

DIPLOMA IN NAUTICAL SCIENCE

Term-End Examination

June, 2007

BNA-012 : APPLIED SCIENCE

Time : 2 hours

Maximum Marks : 70

Note :

- (i) This question paper consists of Section A and Section B.
- (ii) In Section A attempt three questions in all. Question No. 1 is **compulsory**.
- (iii) Attempt all questions in Section B.

SECTION A

(Nautical Physics)

Note : Question no. 1 is **compulsory**. Attempt **two** more questions from this section.

1. (a) What do you mean by expansion of liquids ? Define apparent and real expansion of liquids.

A tank is loaded at a temperature of 12 °C. The volume of liquid in the tank is 803 m³. The discharging temperature is estimated to be 31 °C. At this temperature the tank has a capacity of 815 m³. Determine whether the tank has been overloaded.

5

(Volume coefficient of the liquid = $720 \times 10^{-6}/^{\circ}\text{C}$).

(b) Explain the Doppler effect of sound. A ship is moving towards the port with speed v_s giving a siren of frequency f . Calculate the apparent frequency detected by the observer at the port. 5

(c) A small mass of 0.2 kg is attached to one end of a helical spring and produces an extension of 15 mm. The mass is now pulled down 10 mm and set into vertical oscillations of amplitude 10 mm. Determine

- the period of oscillation.
- the maximum kinetic energy of the mass.
- the potential energy of the spring when the mass is 5 mm below the centre of oscillation. 5

($g = 9.8 \text{ m/s}^2$).

2. (a) Define the terms :

work, power, kinetic energy and potential energy.
A body of mass $m = 4.5 \text{ kg}$ is dropped from rest at a height $h = 10.5 \text{ m}$ above the earth's surface. Neglecting air resistance, determine its speed just before it strikes the ground. 5

(b) Assuming the variation of the weight of a body with its position on the earth's surface is due to the rotation of the earth, find the difference in the weight of one gram as measured at the equator and at the poles. 5

(Radius of the earth = $6.378 \times 10^8 \text{ cm}$)

3. (a) Explain the various characteristics of sound. What will be power loss in decibels from 300 mW to 100 mW of a siren ? 5
- (b) Define centre of gravity and centroid. With the help of figures indicate the centroids of a line, a rectangle, a triangle, a semicircle and a parallelogram. Where will be the position of the centroid of a ship ? 5
4. (a) Explain the phenomenon of conduction of heat. Calculate the amount of heat conducted per second through one square metre of the wall if its thickness is 15 cm and its conductivity is 0.0012 S.I. units. The outside and inside temperature is being 35 °C and 28 °C, respectively. 5
- (b) With the help of ray diagram, explain the working of astronomical telescope. 5

SECTION B

(Nautical Chemistry)

Attempt **all** questions in this section.

5. Attempt **all** parts : 4×2

(a) Which of the elements having the following atomic numbers belong to the same group of the periodic table ?

$$Z = 24, 29, 42, 47.$$

(b) Why is rusting of iron faster in sea water ?

(c) What happens when iron sulphide is treated with dilute sulphuric acid ?

(d) How does ionization energy vary across a period ? Explain.

6. Attempt any **three** parts : 3×3

(a) Explain why alcohols have higher boiling points than corresponding isomeric ethers. Illustrate with a suitable diagram.

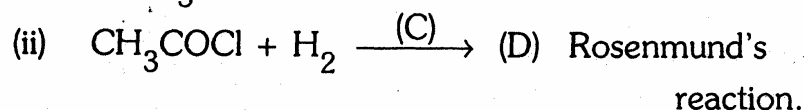
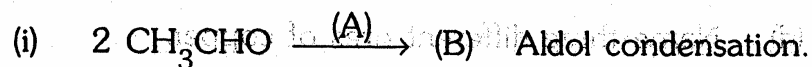
(b) A primary alcohol with vapour density 29 contained C = 62.1% and H = 10.3%. Determine the molecular formula of the compound.

(c) What are ionic compounds ? Give the four characteristics of ionic compounds.

(d) What are the main components of our environment ? Explain three factors responsible for the pollution of the environment.

7. Attempt any **three** parts : 3×3

(a) Identify (A) to (D) as reactant or reagent.



(b) Give three postulates of Bohr's model of atomic structure.

(c) (i) What is corrosion ?

(ii) What are the two methods used to protect a ship's hull from rusting ?

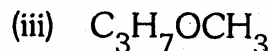
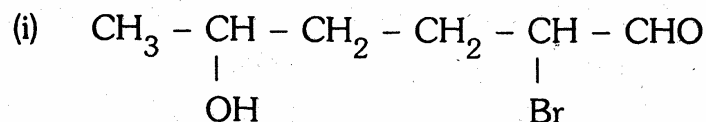
(d) Discuss the halogenation of methane giving appropriate mechanism.

8. Attempt any **three** parts : 3×3

(a) Calculate the total pressure in a 10 L cylinder which contains 0.4 g of helium, 1.6 g of oxygen and 1.4 g of nitrogen at 27 °C. Also calculate the partial pressure of helium gas in the cylinder. Assume ideal behaviour for gases.

Given $R = 0.0821 \text{ L atm/K-mol}$.

(b) Give I.U.P.A.C. names of the following compounds :



- (c) What are the different forms of iron and how do they differ from each other ?
- (d) Name three different ores of copper.