namibia university
OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT

InSTEM

QUALIFICATION: INTRODUCTION TO SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS	
QUALIFICATION CODE: 04STEM	**LEVEL:** 4
COURSE CODE: IPH402S	**COURSE NAME:** INTRODUCTION TO PHYSICS B
SESSION: JANUARY 2023	**PAPER:** N/A
DURATION: 3 HOURS	**MARKS:** 100

SECOND OPPORTUNITY/SUPPLEMENTARY EXAMINATION QUESTION PAPER	
EXAMINER(S)	**Ms Ilana Malan** **Ms Oksana Kachepa**
MODERATOR:	**Mr Anthony Apata**

INSTRUCTIONS
1. Answer all questions.
2. Write all the answers in ink.
3. No books, notes, correction fluid (Tippex) or cell phones allowed.
4. Pocket calculators are allowed.
5. You are not allowed to borrow or lend any equipment or stationary.
6. **Use graph paper for question 14.2**
7. All **FINAL ANSWERS** must be rounded off to **THREE DECIMAL PLACES**.
8. All CONSTANT VALUES and FORMULAS on page 8.

THIS QUESTION PAPER CONSISTS OF 8 PAGES (Excluding this front page)

SECTION A – TOTAL MARKS 30

This section consists of nine (9) questions. Choose the correct answer and clearly indicate your answer on your answer sheet. Answer all the questions.

Question 1 [2]

A hiker shouts towards a vertical cliff 550 m away. The echo is heard 3.2 s later. What is the speed of sound in the air?

(a)   341 m/s
(b)   344 m/s
(c)   333 m/s
(d)   327 m/s

Question 2 [2]

A source of sound approaches observer. The Doppler effect may be described by the observer as:

(a)   The increase in loudness of the sound.
(b)   The increase in wavelength of the sound.
(c)   The increase in frequency of the sound.
(d)   The increase in relative speed of the sound.

Question 3 [4]

A dolphin click is shown on the oscilloscope screen in Fig. 1 with the time-base division set at 30 microseconds per division. What is the frequency of these clicks?
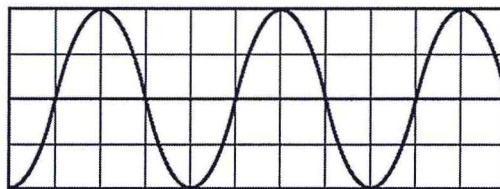

Fig.1

(a)   4 167 Hz
(b)   2 083 Hz
(c)   8 333 Hz
(d)   17 000 Hz

Question 4 [4]

A body of mass 2 kg and volume 5x10⁻⁴ m³ is hung from a balance graduated in Newtons. What would the balance read when the body is fully immersed in paraffin? Density of paraffin is 800 kg/m³.

(a)   15.696 N
(b)   20.399 N
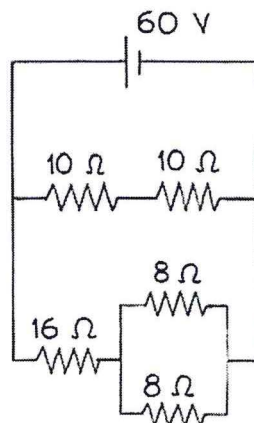(c)   17.883 N
(d)   14.793 N

Question 5 [4]

A manganin wire of radius 0.15 mm has a resistance of 5.33 Ω per metre of length. What is the resistivity of manganin?

(a) 4.895×10^{-6} Ωm
(b) 3.768×10^{-7} Ωm
(c) 1.118×10^{-8} Ωm
(d) 2.813×10^{-7} Ωm

Question 6 [4]

The total resistance of the circuit show in Fig 2 is:

Fig.2

(a)   20 Ω
(b)   30 V
(c)   36 Ω
(d)   10 Ω

2

Question 7   [4]

A transformer outside a house steps the voltage down from V_{in} = 960 volt. What is the voltage output of this transformer if the number of primary coils is 80 and the number of secondary coils is 20.

(a)   480 V
(b)   360V
(c)   120 V
(d)   240 V

Question 8   [4]

If the count rate from a radioactive source is 648 counts per minute and it drops to 81 counts per minute in 45 minutes, what is the half-life of the source?

(a)   450 s
(b)   150 s
(c)   600 s
(d)   900 s

Question 9   [2]

What is the wavelength of light in which the photons have energy of 500 eV?

(a)   2.5 nm
(b)   3.7 nm
(c)   2.8 nm
(d)   6.3 nm

This Section consists of six (6) questions. Answer ALL the questions.

Question 10   **[13]**

10.1   Distinguish between the longitudinal wave and the transverse wave in terms
         of the motion of the particles and give one example of each.   (4)

10.2   The Fig. 3 represents the wavefronts spreading out from two coherent sources.
         The solid circles indicate the crests of waves and the broken lines indicate the
         troughs of waves. State the type of interference observed at points A, B and D.   (3)
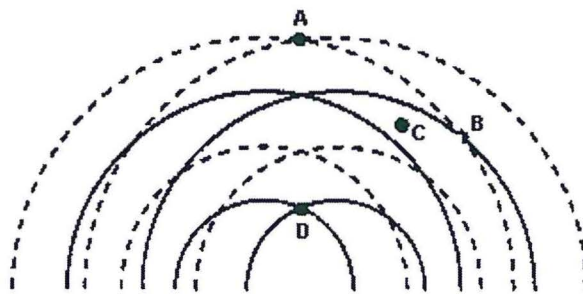
Fig.3

10.3   A train passes a stationary student at a constant speed while sounding its whistle.
         The frequency of the whistle changes, as measured by the student and these
         changes are shown in Fig. 4.
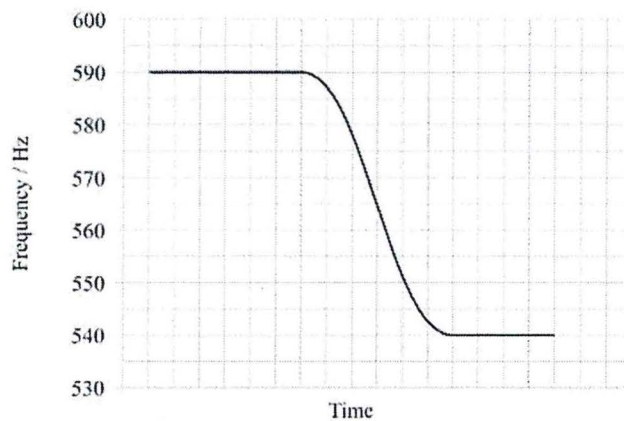
Fig. 4

10.3.1   Determine the speed of the train.   (4)

10.3.2   Determine the frequency of the whistle heard by the observer on the train.   (2)

Question 11   [17]
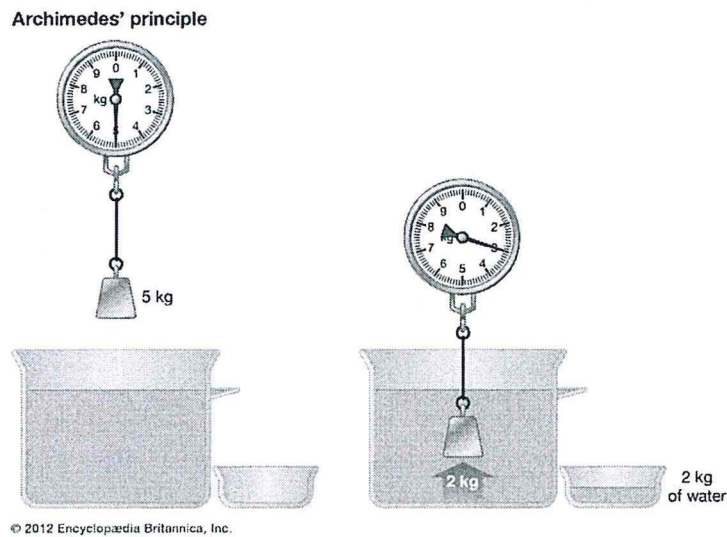
11.1   Using information from Fig.5 determine the following:

11.1.1   The buoyant force acting on the object fully immersed in water.   (2)

11.1.2   Volume of the object.   (2)

11.1.3   Density of the object.   (2)

Archimedes' principle

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Fig.5

11.2   A solid cube of wood floats on the 36 cm² side in the container filled with oil.
         Determine the visible height of the cube above the oil surface.   (4)

11.3   Describe an ideal fluid?   (3)

11.4   Blood is flowing through an artery of radius 2 mm at a rate of 40 cm/s.
         Determine the volume of blood that passes through the artery in a period of
         24 hours. Express your answer in litres.   (4)

Question 12 [13]

12.1 The battery with an e.m.f. of 12 V and negligible internal resistance supplies current to four resistors connected as shown in Fig. 6. Using the Kirchhoff's laws determine the currents I_1, I_2 and I_3 if: (10)

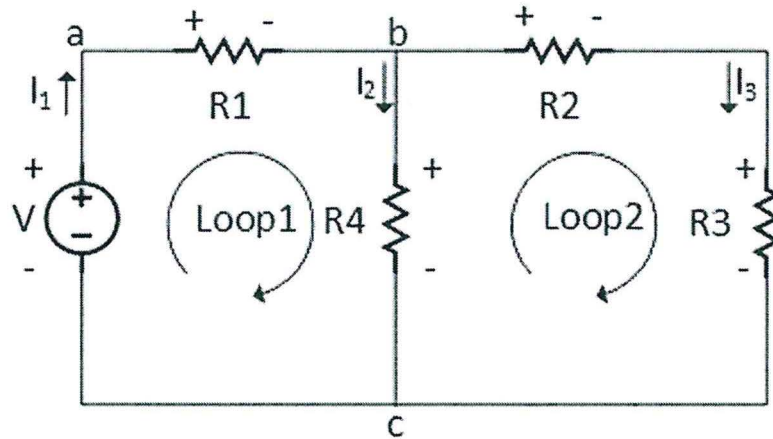$R_1 = 2\ \Omega$ $R_2 = 3\ \Omega$ $R_3 = 1.5\ \Omega$ $R_4 = 1\ \Omega$.

Fig.6

12.2 Three cells each with an emf of 2 V and each with an internal resistance of 0.15 Ω, are connected to three external resistors. The 5 Ω and 7 Ω are connected in parallel with each other. The third resistor of 49/30 Ω is connected in series to the two parallel resistors. Determine the total current when:

12.2.1 the cells are connected in series (2)

12.2.2 the cells are connected in parallel (3)

Question 13 [12]

13.1 Explain two ways how the current can be induced in the coil. (2)

13.2 Give three ways in which induced current can be increased. (2)

13.3 Explain how a transformer works. (5)

13.4 The turns ratio of a step-down transformer is 6:3 with 600 turns on the secondary coil. When an AC pd of 50 V is connected to the primary coil, current of 20 mA flows in it. Determine current in the secondary coil. State any assumption(s). (3)

Question 14 [9]

Caesium-137 is a radioactive isotope of caesium which is formed by the nuclear fission of uranium-235. It decays by beta emission.

14.1 If 120 g of Caesium-137 is stored in concrete, how many years will it take for its mass to decrease to 7.5 g? Show your working using a table. (4)

14.2 On the graph paper provided draw the decay curve for Caesium-137. (5)

Question 15 [6]

15.1 Define the work function of a metal. (2)

15.2 A zinc cathode was illuminated by electromagnetic radiation of wavelength 210 nm. Determine the maximum speed of the emitted electrons. (4)

LIST OF CONSTANTS:

g = 9.81 m/s^2
density of water = 1000 kg/m^3
density of wood = 530 kg/m^3
density of oil = 950 kg/m^3
density of paraffin = 800 kg/m^3.
speed of sound in the air = 340 m/s
speed of light in vacuum = 3 x 10^8 m/s
half-life of Caesium-137 = 30 years
mass of electron = 9.1 x 10^{-31} kg
charge of electron=1.6x10^{-19} C
Planck constant = 6.626 x 10^{-34} Js
work function of Zinc = 4.3 eV
1 eV = 1.6 x 10^{-19} J
1 ml = 1 cm^3

List of equations

$$v = f\lambda$$

$$P = \frac{F}{A}$$

$$P = \rho g h$$

$$F_B = W_f$$

$$\rho = \frac{m}{V}$$

$$\text{flow rate} = \frac{V}{t} = Av$$

$$A_1 v_1 = A_2 v_2$$

$$Q = \frac{I}{t}$$

$$power = VI$$

$$f_o = f\left(\frac{v \pm u}{v}\right)$$

$$f_o = f\left(\frac{v}{v \pm u}\right)$$

$$emf = \left(I_T R_T\right) + \left(I_T r_T\right)$$

$$R = \rho \frac{A}{L}$$

$$C = \frac{Q}{V}$$

$$power_p = power_s$$

$$E = hf = \phi + KE$$

$$N_p : N_s = V_p : V_s$$

AMalan

17 October 2022