MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2018/2019

PPP0101 PRINCIPLES OF PHYSICS

(Foundation in Information Technology)

5 MARCH 2019
9.00 A.M. – 11.00 A.M.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 7 pages, including the cover page.
2. Answer all questions.
3. Write your answers in the Answer Booklet provided.
4. Show all relevant steps to obtain maximum marks.

QUESTION 1 (10 MARKS)

a) (i) Define friction force.

[1 mark]

(ii) Define Newton's Third Law.

[1 mark]

b) If the acceleration of an object is zero, are there forces acting on the object? Explain in detail. [Hint: you may use diagram as an aid]

[2 marks]

c) The three ropes in Figure Q1(b) are tied together. Two of these ropes are anchored to walls at roof, to support the load of 15 kg. The system is at rest.

(i) Identify the forces acting on the system by sketching a free-body diagram.

[1.5 marks]

(ii) Find the tension forces acting in the ropes.

[2.5 marks]

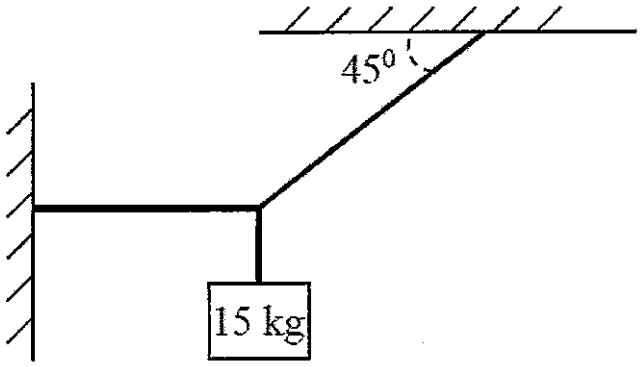

Figure Q1(b)

d) A 20.0kg block rests on a horizontal table. The coefficient of kinetic friction between the block and table is 0.15. What force is required to pull the block at constant speed if a horizontal rope is attached ?

[2 marks]

Continued...

QUESTION 2 (10 MARKS)

a) A 0.70 kg mass is undergoing a Simple Harmonic Motion with a displacement as a function of time given by

$$x(t) = (4.50cm)\cos[(5.35rad/s)t - \frac{3\pi}{2}]$$

Determine

(i) the maximum displacement. [0.5 mark]

(ii) the frequency. [1 mark]

(iii) the maximum speed and the maximum acceleration. [3 marks]

(iv) the speed and acceleration of the mass at $t = 2.0$ s [3 marks]

b) Peter pulls a simple pendulum 0.755 m long to the side through an angle of 5.50° and release it. Determine

(i) the time needed for the pendulum bob to reach its highest speed. [2 marks]

(ii) the time needed for the pendulum bob to reach its highest speed, if the pendulum is released at an angle of 2.45° instead of 5.50°. [0.5 mark]

QUESTION 3 (15 MARKS)

a) Define and sketch the diagram for the following:

(i) transverse wave [2 marks]

(ii) longitudinal wave [2 marks]

b) A transverse traveling wave on a cord is represented by $x = 0.22\sin(5.6x + 34t)$, where x is in meters and t is in seconds. For this wave, determine

(i) the wavelength. [1.5 marks]

(ii) the frequency. [1.5 marks]

(iii) velocity (magnitude and direction). [2 marks]

(iv) maximum and minimum speeds of particles of the cord. [2 marks]

c) The intensity of a whisper at one meter *is* $I = 1.0x10^{-10} W/m^2$. What is the sound intensity of a whisper at a distance of 2.0 m, in W/m^2? What is the corresponding sound intensity level in dB of the whisper at distance of 2.0 m? [2 marks]

d) Define Doppler Effect and provide one (1) example in daily life. [2 marks]

Continued...

QUESTION 4 (15 MARKS)

a) A pair of narrow, parallel slits separated by 6.75 μm is illuminated by the green component from a mercury vapor lamp (λ = 445 nm). The interference pattern is observed on a screen 2.30 m from the plane of the parallel slits. Calculate the

(i) distance from the central maximum to the first bright region on either side of the central maximum, [2 marks]

(ii) distance between the first and second dark bands in the interference pattern, and [2 marks]

(iii) number of bright fringes will be produced on either side of the central maximum. (Hint: The pattern will display an isosceles triangle) [2 marks]

b) Calculate the angles θ_1, θ_2, θ_3, and θ_4 in **Figure Q4(b)** below. [6 marks]

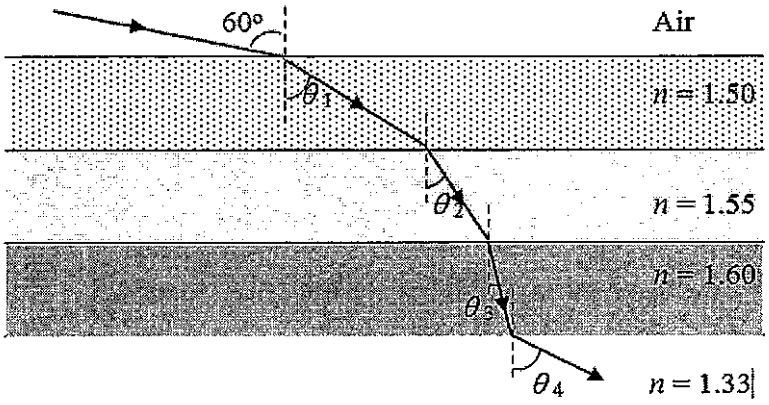

Figure Q4(b)

c) A diffraction grating has 13500 lines/cm. A beam of light of wavelength 330 nm is incident normally on the grating. Determine the angular position of the second order maxima. [3 marks]

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APPENDIXES

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	=	9.81 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

Continued...

LIST OF FORMULA

Differential Rule

$y = kx^n$

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

Trigonometric Identity

$\sin\theta = \frac{opposite}{hypotenuse}$ $\cos\theta = \frac{adjacent}{hypotenuse}$

$\tan\theta = \frac{opposite}{adjacent}$

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

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

NEWTONIAN MECHANICS

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

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

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

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

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

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

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

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

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

Spring with mass, Simple pendulum,

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

Cosine Wave:

$x = A\cos\omega t$

$v = -\omega A\sin\omega t$

$a = -\omega^2 A\cos\omega t$

Sine Wave:

$x = A\sin\omega t$

$v = \omega A\cos\omega t$

$a = -\omega^2 A\sin\omega t$

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WAVES AND OPTICS

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

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

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

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

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

Wave Type:

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

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

End of paper.