



COLLEGE OF HEALTH, AGRICULTURE AND NATURAL SCIENCES

DEPARTMENT OF PUBLIC HEALTH AND NURSING

COURSE CODE: SNS1204 COURSE NAME: BIOPHYSICS

END OF SECOND SEMESTER EXAMINATIONS

APRIL/MAY 2026

LECTURER: Dr H NYAKOTYO

DURATION: 3 HRS

INSTRUCTIONS

You are required to answer questions as instructed in each section

Start **each** question on a new page in your answer booklet

Answer **ALL** parts of the question in **Section A** and any **THREE** questions from Section B. Each question carries 20 marks

Section A carries 40 marks and each question in Section B carries 20 marks.

Credit will be awarded for logical, systematic and neat presentations

PHYSICAL CONSTANTS

$R = 8.31 \text{ J/(K}\cdot\text{mol)}$

Permittivity of free space, $\epsilon_0 = 8.85 \times 10^{-12} \text{ Fm}^{-1}$

Permeability of free space, $\mu_0 = 4\pi \times 10^{-7} \text{ Hm}^{-1}$

Mass of electron, $m_e = 9.11 \times 10^{-31} \text{ kg}$

Mass of proton, $m_p = 1.67 \times 10^{-27} \text{ kg}$

Avogadro constant, $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$

Universal Gravitation Constant, $G = 6.7 \times 10^{-11} \text{ Nm}^2\text{kg}^{-2}$

Acceleration due to gravity, $g = 9.8 \text{ ms}^{-2}$

SECTION A

QUESTION 1

- (a) Clearly distinguish between *random error(s)* and *systematic error(s)*. Give an example of each type of error. [4]
- (b) A 50 N force pushes a 20 kg cart a distance of 20 m, but must overcome a 20 N frictional resistance force.
- (i) What is the *resultant force* acting on the cart? [2]
- (ii) Calculate the work done by the resultant force. [2]
- (iii) If the cart starts from rest, what will be its velocity at the end of the 20 m distance? [2]
- (c) Explain concisely what is meant by following terms:
- (i) Scalar quantity [2]
- (ii) Accuracy of a measurements [2]
- (iii) Precision of a set of measurements [2]
- (iv) Work [2]
- (d) State Newton's first law of motion [2]
- (e) A man exerts a force of a 50 N on a heavy cart and pushes it 60 m in 100 s. Calculate the power used in pushing the cart. [5]

(f) The table below shows the properties of sub-atomic particles. Fill in the missing information.

PARTICLE	RELATIVE MASS	RELATIVE CHARGE	CHARGE (C)
Proton			$+1.6 \times 10^{-19}$
	1		
Electron		-1	

[7]

(g) What is ultrasonic sound? State any two medical uses of ultrasound. [4]

(h) Distinguish between *temperature* and *internal energy*. [4]

SECTION B

QUESTION 2

(a) (i) State Ohm's law. [2]

(ii) Calculate the value of resistance R in the circuit in Figure 1. [4]

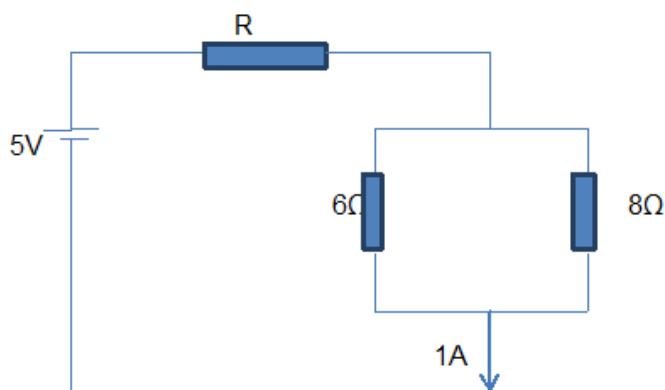
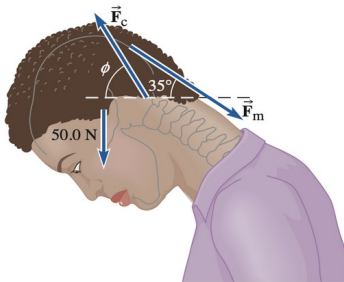


Figure 1

(b) The equipment used for an ECG test had a power rating of 11000 W. Calculate the current needed by this equipment if the voltage at the mains is 120V. [4]

(c) A student's head is bent over her physics book. The head weighs 50.0 N and is supported by the muscle force $\vec{F}_m$ exerted by the neck extensor muscles and by the contact force $\vec{F}_c$ exerted at the atlantooccipital joint. Given that the magnitude of $\vec{F}_m$ is 60.0 N and is directed 35° below the horizontal. Find the magnitude of $\vec{F}_c$. [10]



QUESTION 3.

(a) Discuss three ways in which heat can be transferred between two points. [6]

(b) The skin temperature of a patient is 40°C and the temperature of the environment surrounding him is 23°C . If the total skin area is 2 m^2 and the radiation efficiency is 0.9, calculate the rate of loss of heat by the patient to the surroundings. [8]

(c) A medication at the bed-side of this patient states that it should be kept below a temperature of 35°C or -31°F . Determine whether the two temperatures are the same [6]

QUESTION 4.

(a) _____ across a resistor in a purely resistive circuit is given by $V_R = 10 \sin 2\pi t$

i. What is the peak voltage across the resistor? [1]

- ii. What is the angular frequency of the ac voltage? [1]
- iii. Determine the period of the ac voltage. [2]
- iv If the value of the resistance is $2\ \Omega$, write the equation for the ac current. [2]

(b) Outline the major differences in the penetrating power and ionizing ability of the three types of radiation emitted by an unstable nucleus. [8]

(c) A radioactive isotope used for an organ scan has a physical half-life of 8 days. Given that the biological half-life of the isotope is 3 days, calculate:

- (i) The effective half-life [3]
- (ii) The remaining dosage after 12 days if the initial amount was $100\ \mu\text{Cu}$. [3]

QUESTION 5.

Define the following terms:

- (a)(i) Gray [2]
- (ii) Becquerel [2]
- (iii) Half-life [2]

(b) Outline the major differences in the penetrating power and ionizing ability of the three types of radiation emitted by an unstable nucleus. [8]

(c) A radioactive isotope used for an organ scan has a physical half-life of 8 days. Given that the biological half-life of the isotope is 3 days, calculate:

- (i) The effective half-life. [3]
- (ii) The remaining dosage after 12 days if the initial amount was $100\ \mu\text{Cu}$. [3]

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