Cork Institute of Technology

Bachelor of Science in Nautical Science – Stage 1

National Diploma in Science in Nautical Science – Stage 1

(NFQ – Level 7)

SUMMER 2005

APPLIED NAUTICAL SCIENCE

(Time: 3 Hours)

Section A

1.   (a) In an experiment the speed of sound in air at a temperature of 22^OC was found to be 339 m/s. What would the speed of sound in air be at $8\,^OC$?   (10 marks)

(b) A pilot boat is stopped, awaiting a ship's arrival. The ship is travelling directly towards it at 14 knots. The ship sounds a whistle blast at a frequency of 800 Hz.
Calculate the frequency of the sound heard on the pilot boat. Take the velocity of sound in air as 340 m/s. (1 nautical mile = 1852 m).   (10 marks)

2.   A perfect gas is compressed according to the law PV^N = Constant. The initial condition of the gas is 0.95 bar, 0.35 m^3, and 15^0C. If the pressure after compression is 5.5 bar and the volume is 0.1 m^3 find:
      (a)   The polytropic index n   (8 marks)
      (b)   The mass of gas   (6 marks)
      (c)   The final temperature   (6 marks)
Take R for the gas as 0.287 kJ/kg K

3.   (a) Sketch a sprinkler system suitable for the protection of accommodation spaces in passenger vessels.   (10 marks)
(b) Explain the operation of the system sketched in (a)   (10 marks)

4.   Explain, with the aid of diagram, the process of electro-chemical corrosion of a steel plate in sea water.   (7 marks)

What is meant by the term 'sacrificial anode' and how does it protect a ship's hull? (4 marks)

What metals are used in sacrificial anodes?   (4 marks)

What restrictions apply to the use of sacrificial anodes on tankers?   (5 marks)

5.   State the frequency ranges for Low Frequency, High Frequency and Very High Frequency. (6 marks)

Explain, with the aid of a sketch, the nature of the ionosphere.   (14 marks)

6.   (a) Sketch a sinusoidal waveform and label the amplitude, wavelength and velocity of the wave.   (6 marks)

(b) Explain the difference between transverse and longitudinal waves.   (5 marks)

(c) State the relationship between periodic time and frequency.   (3 marks)

(d) Explain what is meant by the terms 'constructive interference' and 'destructive interference'.   (6 marks)

Section B

Q7.   State Kirchhoff's Laws.

The circuit shown in Fig Q7 is supplied by a 12 volt battery of negligible internal resistance.

Calculate the current flowing in all parts of the circuit.

Q8.   Briefly, with the use of a sketch, explain the operation of a single phase transformer.
A load of resistance 200 Ω is connected to the secondary side of a transformer. The terminal voltage at the secondary is 220V. If the primary is connected to a 440V a/c supply, calculate

(a)   the secondary current

(b)   the turns ratio

(c)   the VA of the transformer

Q9.   Sketch & describe the operation of a simple A.C. generator. Include the direction of the field, motion of the armature and the direction of current in the field.

Q10.   What is meant by Resistivity and why is it used. A wire wound resistor is required to have a resistance of 20Ω, what length of wire is required? The diameter of the wire is 0.25mm and the resistivity of the material is $p = A \times 10^{-8} \Omega m$.

(a)   If the resistor is connected to a 12 volt supply, calculate the power dissipated in the resistor.

(b)   If the above conditions were for 20°C, what would be the power dissipated if the temperature was raised to 45°C.

$$\alpha \quad = 0.00428^{\circ}/C$$

Q11.   A series A/C circuit has a resistance of 15Ω, an inductance of 0.15H and a capacitance of 100 μ F and is connected to a 220 V 50Hz supply.

Calculate (a) the importance of the circuit

(b) the current taken from the supply

(c) the voltage across each component

(d) the power

Sketch the vector diagram.