Fig Q9(a) represents an open topped trough. The top and base are rectangles and the ends, which are vertical, are both in the shape of a trapezium. The top is 2.4 m long and 1.2 m wide. The base is 2.4 m long and 0.6 m wide. All the sloping edges are 1 m long.

Calculate EACH of the following:

(i) the volume of the trough; (6)

(ii) the total surface area of the trough. (4)

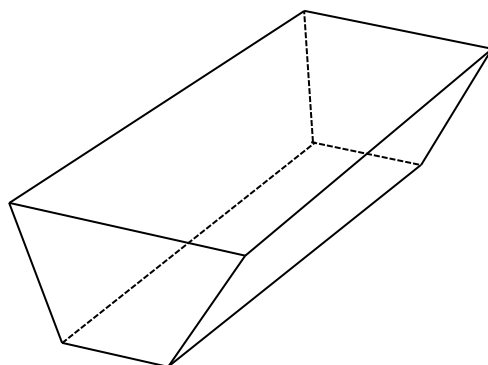


Fig Q9(a)

- (b) Determine the number of solid spheres of diameter 8 mm which can be made by melting down a solid cylinder of diameter 50 mm and length 60 mm allowing for 5% wastage in the process.

(6)