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/3 (< 3000 kW)
CLASS 1 FISHING ENGINEER
STCW 95 CHIEF ENGINEER REG. III/2 – "YACHT 2"

043-11 – GENERAL ENGINEERING SCIENCE I

THURSDAY, 23 JULY 2009

1400 - 1600 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

GENERAL ENGINEERING SCIENCE I

Attempt ALL questions

Marks for each question are shown in brackets.

1. Simplify the following:

   (a) $\dfrac{a \times a^2 \times a^5}{a^3 \times a^7}$ (4)

   (b) $\dfrac{x}{2} + \dfrac{2x}{3} - \dfrac{2x}{5}$ (4)

2. The abrasive tank in a pressure cleaning machine is in the shape of an inverted cone having a diameter of 1.4m and an apex angle of 60°.

   Determine the volume of the abrasive tank. (8)

3. Two sides of a triangle measure 5.3cm and 7.3cm respectively, and the included angle between them is 44° 27'.

   Calculate the area of the triangle in square metres. (8)

4. (a) Given that $n^2r + 1 =$ NR, rearrange the terms to make n the subject. (4)

   (b) Calculate the value of R when $r = 0.725$, N = 16 and $n = 7.192$. (4)

5. (a) Plot the graph of $y = \dfrac{x^2}{2} - 3x$ between the limits of $x = 0$ and $x = 6$. (8)

   (b) Using the graph obtained in Q5(a) state the value of x when $y = -3$. (2)

6. The thread of a screwjack has a pitch of 12mm and the machine is operated by a lever having an effective length of 350mm. When an effort of 80N is applied a load of 455kg can just be lifted.

Calculate EACH of the following:

(a) the force ratio of the machine; (3)

(b) the movement ratio of the machine; (3)

(c) the efficiency of the machine under these load conditions. (2)

7. A body is travelling at 2.27m/s when it uniformly accelerates to 5m/s in 6.3 seconds.

(a) Define EACH of the following:

(i) acceleration, stating units; (1)

(ii) distance travelled, in terms of velocity and time. (1)

(b) Calculate EACH of the following:

(i) the acceleration of the body; (3)

(ii) the distance the body travelled in 6.3 seconds. (3)

8. Determine the value of the uniformly distributed load (UDL) in kN/m for the loaded beam shown in Fig Q8, given that the value of R_B is to be 85kN. (10)

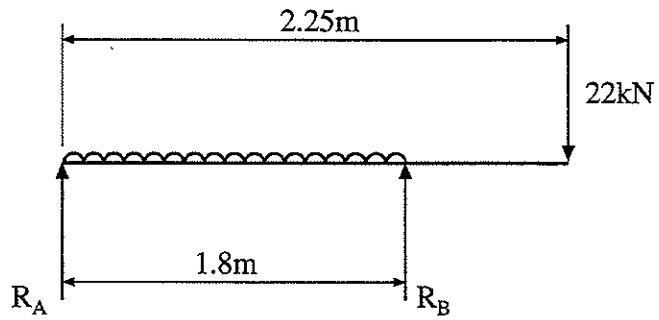

Fig Q8

9. Determine the factor of safety for a rod 101.6mm in diameter if the maximum static tensile load is 327kN and the ultimate tensile stress of the material is 460MN/m^2. (8)

10. (a) A ship has a displacement of 6495 tonne and when a mass of 28 tonne, already on board, is moved transversely across the upper deck by a distance of 8.3m, an angle of heel of 2° is generated.

Determine the position of the centre of gravity KG above the keel given that $m \times d = \Delta\ GM\ tan\theta$ and KM = 4.02m. (6)

(b) State the effect the removal of the 28 tonne mass will have on the position of *G* and the stability of the vessel. (2)

11. A rectangular bulkhead, 18m wide, is flooded on one side only with water of density 1020kg/m^3.

Calculate EACH of the following:

(a) the depth of flooding if the hydrostatic pressure at the bottom of the bulkhead is 63kN/m^2; (3)

(b) the hydrostatic load on the bulkhead at the depth of flooding determined in Q11(a). (5)

12. A vessel has an underwater volume of 3415m^3 when in water of density 1025kg/m^3.

A double bottom tank 15m long x 12m wide x 2.3m deep, on the centreline, is now completely filled with oil having a relative density of 0.86.

Determine the position of the centre of gravity above the keel, KG, given that the original KG was 6.1m. (8)