



PAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING

InSTEM

QUALIFICATION: INTRODUCTION TO SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS	
QUALIFICATION CODE: 04STEM	LEVEL: 4
COURSE CODE: IPH402S	COURSE NAME: INTRODUCTION TO PHYSICS B
SESSION: NOVEMBER 2022	PAPER: N/A
DURATION: 3 HOURS	MARKS: 100

FIRST OPPORTUNITY EXAMINATION QUESTION PAPER	
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INSTRUCTIONS
<ol style="list-style-type: none">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. All FINAL ANSWERS must be rounded off to THREE DECIMAL PLACES.7. All CONSTANT VALUES and FORMULAS on page 9.

THIS QUESTION PAPER CONSISTS OF 9 PAGES (Excluding this front page)

SECTION A – TOTAL MARKS 30

This section consists of ten (10) questions. Choose the correct answer and clearly indicate your answer on your answer sheet. Answer all the questions.

QUESTION 1 [2]

What is the difference between a transvers wave and a longitudinal wave?

- (a) medium particles do not vibrate in the same direction
- (b) sound waves are transverse waves
- (c) all EM radiation are examples of longitudinal waves
- (d) only longitudinal waves are progressive eaves

QUESTION 2 [4]

What is the effective capacitance of the combination of capacitors shown in Figure 1?

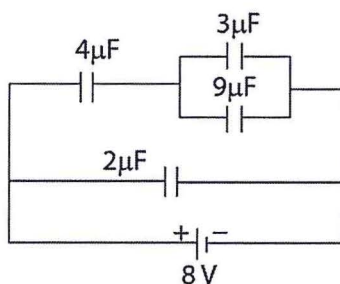


Figure 1

- (a) 18 μF
- (b) 0.833 μF
- (c) 5 μF
- (d) 1.515 μF

QUESTION 3 [4]

A copper wire of cross-sectional area 2 mm² carries a current of 10 A. How many electrons pass through the wire in half an hour?

- (a) 6.25 x 10¹⁹
- (b) 1.13 x 10²³
- (c) 2.88 x 10⁻¹⁵
- (d) 18 000

QUESTION 4**[2]**

Choose the correct statement:

- (a) there is a slight delay in the flow of electric current as soon as the switch is closed
- (b) charged particles in electrolytes include electrons
- (c) current can be seen as the flow of protons
- (d) only electrons carry the elementary charge

QUESTION 5**[4]**

Four cells, each with an emf of 2 V and an internal resistance of 0.2Ω are connected in parallel to each other and to one an external resistor of 2Ω . Calculate the total current.

- (a) $\frac{40}{41}$ A
- (b) $\frac{41}{40}$ A
- (c) $\frac{5}{7}$ A
- (d) $\frac{20}{7}$ A

QUESTION 6**[2]**

Choose the correct statement:

- (a) the right hand grip rule is used to determine current in a straight wire
- (b) the right hand rule is used to determine current in a straight wire
- (c) the right hand grip rule determines the magnetic field around a straight conductor
- (d) the right hand rule determines the magnetic field around a straight conductor

QUESTION 7**[4]**

A 98.1 N piece of iron has an apparent mass of 9.0094 kg when submerged in an unknown liquid. What is the name of the liquid?

- (a) water
- (b) alcohol
- (c) oil
- (d) seawater

QUESTION 8**[2]**

A fast-moving fire truck emits an 880 Hz siren. The pitch heard by a stationary observer, changes by 56 Hz. The observed frequency while the truck is receding is:

- (a) 880 Hz
- (b) 56 Hz
- (c) 936 Hz
- (d) 824 Hz

QUESTION 9**[4]**

A step-down transformer has a turns ratio of 12:4. When an alternating pd of 0.3 kV is connected to the primary coil, a current of 30 mA flows in it. Determine the current in the secondary coil if the percentage power loss in the transformer is 10 %.

- (a) 81 mA
- (b) 90 mA
- (c) 0.9 mA
- (d) 27 mA

QUESTION 10**[2]**

A decay graph does not have a straight line because:

- (a) the same number of particles decay with every half life
- (b) the sample size decrease with the same amount every half life
- (c) the portion of undecayed particles decrease after every decay period
- (d) the half-life does not remain the same throughout the decay process

SECTION B – TOTAL MARKS 70

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

QUESTION 11

[10]

11.1 Answer questions 11.1.1 to 11.1.3 with regards to **Figure 2**.

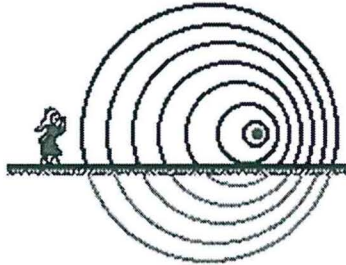


Figure 2

11.1.1 What effect is depicted in **Figure 2**? (1)

11.1.2 Will the observer in **Figure 2** hear a lower or higher frequency? Give a reason for your answer. (2)

11.1.3 Determine the speed with which the source is moving if the observer hears the frequencies 800 Hz and 900 Hz. (4)

11.2 Determine the speed of the wave from **Figure 3**. (3)

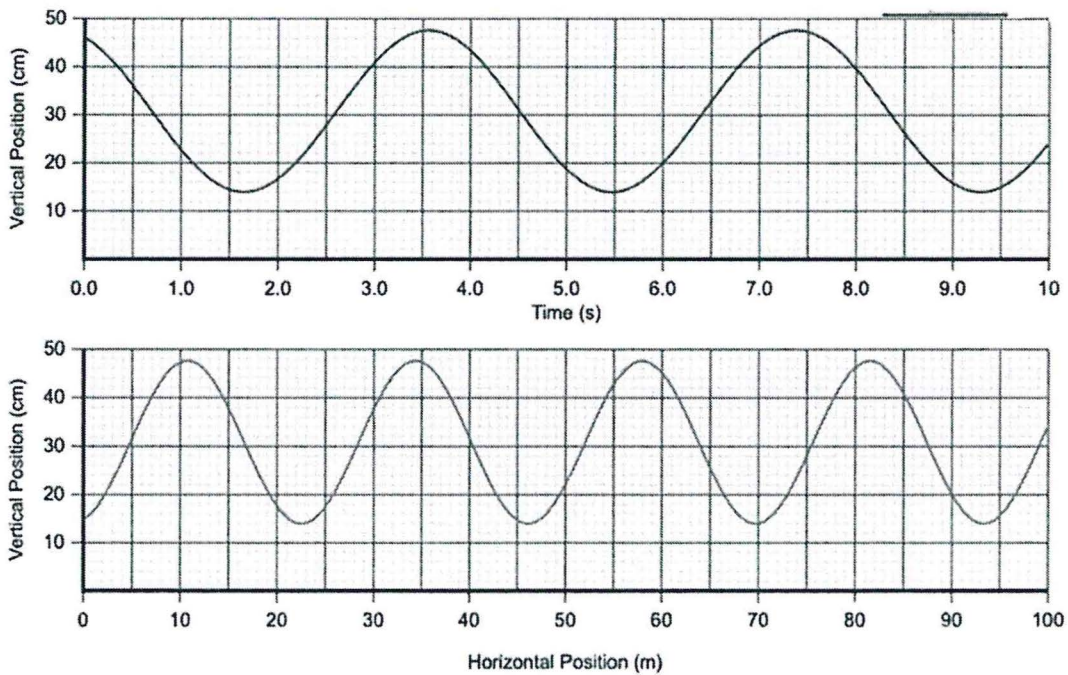


Figure 3

QUESTION 12

[12]

- 12.1 In which case(s) of objects placed in a fluid will $V_{\text{object}} = V_{\text{displaced}}$? Explain. (2)
- 12.2 State two characteristics of an ideal fluid. (2)
- 12.3 A piece of dolomite rock with a density of 2.9 g/cm^3 is placed in a graduated cylinder filled with seawater, see **Figure 4**. The level of the seawater rises to 68 ml. Determine the apparent mass of the stone in the seawater. (4)

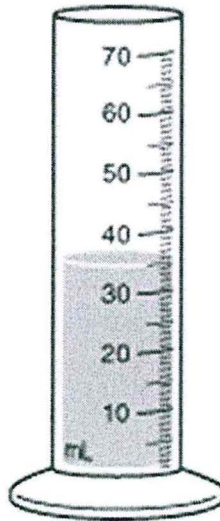


Figure 4

- 12.4 The cylinder in **Figure 4** is emptied, the rock is removed and then filled with alcohol using a plastic tube with a very small diameter. If it takes 2 minutes and 37 seconds to fill to the halfway mark, what is the mass flow rate? (2)
- 12.5 At what velocity does the alcohol flow with the tube having a diameter of 3 mm. (2)

QUESTION 13

[16]

- 13.1 Discuss what you understand with the emf voltage measured in a circuit and electrical energy. (2)
- 13.2 Define electrical power. (1)
- 13.3 Determine currents I_{18} , I_{12} and I_{36} in **Figure 5** using Kirchoff's laws. (9)

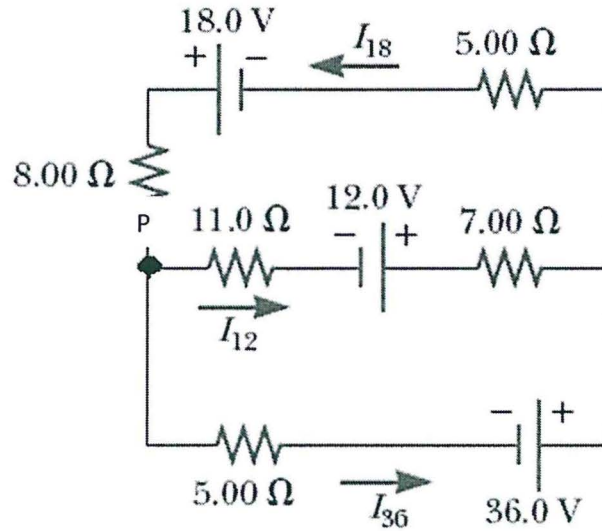


Figure 5

- 13.4 How do the plates of the capacitor become positive and negatively charged? (2)
- 13.5 Calculate the total charge stored on two capacitors connected in parallel. The two capacitors are $70 \mu\text{F}$ and $120 \mu\text{F}$ and are connected to a 20 V supply. (2)

QUESTION 14

[14]

- 14.1 How would you use the right-hand grip rule? (2)
- 14.2 What will happen in a piece of metal wire that is moved perpendicular to a magnetic field? (2)
- 14.3 How is it possible for current to flow in the secondary coil of a transformer without any physical connection to the primary coil? (2)
- 14.4 Answer questions 14.4.1 to 14.4.3 with reference to **Figure 6**.

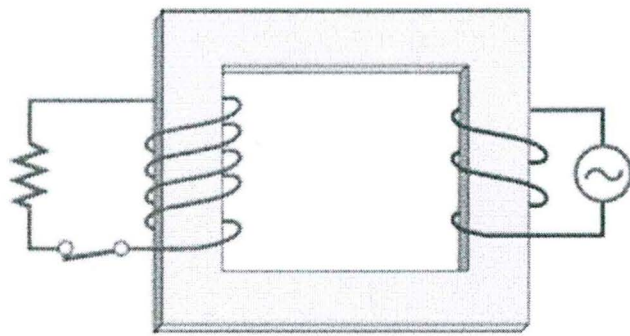


Figure 6

- 14.4.1 Is this a step-up or step-down transformer? Give a reason for your answer. (3)
- 14.4.2 Input voltage = 220 V. The turns on the two coils are 2800 and 700. Determine V_s . (1)
- 14.4.3 With the resistor = 660 Ω and the efficiency of the transformer 78 %, determine the current in the primary coil. (4)

QUESTION 15**[10]**

- 15.1 Distinguish between the terms nucleon and nuclide. (2)
- 15.2 Why do the alpha and beta particles have such different masses? (2)
- 15.3 After 966 days 99.21875 % of a sample of a radioactive element has undergone decay. Use a decay table to determine the number of half-lives and the time for one half life. Identify the element from the constants on page 9. (6)

QUESTION 16**[8]**

- 16.1 What is a photon? (1)
- 16.2 Briefly describe the photo electric effect. (2)
- 16.3 When radiation with wavelength 440 nm is used during the photo electric effect, electrons with a velocity of 1.6×10^5 m/s is observed. Identify the material looking at the work functions on page 9. (5)

LIST OF CONSTANTS:

$g = 9.81 \text{ m/s}^2$
 density of water = 1000 kg/m^3
 speed of sound in the air = 340 m/s
 speed of light in vacuum = $3 \times 10^8 \text{ m/s}$
 mass of electron = $9.1 \times 10^{-31} \text{ kg}$
 density of iron = 7874 kg/m^3
 density of seawater = 1023 kg/m^3
 $1 \text{ ml} = 1 \text{ cm}^3$

density of wood = 530 kg/m^3
 density of copper = 8.9 g/cm^3
 $1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$
 Planck constant = $6.626 \times 10^{-34} \text{ Js}$
 charge of electron = $1.6 \times 10^{-19} \text{ C}$
 density of alcohol = 780 kg/m^3
 density of oil = 950 kg/m^3

Radioactive element	Half life (days)
Cadmium	463
Cobalt-57	271
Cesium	138

Material	Work function (eV)
Sodium	2.75
Zinc	4.3
Potassium	2

List of equations

$v = f\lambda$	$P = \frac{F}{A}$	$P = \rho gh$
$F_B = W_f$	$\rho = \frac{m}{V}$	flow rate = $\frac{V}{t} = Av$
$A_1v_1 = A_2v_2$	$Q = \frac{I}{t}$	power = VI
$f_o = f \left(\frac{v \pm u}{v} \right)$	$f_o = f \left(\frac{v}{v \pm u} \right)$	emf = $(I_T R_T) + (I_T r_T)$
$R = \rho \frac{L}{A}$	$C = \frac{Q}{V}$	power _p = power _s
$E = hf = \phi + KE$	$N_p : N_s = V_p : V_s$	

Mela

17 October 2022