MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2018/2019

PPP0101 PRINCIPLES OF PHYSICS

(Foundation in Information Technology)

26 OCTOBER 2018
3.00 P.M. – 5.00 P.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 (15 MARKS)

a) (i) If the acceleration of an object is zero, are there forces acting on the object? Explain.

[1.5 marks]

(ii) If an object is moving, is it possible for the net force acting on it to be zero? Explain.

[1.5 marks]

b) The three ropes in Figure Q1(b) are tied to a small, very light ring. Two of these ropes are anchored to walls at right angles with the tensions shown in the figure.

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

[3 marks]

(ii) Find the magnitude and direction of the tension T_3 in the third rope.

[6 marks]

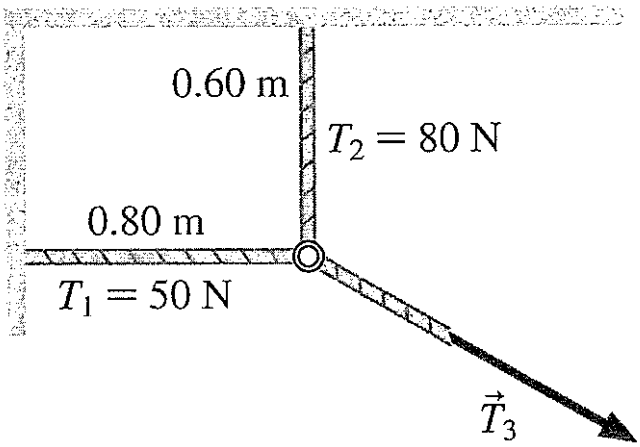

Figure Q1(b)

c) A golf ball of mass 0.045 kg is hit off the tee at a speed of 45 m/s. The golf club was in contact with the ball for 3.5×10^{-3}s. Find

(i) the impulse (magnitude and direction) imparted to the golf ball

[1.5 marks]

(ii) the average force exerted on the ball by the golf club.

[1.5 marks]

QUESTION 2 (10 MARKS)

a) The position of a 50 g oscillating mass is given by $x(t) = (2.0cm)\cos(10t)$, where t is in seconds. Determine:

(i) the amplitude. [1 mark]

(ii) the period. [1.5 marks]

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(iii) the spring constant. [1.5 marks]

(iv) the maximum speed. [1.5 marks]

(v) the total energy. [1.5 marks]

(vi) the total velocity at t = 0.40 s. [1.5 marks]

b) Does a car bounce on its springs faster when it is empty or when it is fully loaded? Explain your answer.

[1.5 marks]

QUESTION 3 (15 MARKS)

a) Figure Q3(a) shows a history graph and a snapshot graph for a wave pulse on a string. They describe the same from two perspectives.

(i) In which direction is the wave traveling? Explain.

[1.5 marks]

(ii) What is the speed of this wave?

[2 marks]

(iii) In your own words, define what a transverse wave and longitudinal wave is.

[2 marks]

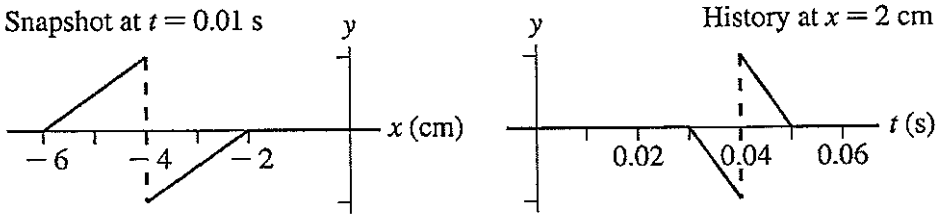

Figure Q3(a)

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. [2.5 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?

[2 marks]

Continued...

QUESTION 4 (10 MARKS)

a) A parallel beam of light containing two wavelengths, $\lambda_1 = 465\,\text{nm}$ and $\lambda_2 = 652$ nm, enters the silicate flint glass of an equilateral prism which as shown in Figure Q4(a). At what angle does each beam leave the prism (with respect to the normal to the face)? The indices of refraction are estimated to be 1.642 for 465 nm and 1.619 for 652 nm.

[6 marks]

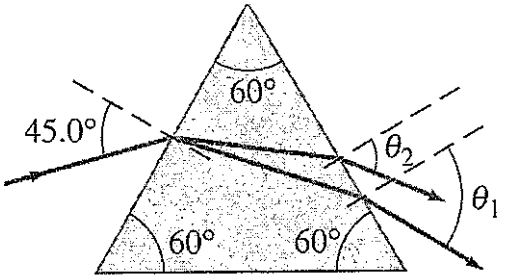

Figure Q4(a)

b) (i) Does Huygens' principle apply to sound waves?

[1 mark]

(ii) Monochromatic red light with $\lambda = 650\,\text{nm}$ is incident on a double slits and the interference pattern is viewed on a screen some distance away. Explain how the fringe pattern would change if the red light source is replaced by a blue light source which has wavelength value of 495 nm.

[1.5 marks]

(iii) The third order bright fringe of 610 nm light is observed at an angle of 28° when the light falls on two narrow slits. How far apart are the slits?

[1.5 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

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

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

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

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

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.