

INTI INTERNATIONAL UNIVERSITY

FOUNDATION IN SCIENCE (CFSI)
 PHY1203: GENERAL PHYSICS 1
 FINAL EXAMINATION: JANUARY 2016 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) A loaded sled of 5 kg rests on a plane inclined at 20° to the horizontal as shown in Figure Q1(a). Between the sled and the plane, the coefficient of static friction is 0.3, and the coefficient of kinetic friction is 0.25.

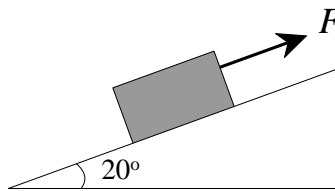


Figure Q1(a)

- (i) Calculate the minimum magnitude of the force F , parallel to the plane that will prevent the sled from slipping down the plane. (4 marks)
- (ii) Calculate the minimum magnitude of the force F , parallel to the plane that is required for the sled to move up the plane. (4 marks)
- (iii) Determine the magnitude of the force F that is required to move the sled up the plane at a constant speed. (3 marks)
- (b) A ball is thrown horizontally from a height of 25 m above the ground with a velocity of 6.5 m/s.
- (i) Determine the time taken (in second) for the ball to hit the ground. (2 marks)
- (ii) Determine the range (horizontal distance) of the motion. (2 marks)
- (iii) Calculate the speed of the ball just before it hits the ground. (4 marks)
- (iv) Determine the direction of the ball's velocity with respect to the horizontal at the point of impact. (2 marks)

- (c) A spring compressed by 12.5 cm stores 5.7×10^{-2} J as elastic potential energy.
- (i) Determine the spring constant k . (2 marks)
- (ii) Determine the magnitude of the force needed to compress the spring by 12.5 cm. (2 marks)

Question 2

- (a) Determine the speed of a transverse wave that is travelling in a rope of length 1.8 m and mass 83 g under a tension of 610 N. (3 marks)
- (b) A sphere of radius 16 cm floats in a liquid of density 950 kg/m^3 . Given that 75% of the sphere is submerged in the liquid, calculate the mass of the sphere. (4 marks)
- (c) It is given that particle A has a mass of 6 g and particle B has a mass of 4 g. The particles are separated by a distance of 25 cm. Calculate the attractive force between the particles. (3 marks)
- (d) A man has a mass of 72 kg on the Earth's surface.
- (i) Determine his weight on the Earth's surface. (2 marks)
- (ii) Calculate the gravitational acceleration at a height of 5000 km above the Earth surface. (3 marks)
- (e) A person first runs at a constant speed of 12 km/h along a straight line from point A to point B and then walks back along the same line from B to A at a constant speed of 7 km/h. Calculate the average speed over the entire trip in m/s. (5 marks)
- (f) Three particles of different masses have the following coordinates:

<u>Particle</u>	<u>Mass (kg)</u>	<u>Coordinates (m)</u>
1	4	(0, 0)
2	2	(50, 0)
3	3	(80, 50)

Find the coordinates of the center of mass of the system.

(5 marks)

Question 3

- (a) At optimum performance, the platter of a computer hard drive is rotating at 7200 rpm (rpm = revolutions per minute).
- (i) Calculate the angular speed of the hard drive in rad/s. (2 marks)
- (ii) If the reading head of the drive is located 3 cm from the rotational axis, calculate the linear speed of the point on the platter just below it. (2 marks)
- (b) It is given that the density of aluminum is 2.698 g/cm^3 . In the process of manufacturing a roll of aluminum foil, the dimensions of a block of aluminum is measured to be 1.4 m width, 45 cm height and 4.4 m long.
- (i) Determine the density of aluminum in kg/m^3 . (1 mark)
- (ii) Calculate the mass of the block. (2 marks)
- (iii) If the aluminum block is pressed into a thin foil of 0.2 mm thickness and 30 cm width, calculate the length of the foil produced. (4 marks)
- (c) An airplane propeller has a rotational inertia of $40 \text{ kg}\cdot\text{m}^2$. Calculate the torque needed to accelerate it at a rate of 25 rad/s^2 . (3 marks)
- (d) A carousel, initially at rest, is given a constant angular acceleration of $\alpha = 0.06 \text{ rad/s}^2$, which increases its angular velocity for 8 s. At $t = 8 \text{ s}$, calculate the magnitude of
- (i) the angular velocity of the carousel, and (2 marks)
- (ii) the angular displacement of the carousel. (2 marks)
- (e) A 5 kg solid cylinder rolls along a horizontal floor so that its center of mass is moving at a speed of 4 m/s. How much work must be done on the cylinder to stop it? (3 marks)
- (f) A car of mass 2000 kg is moving at a speed of 45 km/h and then accelerates to 75 km/h. Calculate the energy gained by the car during this motion. (4 marks)

Question 4

- (a) Four forces are pulling a box located at the origin as shown in Figure Q4(a). Given that $F_1 = F_3 = 8\text{ N}$, $F_2 = 6\text{ N}$ and $F_4 = 4\text{ N}$.

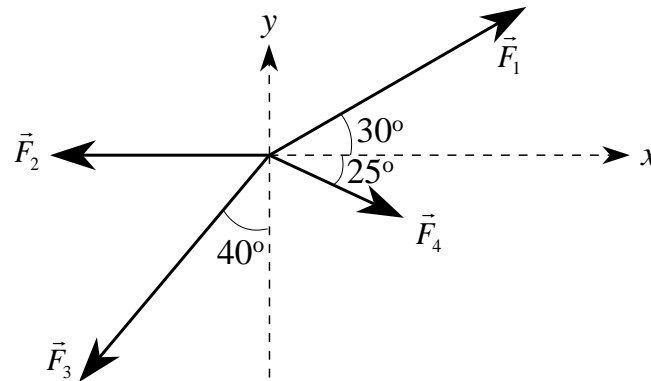


Figure Q4(a)

- (i) Determine the net force acting on the box in unit vector notation. (5 marks)
- (ii) Determine the magnitude of the net force acting on the box. (2 marks)
- (iii) Determine the direction of the net force with respect to the positive x -axis. (3 marks)
- (b) Two vector are given as $\vec{P} = 2\hat{i} - 5\hat{j} - 3\hat{k}$ and $\vec{R} = 7\hat{i} - 6\hat{j} - 4\hat{k}$. Determine
- (i) $|\vec{P}|$ and $|\vec{R}|$, (4 marks)
- (ii) $\vec{P} \cdot \vec{R}$, (2 marks)
- (iii) the angle between \vec{P} and \vec{R} , (3 marks)
- (iv) $\vec{P} \times \vec{R}$, and (3 marks)
- (v) $3\vec{P} - 2\vec{R}$. (3 marks)

Question 5

- (a) Figure Q5(a) shows three boxes connected by cords, one of which wraps over a pulley with negligible friction on its axle and negligible mass. The mass of the boxes are $m_A = 7$ kg, $m_B = 2$ kg, and $m_C = 3$ kg. When the system is released from rest,

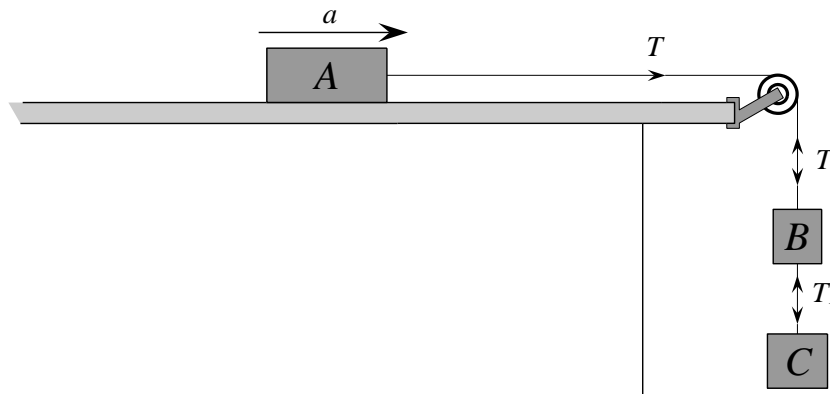


Figure Q5(a)

- (i) calculate the acceleration of the system, (6 marks)
- (ii) calculate the tension T in the cord connecting A and B , and (2 marks)
- (iii) calculate the tension T_1 in the cord connecting B and C . (2 marks)
- (b) It is given that 1 ml of water has a mass of 1 g. In an experiment, 800 ml of water at 95 °C is mixed in a container containing 1200 ml of water at 40 °C. Calculate the final temperature of the mixture. (3 marks)
- (c) An ideal gas at 10 °C and 100 kPa occupies a volume of 2.5 m³. Assume no leaks.
- (i) Determine the number of moles of gas in the system. (3 marks)
- (ii) If the pressure is now raised to 200 kPa and the temperature is raised to 20 °C, determine the volume of the gas. (3 marks)
- (d) Two glass marbles which are moving along a straight line towards each other undergo a complete elastic collision. The speed of one marble is 5 m/s and its mass is 43 g, the speed of the other marble is 7 m/s and its mass is 47 g. Calculate the speed of the marbles after the collision and determine if the marbles have changed direction. (6 marks)

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