INTI INTERNATIONAL UNIVERSITY

FOUNDATION IN SCIENCE (CFSI)
PHY1203: GENERAL PHYSICS 1
FINAL EXAMINATION: AUGUST 2015 SESSION

Instruction: 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) Vector $\vec{A}$ has a length of 5 m at 36° with respect to the +*x* axis, and vector $\vec{B}$ has a length of 4 m at 40° below the +*x* axis. Calculate the magnitude and find the direction of a vector $\vec{C}$ with $\vec{C} = \vec{B} - 2\vec{A}$.

(6 marks)

(b) Two vector are given as $\vec{P} = 3\hat{i} - 5\hat{j} - 2\hat{k}$ and $\vec{R} = 4\hat{i} - 7\hat{j} + 5\hat{k}$. Find

(i) $\left|\vec{P}\right|$ and $\left|\vec{R}\right|$,

(4 marks)

(ii) $\vec{P} \bullet \vec{R}$,

(2 marks)

(iii) angel between $\vec{P}$ and $\vec{R}$,

(3 marks)

(iv) $\vec{P} \times \vec{R}$, and

(3 marks)

(v) $2\vec{P} - \vec{R}$.

(3 marks)

(c) Calculate the average mass of Earth from the knowledge that its satellite, Moon orbits at an average radius of 3.82×10^8 m from the center of Earth with an orbital period of 27.3 days.

(4 marks)

Question 2

(a) A 600 g object is attached to a spring with spring constant of 7 N/m which vibrates in simple harmonic motion with amplitude of 12 cm.

(i) Calculate the angular frequency of the oscillation.

(2 marks)

(ii) Calculate the speed of the object when it is at the equilibrium position.

(3 marks)

(b) A car first traveled 240 km in 3 hours then it maintained at speed of 60 km/h for 2 hours. The driver took one hour rest and finished the last trip of 150 km at a speed of 50 km/h. Determine its average speed.

(4 marks)

(c) The position of the particle is given by $x(t) = (2t^3 + 5 - 3t^2)$ m. Find

(i) the position of the particle at t = 5 s,

(2 marks)

(ii) the velocity of the particle at t = 5 s, and

(2 marks)

(iii) the average velocity of the particle between t = 1 s and t = 5 s.

(3 marks)

(d) A 1.2 m string is under a tension of 42 N. Given that the mass of the whole string is 200 g.

(i) Calculate the linear mass density of the string.

(2 marks)

(ii) Calculate the speed of wave on the string.

(2 marks)

(iii) Calculate the frequency of its fundamental overtone.

(2 marks)

(e) One end of a 45 cm long copper rod with a diameter of 2 cm is kept at 460 ^{o}C, and the other end is immersed in water at 22 ^{o}C. Given that thermal conductivity of copper is 380 WC^{o}/m, calculate the heat conduction rate along the rod.

(3 marks)

Question 3

(a) A small cylindrical beaker contains 800 ml of water. Given that the depth of the water was measured to be 6.4 cm (Given that 1 ml = 1 cm^3).

(i) Calculate the inner radius of the cylindrical beaker.

(2 marks)

(ii) If the beaker is broken and all the water splashed to the ground. Given that the average depth of the water spot was 0.2 mm, calculate the total area of the water spot.

(2 marks)

(b) Given that the traditional unit of length in Japan is the *ken* (1 *ken* = 1.97 m). Calculate the volume of a cylindrical water tank of 11 *kens* height and 8 *kens* in diameter. Give the answer in cubic meters.

(4 marks)

(c) A particle initially moves at a horizontal speed of v_i = 15 m/s. It then slides down a frictionless cliff as shown in Figure Q3(c) and moves at a new speed of v_f . Calculate the final speed v_f.

(4 marks)

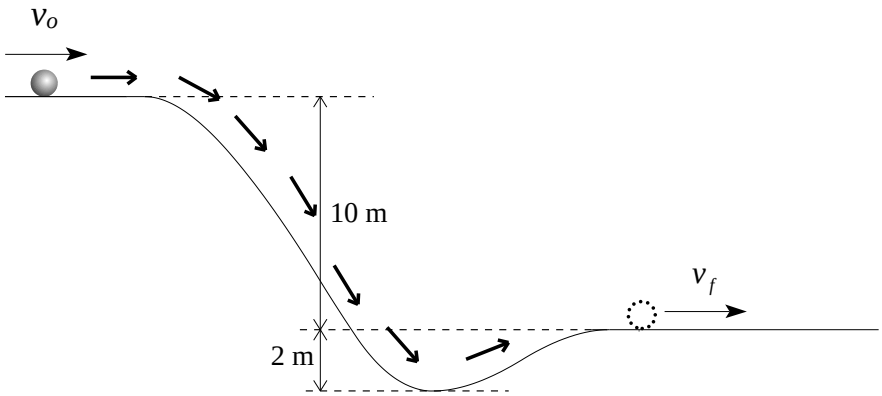

Figure Q3(c)

(d) A 150 g object is hung to a spring causing the spring to stretch for 20 cm.

(i) Calculate the spring constant of the spring.

(2 marks)

(ii) Calculate the energy stored in the spring as elastic potential energy.

(2 marks)

(e) Two glass marbles are moving along a straight line at the same direction undergo a collision. The speed of one marble is 6 m/s and its mass is 32 g, the speed of the other marble is 2 m/s and its mass is 36 g.

(i) If the collision is a complete elastic collision, calculate the speeds and directions of the marbles after the collision.

(6 marks)

(ii) If the collision is an inelastic collision and after the collision, the objects stick together and move at a combined speed. Calculate the final speed of these objects.

(3 marks)

Question 4

(a) Starting from rest, a disk rotates about its central axis with constant angular acceleration of 2.4 rad/s^2.

(i) Calculate the angular displacement of the disk for the first 5 s.

(2 marks)

(ii) Determine the instantaneous angular velocity of the disk after the first 5 s.

(2 marks)

(b) Figure Q4(b) shows three boxes connected by cords, one of which wraps over a pulley having negligible friction on its axle and negligible mass. The mass of the boxes are m_A = 8 kg, m_B = 3 kg, and m_C = 4 kg. The system is then released from rest.

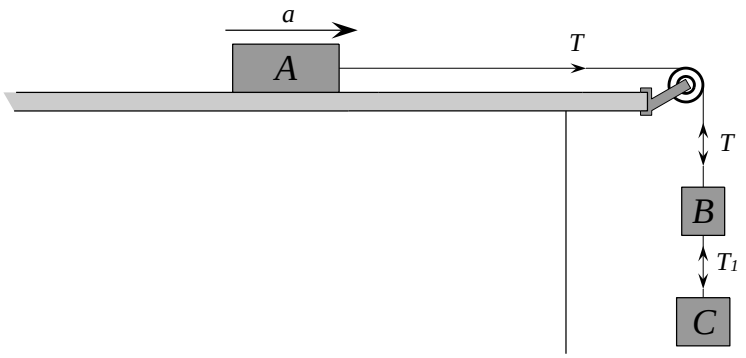

Figure Q4(b)

(i) Calculate the acceleration of the system.

(5 marks)

(ii) Calculate the tension T in the cord connecting A and B.

(2 marks)

(iii) Calculate the tension T_1 in the cord connecting B and C.

(2 marks)

(c) A ball is thrown horizontally from a height of 35 m above the ground with a velocity of 7.2 m/s.

(i) Calculate the time it takes to reach the ground.

(2 marks)

(ii) How far from a point on the ground directly below the launch point does the ball strikes the ground?

(2 marks)

(iii) Calculate the speed of the ball just before it strikes the ground.

(5 marks)

(iv) In what direction does the ball's velocity point to respect to the horizontal?

(3 marks)

Question 5

(a) A disk has a mass of 2 kg and 2 cm in thickness. It is rotating about an axis perpendicular to its plane and passing through its center of mass. Calculate the rotational inertia of the disk if given that the radius of the disk is 12 cm.

(2 marks)

(b) A sphere of radius 16 cm floats on a liquid of density 950 kg/m^3. Given that 70% of the sphere is submerged in the liquid. Calculate the density and mass of the sphere.

(3 marks)

(c) Given that three particles are moving on an *x-y* plane. The mass, coordinate and the velocity of the particles at a certain time are shown below.

Particle	Mass (g)	Coordinate (m)	velocity (m/s)
1	15	(2 , 3)	$-5\hat{i}$
2	12	(4 , -6)	$4\hat{j}$
3	10	(8 , 8)	$3\hat{i}-2\hat{j}$

(i) Determine the coordinate of the center of mass for this system of particles.

(3 marks)

(ii) Calculate their total angular momentum about the origin. Give the answer in unit vector notation.

(8 marks)

(d) A 5 kg mass rests on a horizontal plane as shown in Figure Q5(d). Between the mass and the surface of the plane, the coefficient of static friction is 0.25, and the coefficient of kinetic friction is 0.20.

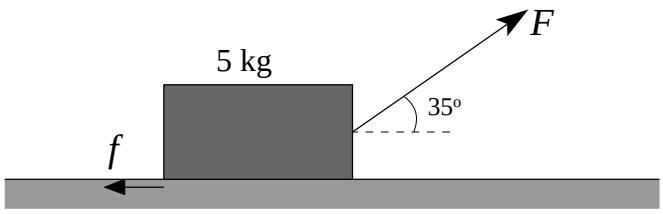

Figure Q5(d)

(i) Calculate the minimum magnitude of the force *F* at a direction shown that will just start to move the mass.

(4 marks)

(ii) Calculate the magnitude of the force *F* in the direction shown that will cause the mass to move along the plane at a constant speed.

(2 marks)

(iii) Calculate the acceleration of the mass if the magnitude of force *F* in the direction shown is 30 N.

(3 marks)

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