UNIVERSITI KUALA LUMPUR
KAMPUS CAWANGAN MALAYSIAN SPANISH INSTITUTE

FINAL EXAMINATION
JULY 2023 SEMESTER

COURSE CODE	:	SSP01304
COURSE NAME	:	PHYSICS 1
PROGRAMME NAME	:	FOUNDATION IN SCIENCE AND ARTS
DATE	:	28 DECEMBER 2023
TIME	:	9.00 AM – 11.00 AM
DURATION	:	2 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please CAREFULLY read the instructions given in the question paper.

2. This question paper has information printed on both sides of the paper.

3. This question paper consists of TWO (2) sections; Section A and Section B.

4. Answer ALL questions in Section A and answer TWO (2) questions only in Section B.

5. Please write your answers on the answer booklet provided.

6. Answer all questions in English language ONLY.

7. Formula table has been appended for your reference.

THERE ARE 8 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (Total: 60 marks)

INSTRUCTION: Answer ALL questions.

Please use the answer booklet provided.

Question 1

(a)   Brad has a job at a construction site. He often uses power tools on the site. A hand-held circular saw (Figure 1) contains a disc-shaped blade that spins rapidly to cut through wood. The axle is fixed through the centre of the blade. An electric motor makes the axle spin, and then in turn makes the blade spin.
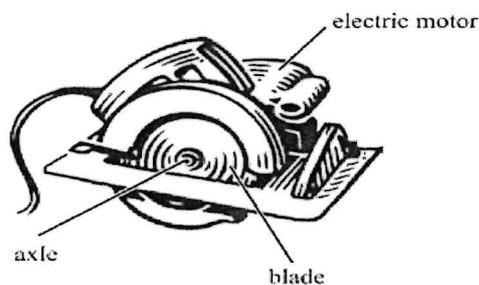

Figure 1

    i.   When operated at full speed with no load, the blade rotates at 4500 rpm. Show that the angular velocity of the blade is 471 rads^{-1}.

(2 marks)

    ii.   Brad then turns off the switch. If it takes 7.5 s to stop from a full speed, calculate its angular acceleration.

(2 marks)

    iii.   Calculate the angular displacement of the blade in this 7.5 s.

(2 marks)

(b)   A cyclist goes round a circular track, of radius 10 m, at a constant speed of 8.0 m s^{-1}.

    i.   What is the acceleration of the cyclist?

(2 marks)

    ii.   What is the resultant force on the cycle and the rider if together they have a mass of 90 kg?

(2 marks)

Question 2

(a)   State Newton's law of gravitation.

(2 marks)

(b)   Define gravitational field strength.

(2 marks)

(c)   A 100 kg satellite of the Earth is at an altitude 2.0×10^6 m.

i.   Calculate the gravitational potential energy of the satellite- Earth system.

(2 marks)

ii.   Calculate the magnitude of the gravitational force exerted by the Earth on the satellite.

(2 marks)

iii.   Calculate the force exerted by the satellite on the Earth.

(2 marks)

Question 3

(a)   Define:

i.   Stress and the given SI unit.

(2 marks)

ii.   Strain

(1 mark)

(b)   A 180 kN tensile force is applied to a metal wire of length 2 cm and radius 40 mm. If its elongation is 0.05 mm, calculate:

i.   Tensile stress

(4 marks)

ii.   Tensile strain

(3 marks)

Question 4

(a)   State:

      i.   Archimede's principle

(2 marks)

      ii.   Bernoulli's principle

(2 marks)

(b)   A boat with its cargo has a total mass of 1.2×10^7 kg. Calculate:

      i.   The upthrust on the boat when it is in stable equilibrium.

(2 marks)

      ii.   The volume of the boat below the water line.

Density of water	1000 kgm^{-3}

(2 marks)

(c)   Discuss the importance of the correct loading of the container ship with regards to light and heavy containers.

(2 marks)

Question 5

(a) In ice-skating, the dancer as shown in Figure 2 below can increase her number of turns by folding her arms to her body. Explain, why folding her arms can increase her number of turns?
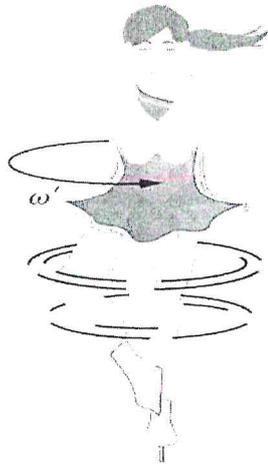

Figure 2

(3 marks)

(b) Alice is skating on ice at 3.27 rads^{-1} and has a moment of inertia of 0.24 kgm^2. Calculate the angular momentum of Alice while skating on ice.

(2 marks)

(c) A satellite is orbiting at height of 596 km above the Earth's surface. Calculate:

i. Its speed

(3 marks)

ii. The period of revolution in the orbit

(2 marks)

Question 6

(a)   Figure 3 below shows some smoke rising. At **A**, the type of fluid flow changes. Describe the fluid flow below and above point **A**.
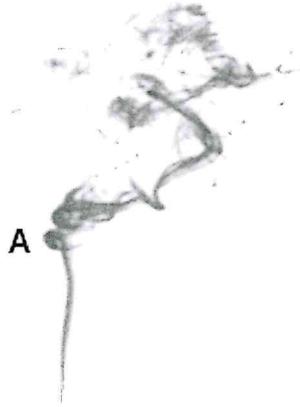

Figure 3

(4 marks)

(b)   A Slinky is a long spring made of metal. One end of a Slinky is fixed to the ceiling. The force acting on the Slinky was varied by hanging weights from the other end. The graph in Figure 4 shows the results.
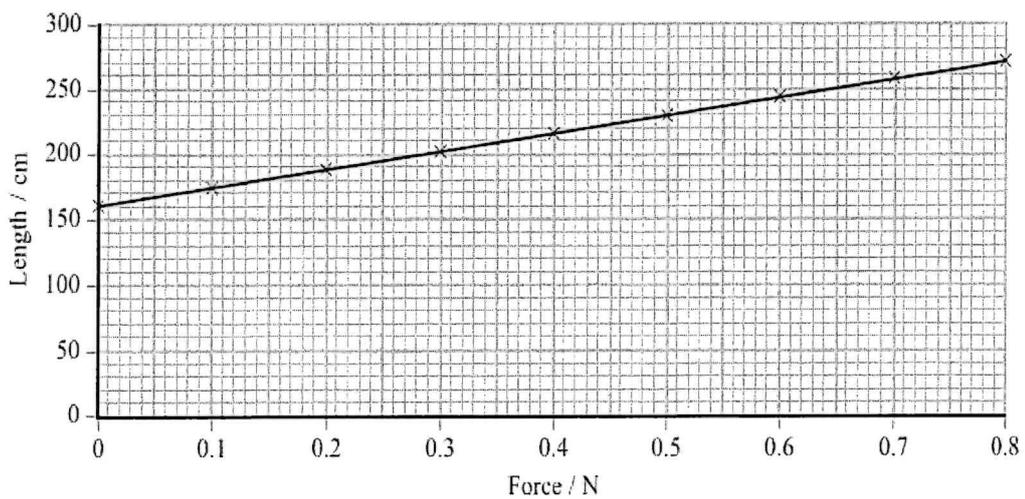

Figure 4

i.   Explain whether the results follow Hooke's law.

(3 marks)

ii.   Show that the stiffness, k of the Slinky is about 0.7 Nm^{-1}.

(3 marks)

SECTION B (Total: 40 marks)

INSTRUCTION: Answer only TWO questions ONLY.

Please use the answer booklet provided.

Question 1

(a) At 0^0 C, the density of a gold bar is 19300 kgm^{-3} while its Young's modulus is 77.2 GPa.

    i.   Calculate the speed of sound waves in the gold bar.

(4 marks)

    ii.   Evaluate the speed of sound waves in the gold bar at 100^0 C.

(4 marks)

    iii.   Determine the temperature value when the sound waves speed reduces to $\frac{1}{3}$ of its speed at 0^0 C.

(4 marks)

(b) A military jet takes off from a runway. The sound level heard by a sergeant, standing 50 m away, is 145 dB. Meanwhile, a general is sitting 100 m away.

    i.   Calculate the intensity of sound waves heard by the sergeant.

(4 marks)

    ii.   Evaluate the intensity of the sound heard by the general.

(4 marks)

Question 2

(a)   A spring-mass of 18 Nm⁻¹ and a 5 kg block its end.

    i.   Determine its frequency.

(4 marks)

    ii.   Calculate its restoring force at -0.12 m from equilibrium.

(4 marks)

    iii.   Evaluate potential energy at 0.18 m from equilibrium.

(4 marks)

(b)   A chimpanzee swings on a rope hanging from a tree. The distance of the swinging motion from end to end is 15 m while its period is 2.5 s. Write down the sinusoidal SHM equation if the swinging had started from the + maximum displacement position.

(4 marks)

(c)   A jackhammer oscillates at velocity according to $v = 0.8 \sin 3t$ (ms⁻¹). Derive the equation for acceleration.

(4 marks)

Question 3

(a)   Sketch and label the lightly damped, heavily damped and critically damped SHM on amplitude vs time graph.

(4 marks)

(b)   A damped spring-mass (spring constant= 14 N/m and mass = 0.8kg), initially oscillates with an amplitude of 11 cm. It has a damping coefficient is 0.65 Ns/m.

    i.   Determine its amplitude at 3 s.

(4 marks)

    ii.   Calculate the time for the amplitude to be half of the initial amplitude.

(4 marks)

    iii.   Calculate the damped frequency.

(4 marks)

(c)   A 0.8 kg SHM system has a frequency of 12 Hz and damping coefficient of 0.9 Ns/m. It is driven by a force of 44 N at 25 Hz. Evaluate the maximum amplitude achievable.

(4 marks)

END OF EXAMINATION PAPER

List of data, formulae and relationships

Acceleration of free fall	$g = 9.81$ ms^{-2} (close to Earth's surface)
Gravitational constant	$G = 6.67 \times 10^{-11}$ Nm^{2}kg^{-2}
Mass of Earth	$M_E = 6.0 \times 10^{24}$ kg
Radius of Earth	$R_E = 6.4 \times 10^6$ m
Gravitational field strength	$g = 9.81$ Nkg^{-1} (close to Earth'
Density of water	$\rho = 1000$ kgm^{-3}
Threshold intensity	$I_0 = 1 \times 10^{-12}$ Wm^{-2}

Mechanics	$\omega = \dfrac{2\pi}{T} = 2\pi f$
	$\omega_f = \omega_i + \alpha t$
	$\theta = \omega_i + \dfrac{1}{2}\alpha t^2$
	$\omega_f{}^2 = \omega_i{}^2 + 2\alpha\theta$
	$\theta = \dfrac{1}{2}(\omega_0 + \omega_i)t$
	$v = rw$
	$a = \dfrac{v^2}{r} = r\omega^2$
	$\tau = I\alpha$
	$I = mr^2$
	$W = \tau\theta$
	$KE = \dfrac{1}{2}I\omega^2$
	$L = I\omega$
Gravitation	$F = G\dfrac{Mm}{r^2}$
	$g = G\dfrac{M}{r^2}$
	$U = -G\dfrac{Mm}{r}$
	$s_e = \sqrt{\dfrac{2GM}{r}} = \sqrt{2gr}$

	$$v = \sqrt{\frac{2GM_P}{r_O}} = \sqrt{2gR_P}$$
States of Matter	$$\sigma = \frac{F}{A}$$ $$\varepsilon = \frac{\Delta l}{l_i}$$ $$E = \frac{\sigma}{\varepsilon} = \frac{F l_i}{A \Delta l}$$ $$F = k\Delta x$$ $$S = \frac{Fh}{Ax} = \frac{F}{A\tan\theta}$$ $$B = -p\frac{\Delta V}{V_0}$$
Fluid	$$p = \rho g h$$ $$U = \rho V g$$ $$m = \rho A v$$ $$V = Av$$ $$v_1 A_1 = v_2 A_2$$ $$p_1 + \frac{1}{2}\rho v_1^2 = p_2 + \frac{1}{2}\rho v_2^2$$ $$F = \eta A\left(\frac{\Delta v}{\Delta l}\right)$$ $$F = 6\pi r \eta v$$
Simple Harmonic Motion	$$f = \frac{1}{T}$$ $$y = A\cos(\omega t + kx)$$ $$f = \frac{1}{2\pi}\left(\frac{k}{m}\right)^{1/2} = \frac{1}{2\pi}\left(\frac{g}{l}\right)^{1/2}$$ $$v = \frac{dx}{dt}$$ $$v_{max} = A\omega$$ $$a = \frac{dv}{dt} = \frac{d^2x}{dt^2}$$ $$a = -A\omega^2$$ $$F = k\Delta x = mg\sin\theta$$ $$U = \frac{1}{2}kx^2 = mgl(1-\cos\theta)$$ $$K = \frac{1}{2}mv^2$$

	$$E = K + U = \frac{1}{2}m\omega^2 A^2$$ $$\frac{d^2x}{dt^2} + \omega^2 x = 0$$
Waves	$$A' = Ae^{-\gamma t}$$ $${A_{max}}' = \frac{f_0}{2\gamma m\omega}$$ $$K = \frac{2\pi}{\lambda}$$ $$v = f\lambda = \frac{\omega}{K}$$ $$v_0 = \left(\frac{\beta}{\rho_0}\right)^{1/2} = \left(\frac{Y}{\rho_0}\right)^{1/2}$$ $$v' = v_0\left[1 + \left(\frac{T_c}{273}\right)\right]^{1/2}$$
Sound	$$I = \frac{P}{A}$$ $$\frac{I_a}{I_b} = \frac{r_b{}^2}{r_a{}^2}$$ $$d\beta = 10\left(\log\frac{I}{I_0}\right)$$ $\lambda = \frac{2L}{n}$ (double open-end tube) $\lambda = \frac{4L}{n}$ (single open-end tube) $f = \frac{nv}{2L}$ (double open-end tube) $f = \frac{nv}{4L}$ (single open-end tube)