INTI
International College Penang

FINAL
Examination Paper

(COVER PAGE)

Session	:	April 2019
Programme	:	Foundation In Science (CFSI)
Course	:	**PHY1205 : PHYSICS 1**
Date of Examination	:	28 July 2019 (Sunday)
Time	:	2:00PM – 4:00PM Reading Time : NIL
Duration	:	2 HOURS

Special Instructions :

This paper consists of **FIVE (5)** questions. Answer any **FOUR (4)** questions in the answer booklet provided.

Materials permitted :

Non-Programmable Scientific Calculator

Materials provided :

Physics Booklet

Examiner(s)	:	**Adele Kam**
Moderator	:	Assoc. Prof. Dr. Khoo Bee Ee

*This paper consist of **6** printed pages, including the cover page.*

INTI INTERNATIONAL COLLEGE PENANG

FOUNDATION IN SCIENCE (CFSI)
PHY1205: PHYSICS 1
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Instructions: This paper consists of **FIVE (5)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Question 1

(a) Assume it takes 8 minutes to fill a 35.0 gallon gasoline tank. Calculate the rate at which the tank is filled in m^3/s. (1 gallon = 231 $inch^3$, 1 inch = 2.54 cm). (7 marks)

(b) A missile is launched into the air at an initial velocity of 80 m/s. It is moving with constant velocity until it reaches 1000m, when the engine fails.

(i) How high does the missile go (measured from the ground)? (3 marks)

(ii) How long does it stay in the air (the time from launch till it falls back to the ground)? (6 marks)

(c) Determine the

(i) angle between vectors $\vec{A} = 2\hat{\imath} + 3\hat{\jmath} + \hat{k}$ and $\vec{B} = 4\hat{\imath} + \hat{\jmath} + 2\hat{k}$. (5 marks)

(ii) cross product of $\vec{C} \times \vec{D}$, for $\vec{C} = 2\hat{\imath} + \hat{\jmath} - 3\hat{k}$ and $\vec{D} = 4\hat{\jmath} + 5\hat{k}$. (4 marks)

Question 2

(a) The highest barrier that a projectile can clear is 14 m, when the projectile is launched at an angle of 30.0° above the horizontal. Neglect air resistance.

(i) What is the projectile's launch speed? (5 marks)

(ii) What is the range of the projectile? (3 marks)

(b) As shown in Figure 2 (b), blocks of masses m_1 = 10 kg and m_2 = 30 kg are linked by a massless string through a frictionless pulley.

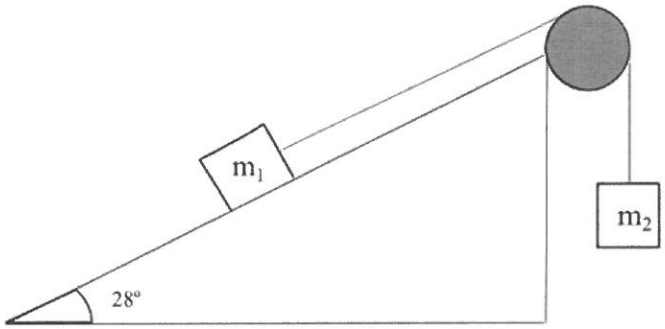

Figure 2(b)

i) Find the magnitude of the acceleration of the two masses if the coefficient of kinetic friction between the inclined plane and mass m_1 is equal to 0.4. (6 marks)

ii) Find the magnitude of the tension in the string. (3 marks)

(c) At point A in the Figure 2(c) shown below, a spring (spring constant k = 1000 N/m) is compressed 50.0 cm by a 2.00 kg block. When released the block travels over the frictionless track until it is launched into the air at point B. The inclined part of the track makes an angle of $\theta = 55.0°$ with the horizontal and point B is a height h = 4.50 m above the ground. Determine the speed of the block when it is launched at point B. (8 marks)

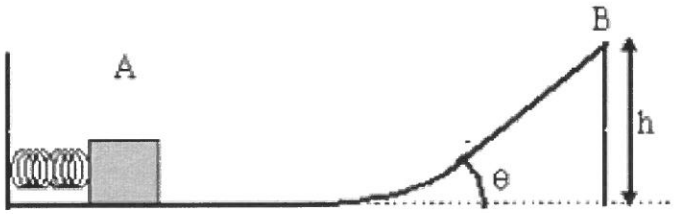

Figure 2(c)

Question 3

(a) Object A has mass M and object B has mass 4M. The two objects are moving with equal kinetic energy. What is the ratio of their linear momenta, i.e. $\frac{Momentum\ of\ A}{Momentum\ of\ B}$? (8 marks)

(b) Large freight trains accelerate very slowly. Suppose one such train accelerates from rest, giving its 0.350 m radius wheels an angular acceleration of 0.250 rad/s^2. After the wheels have made 200 revolutions, determine

(i) how far the train has moved down the track. (3 marks)

(ii) the final angular velocity of the wheels. (3 marks)

(iii) the linear velocity of the train. (2 marks)

(c) Consider a person who spins a large grindstone by placing her hand on its edge and exerting a force, F, through part of a revolution as shown in Figure 3(c). The force is kept perpendicular to the grindstone's 0.320 m radius at the point of application, and the effects of friction are negligible. Moment inertia of the disk is ½ Mr^2.

(i) How much work is done if she exerts a force of 200 N through a rotation of 1.00 rad? (3 marks)

(ii) What is the final angular acceleration, α, if the grindstone has a mass of 85.0 kg? (4 marks)

(iii) What is the final rotational kinetic energy? (2 marks)

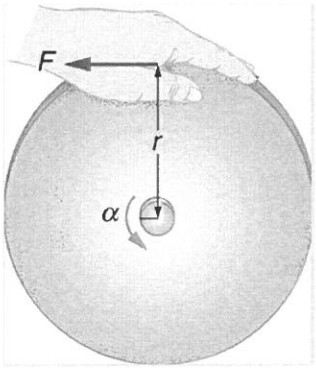

Figure 3(c)

Question 4

(a) Figure 4(a) shows three particles far away from any other objects and located on a straight line. The masses of these particles are: m_A = 400 kg, m_B = 500 kg, and m_C = 100 kg. Find the magnitude of the net gravitational force acting on each particle, i.e. F_A, F_B and F_C. (9 marks)

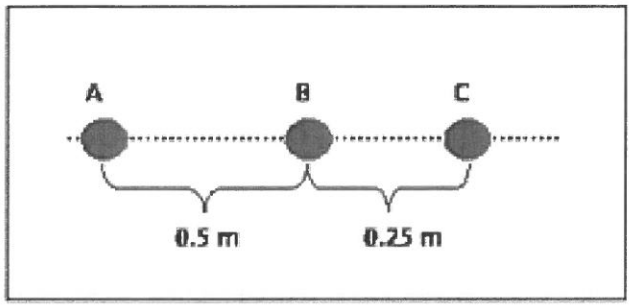

Figure 4(a)

(b) A 1500 kg satellite orbits the Earth at an altitude of 2.5×10^6 m.

(i) What is the orbital speed of the satellite? (3 marks)

(ii) What is period of the satellite? (3 marks)

(iii) What is the kinetic energy of the satellite? (2 marks)

(c) (i) A cubical copper block of density 8920 kg/m^3 is 1.5 cm on each edge. It is held by a string and fully submerged in oil with density of 810 kg/m^3. What is the tension (N) in the string? (5 marks)

(ii) Find the pressure at a depth of 13 m in water when the atmospheric pressure is that corresponding to a mercury column of height 770 mm. The densities of water and mercury are 1 x 10^3 kg/m^3 and 13.6 x 10^3 kg/m^3 respectively. (3 marks)

Question 5

(a) A block of unknown mass is attached to a spring of spring constant 6.50 N/m and undergoes simple harmonic motion with an amplitude of 10.0 cm. When the mass is halfway between its equilibrium position and the endpoint, its speed is measured to be + 30.0 cm/s. Calculate the

(i) mass of the block, (4 marks)

(ii) period of the motion (2 marks)

(iii) maximum acceleration of the block. (2 marks)

(b) On a six-string guitar, the high E string has a linear density of 3.09×10^{-4} kg/m.

(i) If the high E string is plucked, producing a wave in the string, what is the speed of the wave if the tension of the string is 56.40 N? (2 marks)

(ii) The linear density of the low E string is 20 times greater than that of the high E string. Calculate the tension of the low E string needed for the same wave speed as the high E. (2 marks)

(c) A string oscillates according to the equation

$$y = (0.2 \text{ m}) \sin([\pi/4 \text{ m}^{-1}]\, x) \cos([18\pi \text{ s}^{-1}]\, t)$$

Assuming that the two waves that form the superposition of the above are identical except for the direction of travel, determine the

(i) speed of the two waves? (2 marks)

(ii) distance between the nodes of the resultant wave? (3 marks)

(d) (i) A furnace wall that is 0.2 m thick is made of fire clay of thermal conductivity 0.3 W/mK. The inner furnace wall temperature is 650^0C and temperature of the outer wall of the furnace is 150^0C. Determine the rate of heat transfer per unit area by conduction. (2 marks)

(ii) A square plate of iron, 1.5 m x 1.5 m, is initially at 20°C. If the temperature is raised to 100°C, what is the change in the area of the square plate? The coefficient of linear expansion of iron is 1.1×10^{-7} °C^{-1}. (3 marks)

(iii) At what net rate does heat radiate from a 275 m^2 black roof on a night when the roof's temperature is 30°C and the surrounding temperature is 15°C? The emissivity of the roof is 0.900. (3 marks)

~ The End ~