MERCHANT SHIPPING SECRETARIAT
GOVERNMENT OF SRI LANKA
CERTIFICATE OF COMPETENCY EXAMINATION

GRADE : OFFICER IN CHARGE OF A NAVIGATIONAL WATCH ON SHIPS OF 500 GT OR MORE (UNLIMITED)
SUBJECT : **Applied Science**
DATE : 26th Apr 2024 0900Hrs to 1200Hrs

Time allowed THREE hours Total marks : 100
Answer all questions Pass marks : 50%

Formulae and all intermediate steps taken in reaching your answer should be clearly shown. You may draw sketches wherever required. Electronic devices capable of storing and retrieving are **not** allowed

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1.

a. The instant before a batter hits a 0.14-kilogram baseball, the velocity of the ball is 45 meters per second west. The instant after the batter hits the ball, the ball's velocity is 35 meters per second east. The bat and ball are in contact for 1.0×10^{-2} second. Determine the magnitude and direction of the average acceleration of the baseball while it is in contact with the bat.

(4 marks)

b. Define electromagnetic induction.

(3 marks)

c. What are the longest and shortest waves in the electromagnetic spectrum?

(2 marks)

d. A particle rests in limiting equilibrium on a plane inclined at 30^0 to the horizontal. Determine the acceleration with which the particle will slide down the plane when the angle of inclination is increased to 40^0.

(6 marks)

(Total 15 marks)

2.

a. In 1964, the temperature in the Siberian Village of Oymyakon reached -71^0C. What temperature is this on the Fahrenheit scale? (06 marks)

b. The highest officially recorded temperature in Death Valley, California in the United States was 134^0F. What is this temperature on the Celsius scale? (06 marks)

c. An aluminum cup of 100 cm^3 capacity is completely filled with glycerin at 22^0C. How much glycerin, if any, will spill out of the cup if the temperature of both the cup and glycerin is increased to 28^0C?. (The coefficient of volume expansions of glycerin and aluminum are $5.1\times10^{-4}/C^0$ and $69\times10^{-6}/C^0$ respectively).
(08 marks)

(Total 20 marks)

3.

a. An A-5 Vigilante supersonic bomber, with a mass of 21000 kg, departs from its home airbase with a velocity of 400 m/s due east. What is the jet's momentum?

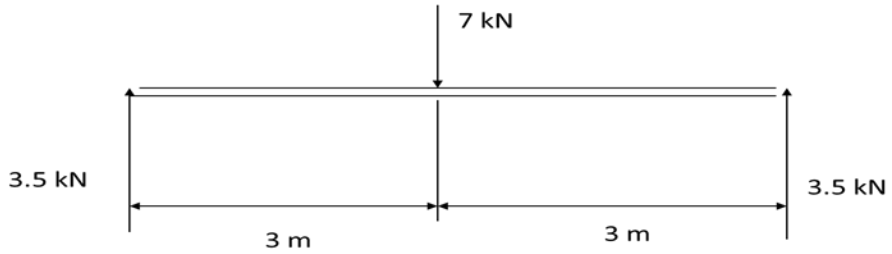
(4 marks)

b. A ray of light is traveling in glass with an index of refraction of n = 1.50 and strikes a glass/air interface. If the angle of incidence is 35°, what is the angle of refraction?

(5 marks)

c. Draw the shear and bending moment diagrams for the beam shown in the Figure.

(6 marks)



(Total 15 marks)

4.

a. Define Anode and Cathode of electrolysis.

(4 marks)

b. Jennifer pushes a sofa 3 meters across the floor by applying a force of 200N. If it takes her 6 seconds to push the sofa, what amount of power did she supply?

(3 marks)

c. Explain how to connect an ammeter and a voltmeter to a circuit.

(4 marks)

d. Motor A lifts a 5000N steel crossbar upward at a constant 2 m/s. Motor B lifts a 4000N steel support upward at a constant 3 m/s. Which motor is supplying more power?

(4 marks)

(15 marks)

5.

a. A compact disc player is designed to vary the disc's rotational velocity so that the point being read by the laser moves at a linear velocity of 1.25 m/s. What is the CD's rotational velocity in revs/s when the laser is reading information on an inner portion of the disc at a radius of 0.03m?

(4 marks)

b. A boat is travelling towards a cliff with a velocity of 10 ms^{-1}. The frequency of its horn is 350 Hz. Find the frequency heard by a boy standing on top of the cliff.(sound speed 330 ms^{-1})

(4 marks)

c. Define the magnetic flux.

(2 marks)

d. Name two applications of diodes.

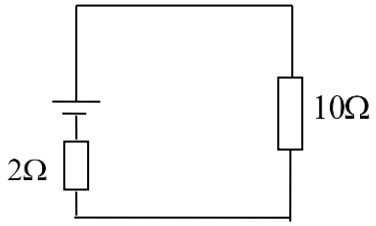
(2 marks)

e. Name 3 types of digital gates.

(3 marks)

(Total 15 marks)

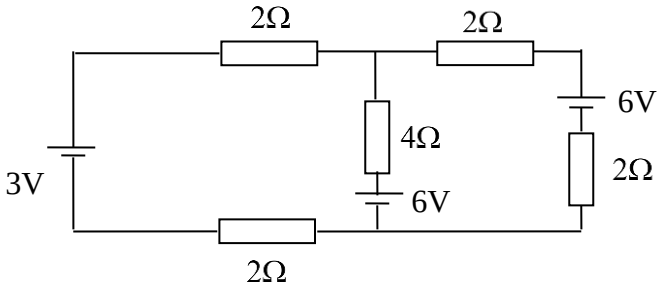
6. A battery with an e.m.f of 12V and internal resistance 2Ω is connected as shown in the figure to a resister of resistance 10Ω. .



a. Calculate the potential difference across the 10Ω resister. (08 marks)

b. Find the magnitude and direction of the current in each of branches of the following circuit.

(12 marks)



(Total 20 marks)