PRIFYSGOL ABERYSTWYTH UNIVERSITY

ADRAN FFISEG

DEPARTMENT OF PHYSICS

SEMESTER 2 EXAMINATIONS, MAY 2026

PH04520 – Introduction to Fundamentals of Physics II

Time allowed – 3 hours

- **Full marks can be attained for complete answers to ALL eight questions in Section A and TWO questions from Section B**
- **The numbers in brackets after the questions indicate the allocation of marks for each question.**
- **Only calculators from the Casio FX83, FX85 or FX991 range may be used.**
- **A booklet of mathematical formulae and standard constants will be provided.**
- **MAE MODD I FYFYRWYR GYFLWYNO ATEBION I'R PAPUR HWN NAILL AI YN Y GYMRAEG NEU'R SAESNEG**
- **STUDENTS MAY SUBMIT ANSWERS TO THIS PAPER IN EITHER WELSH OR ENGLISH**

Once seated, students may complete the front cover of the answer book(s) and the attendance slip ONLY.

DO NOT TURN THE EXAMINATION QUESTION PAPER OVER UNTIL INSTRUCTED TO DO SO.

Section A

Attempt ALL questions in the booklet provided

1 An object in Simple Harmonic motion has a velocity of 0.04 ms^{-1}, a displacement of 0.03 m, and an amplitude of 0.05 m from the centre of oscillation. Calculate the angular frequency and period of oscillation. [5]

2 A 50 g mass oscillates with simple harmonic motion at the end of a spring. The amplitude of the motion is 12 cm and its frequency is 0.588 Hz. Calculate the maximum acceleration of the mass. [5]

3 The equation $y = 3\sin(4x - 5t)\ metres$ represents a wave in a medium. Determine the values of the following wave parameters: [5]

i) amplitude,

ii) wavenumber,

iii) angular frequency,

iv) direction of the wave.

4 In a Young's double slit experiment, the distance between the first and the fifth bright fringes on a screen is 2 mm. The screen is placed 1 m from the slits and the wavelength of the monochromatic light used is 6.33×10^{-7}m. Calculate the separation between the two slits. [5]

5 Write the formulas for the equivalent capacitance of C_1, C_2, and $C_3$when they are connected in series and in parallel. If $C_1 = C_2 = C_3 = 10\ \mu F$, calculate the equivalent capacitance for both cases and state which configuration gives the larger capacitance. [5]

6 Explain the difference between Ohmic and non-Ohmic materials. Using the resistance formula, state the factors that determine the resistance of a resistor, [5]

7 Calculate the voltage between two parallel plates, separated by 0.01 m, to suspend a particle of mass 0.05 kg carrying a charge of $2\ \mu C$? [5]

8 State what is meant by the force on a current-carrying wire placed in a magnetic field. Write the expression for the magnitude of this force and explain the terms involved. [5]

Section B

Answer TWO questions

9 a) A progressive wave is represented by the equation $y = 12\sin(2x - 6t)$ m. A particle is located at position $x = 2$ m. Calculate:

i) the displacement of the particle at time $t = 0$,

ii) the velocity of the particle at time $t = 0$.

[6]

b) The speed of sound in air at sea level is 339 m s^{-1}.

i) Calculate the wavelength of a note whose frequency is 420 Hz.

ii) Determine the frequency of a sound wave whose wavelength is 2 m.

iii) State the type (nature) of sound waves.

[7]

c) State the nature (type) of X-rays. An X-ray has a wavelength of 120 nm. Calculate the frequency and time period of the wave.

[7]

10 a) State the factors that affect the capacitance of a capacitor. Write the mathematical expression for the capacitance of a parallel-plate capacitor.

[4]

b) In a Millikan oil-drop experiment, an oil droplet of mass 10 g is held stationary between two parallel plates separated by 10 mm when a potential difference of 1000 V is applied across the plates. Calculate the electric field between the plates, weight of the droplet, and charge on the droplet.

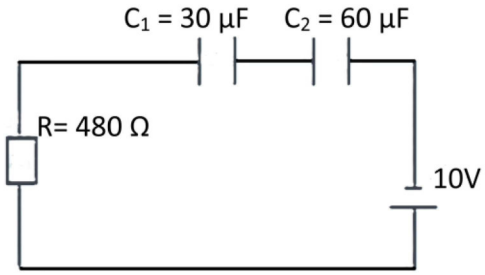
[8]

c) A 480 Ω resistor is connected in series with two capacitors of 30 μF and 60 μF across a 10 V DC supply. The capacitors are initially uncharged. Calculate,

i) the effective capacitance of the circuit,

ii) the charge stored on each capacitor when fully charged,

iii) the time constant of the circuit.



[8]

11 a) In an RLC electrical circuit, the supply frequency is 10 kHz. The capacitance of the capacitor is 1 μF and the inductance of the inductor is 1 mH. The resistance of the circuit is 20 Ω. Determine the individual reactances of the capacitor and the inductor (in ohms) and hence calculate the impedance of the circuit.

[8]

b) Define any two of the following,

i) total internal reflection related to the critical angle

ii) polarisation of the electromagnetic wave and state types of polarisation

iii) Lenz's law, show the mathematical expression of Lenz's law,

iv) State the equation of Coulomb's Law and state its terms.

[8]

c) Two resistors, $R_1 = 40\,\Omega$ and $R_2 = 80\,\Omega$, are connected in series with a 12 V voltage source. Calculate the equivalent resistance of the circuit and the total current flowing through it.

[4]

END OF PAPER