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 78 as amended CHIEF ENGINEER REG. III/2 – "YACHT 2"
STCW 78 as amended SMALL VESSEL CHIEF ENGINEER <3000 GT, <9000 kW UNLIMITED

043-12 – GENERAL ENGINEERING SCIENCE II

FRIDAY, 19 OCTOBER 2018

1400 - 1600 hrs

Examination paper inserts:

Notes for the guidance of candidates:

1. Candidates are required to obtain 50% of the total marks allocated to this paper to gain a pass.
2. Non-programmable calculators may be used.
3. 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

GENERAL ENGINEERING SCIENCE II

Attempt ALL questions

Marks for each question are shown in brackets.

1. (a) Define specific heat capacity, stating the SI unit. (3)

   (b) Calculate the heat energy rejected when a mass of 5 kg of brass is cooled from a temperature of 215°C to 25°C. (4)

   Note: for brass c = 0.393 kJ/kgK

2. With reference to combustion in boilers and internal combustion engines, explain EACH of the following:

   (a) the meaning of the term stoichiometric air supply; (2)

   (b) the reasons for supplying excess air; (3)

   (c) the effects of an inadequate air supply. (4)

3. A hydraulic system pipeline consists of a total length of 15 m of steel pipe with an internal diameter of 25 mm and is completely filled with oil.

   During working the temperature of the system rises by 38°C.

   Calculate the overflow volume of the oil in litres. (7)

   Note: $\alpha_{steel} = 1.2 \times 10^{-5}/°C$

   $\gamma_{oil} = 9 \times 10^{-4}/°C$

4. A six cylinder, single acting, two-stroke diesel engine develops a brake power of 1260 kW at a speed of 120 rev/min. The indicated mean effective pressure is 5.5 bar, the mechanical efficiency is 90% and the length of the stroke is 25% greater than the bore.

Calculate EACH of the following:

(a) the cylinder diameter; (7)

(b) the stroke length. (2)

5. (a) Explain the purpose of insulating engineering plant. (6)

(b) List THREE properties of a good insulator. (3)

6. (a) State Charles' Law for a perfect gas. (3)

(b) During a constant pressure process at 15 bar, the temperature of a perfect gas increases from 27°C to 147°C. The initial specific volume is 0.235m^3/kg.

Calculate EACH of the following:

(i) the final specific volume; (3)

(ii) the specific work done. (3)

7. A coil of copper wire at an initial temperature of 18°C takes a current of 2.75 Amps from a 110 Volt supply. After a period of time the current falls to 2.2 Amps for the same supply voltage.

Calculate the temperature rise of the coil. (10)

Note: temperature coefficient of resistance of copper = 0.00425/°C at 0°C

8. (a) State Faraday's TWO Laws of electromagnetic induction. (4)

(b) A magnetic flux of 4.4 mWb is produced by a current carrying coil having 2250 turns. The current direction is completely reversed in one-tenth of a second.

Calculate the average e.m.f. induced in the coil. (5)

9. (a) Explain the term *the internal resistance of an electric cell*, stating the effect it has on the terminal voltage of the cell. (4)

(b) SIX cells, each having an e.m.f. of 2 volts, are connected in series. The internal resistance of each cell is 0.12 Ω and the current flow is 0.5 Amps.

Calculate the terminal voltage. (4)

10. THREE lamps are connected in parallel. EACH lamp has a resistance of 4.4 Ω and draws a current of 5.2 Amps.

Calculate EACH of the following:

(a) the power dissipated by each lamp; (3)

(b) the supply voltage. (4)

11. (a) State the main differences between electromagnets and permanent magnets, giving TWO examples of EACH. (4)

(b) Explain why electromagnets are preferred for industrial applications. (4)

12. (a) Describe *electrical current flow*. (4)

(b) State the essential properties, with reference to atomic structure of EACH of the following:

(i) an electrical conductor; (2)

(ii) an electrical insulator. (2)