MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

SECOND TRIMESTER, **2016/2017 SESSION**

PPP 0101 – PRINCIPLES OF PHYSICS

(All sections / Groups)

10 MARCH 2017
9.00 a.m – 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 2 printed pages excluding the cover page and the appendixes with FOUR (4) questions.
2. Attempt **ALL** questions. Distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.

Question 1 (10 marks)

(a) (i) Explain what inertia (of an object) means. [1 mark]

(ii) Using the concept of inertia, explain how the seat belt of a car prevents injury. [1 mark]

(b) A book is resting on a rough inclined plane. Draw a free body diagram for the book. Label all the forces and show their direction. [3 marks]

(c) A person with a mass of m kg is in an elevator. The elevator is accelerating downwards with an acceleration of a m/s^2.

(i) What are the forces acting on the person? [1 mark]

(ii) Derive the formula to find the apparent weight of the person. [2 marks]

(iii) Find the apparent weight of the person if the values of m and a are 60 kg and 2 m/s^2 respectively. [2 marks]

Question 2 (10 marks)

(a) Using a simple graph, illustrate the meaning of amplitude and period. [2 marks]

(b) A 0.40 *kg* object rests on a frictionless horizontal surface and is attached to the free end of the spring, which has a spring constant of $k = 500\ Nm^{-1}$. The object is pulled horizontally so that it stretches the spring *12.00 cm* and is released from rest at $t = 0\ s$.

i) Determine the amplitude, A, of the motion. [1 mark]

ii) Obtain angular frequency, ω, of the system. [1 mark]

iii) What will be the changes (remain the same, increase or decrease) to the angular frequency in (ii) if heavier object is used? [1 mark]

iv) What is the maximum speed achieved by the object once it is released from rest ? [1 mark]

v) At which position does the object achieve its maximum speed as in (iv) ? [1 mark]

vi) Obtain maximum acceleration of the system. [1 mark]

vii) At which position does the object achieve its maximum acceleration as in (vi) ? [1 mark]

viii) Obtain period , T, for this motion. [1 mark]

Continued...

Question 3 (15 marks)

(a) A travelling transverse wave is described by $y_1 = 3 \text{ cm} \sin\left[(3 \text{ rad/cm})x + (5 \text{ rad/s})t + \frac{\pi}{3}\right]$ where x and y_1 are in centimetres.

(i) What is the period of the wave? [2 marks]

(ii) What is the wavelength of the wave? [2 marks]

(iii) In which direction in the wave travelling? [1 mark]

(iv) What is the amplitude of the wave? [1 mark]

(v) Find one instance for $x = 2$ cm to have a displacement of 2.5 cm. [3 marks]

(vi) The wave superposes with another wave described by $y_2 = 3 \text{ cm} \sin[(2 \text{ rad/cm})x + (1 \text{ rad/s})t]$. Find the displacement of $x = 5$ cm at $t = 10$ s when they superpose. [4 marks]

(b) State one difference between a transverse wave and a longitudinal wave. [2 marks]

Question 4 (15 marks)

(a) Describe the following:

i) Law of reflection

ii) Snell's law

iii) Critical angle

[3 marks]

(b) State two conditions for total internal reflection to occur.

[2 marks]

(c) Describe the differences between experiments of single slit, double slits and diffraction gratings, in terms of diffraction pattern. [3 marks]

(d) A two-slit pattern is viewed on a screen 1.00 m from the slits. If distance between both sides' third-order maxima are 25.0 cm apart, what is the width of the central bright fringe? [4 marks]

(e) How many dark fringes will be produced on either side of the central maximum if green light ($\lambda = 553$ nm) is incident on a slit that is 8.00 μm wide?

[3 marks]

End of Paper

LIST OF PHYSICAL CONSTANTS

Electron mass,	m_e	=	9.11×10^{-31} kg
Proton mass,	m_p	=	1.67×10^{-27} kg
Neutron mass,	m_n	=	1.67×10^{-27} kg
Magnitude of the electron charge,	e	=	1.602×10^{-19} C
Universal gravitational constant,	G	=	6.67×10^{-11} N.m^2 kg^{-2}
Universal gas constant,	R	=	8.314 J/K.mol
Hydrogen ground state,	E_o	=	13.6 eV
Boltzmann's constant,	k_B	=	1.38×10^{-23} J/K
Compton wavelength,	λ_c	=	2.426×10^{-12} m
Planck's constant,	h	=	6.63×10^{-34} J.s
		=	4.14×10^{-15} eV.s
Speed of light in vacuum,	c	=	3.0×10^8 m/s
Rydberg constant,	R_H	=	1.097×10^7 m^{-1}
Acceleration due to gravity,	g	=	9.80 m s^{-2}
1unified atomic mass unit,	1 u	=	931.5 MeV/c^2
		=	1.66×10^{-27} kg
1 electron volt,	1 eV	=	1.60×10^{-19} J
Avogadro's number,	N_A	=	6.023×10^{23} mol^{-1}
Threshold of intensity of hearing,	I_o	=	1.0×10^{-12} W m^{-2}
Coulomb constant,	$k = \frac{1}{4\pi\varepsilon_o}$	=	9.0×10^9 Nm^2 C^{-2}
Permittivity of free space,	ε_o	=	8.85×10^{-12} C^2/N.m^{-2}
Permeability of free space,	μ_o	=	$4\pi \times 10^{-7}$ (T.m)/A
1 atmosphere pressure,	1 atm	=	1.0×10^5 N/m^2
			1.0×10^5 Pa
Earth: Mass,	M_E	=	5.97×10^{24} kg
Radius (mean),	R_E	=	6.38×10^3 km
Moon: Mass,	M_M	=	7.35×10^{22} kg
Radius (mean),	R_M	=	1.74×10^3 km
Sun: Mass,	M_S	=	1.99×10^{30} kg
Radius (mean),	R_S	=	6.96×10^5 km
Earth-Sun distance (mean),		=	149.6×10^6 km
Earth-Moon distance (mean),		=	384×10^3 km

LIST OF FORMULA

Differential Rule

$$y = kx^n$$

$$\frac{dy}{dx} = knx^{n-1}$$

Trigonometric Identity

$$\sin = \frac{opposite}{hypotenuse} \qquad \cos = \frac{adjacent}{hypotenuse} \qquad \tan = \frac{opposite}{adjacent}$$

$$\sin\alpha + \sin\beta = 2\cos\left(\frac{\alpha-\beta}{2}\right)\sin\left(\frac{\alpha+\beta}{2}\right)$$

$$\sin(\alpha-\beta) + \sin(\alpha+\beta) = 2\sin\alpha\cos\beta$$

NEWTONIAN MECHANICS

$$v = \frac{\Delta x}{\Delta t} \qquad a = \frac{\Delta v}{\Delta t} \qquad v = v_o + at \qquad x - x_o = v_o t + \frac{1}{2}at^2$$

$$v^2 = v_o^2 + 2a(x - x_o) \qquad x - x_o = \left(\frac{v_o + v}{2}\right)t$$

$$v = v_o + gt \qquad y - y_o = v_o t + \frac{1}{2}gt^2 \qquad v^2 = v_o^2 + 2g(y - y_o) \qquad y - y_o = \left(\frac{v_o + v}{2}\right)t$$

$$W = Fs\cos\theta \qquad W = mg \qquad \sum F = F_{net} = ma \qquad f_s \le \mu_S F_N$$

$$f_k = \mu_K F_N \qquad p = mv \qquad \sum F = \frac{\Delta p}{\Delta t}$$

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2 \qquad m_1u_1 + m_2u_2 = (m_1 + m_2)\,v \qquad P = \frac{W}{t} = \frac{E}{t} = \frac{Fd}{t} = F\bar{v}$$

$$K = \frac{1}{2}mv^2 \qquad PE_s = \frac{1}{2}kx^2 \qquad F_s = -kx \qquad PE_G = mgy$$

$$v_{circular} = \frac{2\pi r}{T} \qquad a_c = \frac{v^2}{r} \qquad F_g = G\frac{m_1m_2}{r^2} \qquad U_g = -G\frac{m_1m_2}{r}$$

$$T^2 = K_s r^3 \qquad T_s = 2\pi\sqrt{\frac{m}{k}}$$

Spring with mass, Simple pendulum,

$$\omega = \sqrt{\frac{k}{m}} \qquad \omega = \sqrt{\frac{g}{l}} \qquad T_p = 2\pi\sqrt{\frac{l}{g}} \qquad T = \frac{2\pi}{\omega} = \frac{1}{f}$$

Cosine Wave:	$x = A\cos\omega t$	Sine Wave:	$x = A\sin\omega t$
	$v = -\omega A\sin\omega t$		$v = \omega A\cos\omega t$
	$a = -\omega^2 A\cos\omega t$		$a = -\omega^2 A\sin\omega t$

WAVES AND OPTICS

$v = f\lambda$ $\quad \omega = 2\pi f$ $\quad n = \frac{c}{v}$ $\quad n_1 \sin\theta_1 = n_2 \sin\theta_2$

$\sin\theta_c = \frac{n_2}{n_1}$ $\quad \frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$ $\quad M = -\frac{d_i}{d_o} = \frac{h_i}{h_o}$ $\quad f = \frac{R}{2}$

$d\sin\theta_{max} = m\lambda$ $\quad a\sin\theta_{min} = m\lambda$ $\quad d\sin\theta_{min} = (m+\frac{1}{2})\lambda$

$y_{bright} = \frac{m\lambda L}{d}$ $\quad y_{dark} = (m+\frac{1}{2})\frac{\lambda L}{d}$ $\quad I = \frac{P}{A}$ $\quad \beta = 10\log_{10}\frac{I}{I_o}$

$f' = f\left(\frac{v \pm v_o}{v \mp v_s}\right)$ $\quad y(x,t) = A\sin(kx \pm \omega t + \phi)$

Wave Type:

$y(x,t) = 2A\cos\left(\frac{\phi}{2}\right)\sin(kx - \omega t - \frac{\phi}{2})$

$y(x,t) = 2A\sin kx\cos\omega t$