August 7, 2021

Department of Mathematics and Natural Sciences

PHY111 - Principles of Physics-I

Midterm Assessment, Summer 2021

Time: 2 Hours (5:00 pm to 7:00 pm)

Total Marks: 30

Answer all questions.

1. The motion of a particle which moves along the straight line is defined by the relation $x(t) = t^3 - 9t^2 + 24t - 8$ where x and t are expressed in meters and seconds respectively. Note that the coefficients of t have dimensions accordingly.

(a) (4 marks) Determine when the velocity of the particle is zero.

(b) (4 marks) Calculate the position vector and distance travelled by the particle when the acceleration is zero. Consider that at the starting point time t = 0 sec.

(c) (2 marks) Does the particle move at constant velocity or constant acceleration? Justify your answer.

2. A block of mass $m_1 = 20\ kg$ which lies on an incline frictional surface is connected to another block of mass $m_2 = 100\ kg$ by two massless ropes and two massless, frictionless pulleys as shown in Fig. 1. The inclined surface makes 30º angle with the horizontal line. The coefficient of kinetic friction between the block m_1 and the inclined surface is 0.12.

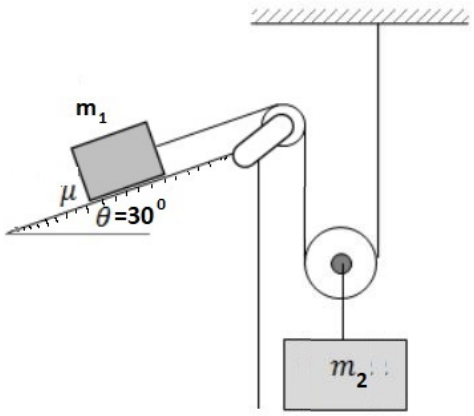

Fig. 1

(a) (2 marks) Draw the free body diagram of block m_1, block m_2 and the hanging pulley.

(b) (5 marks) Find the accelerations of block m_1 and block m_2.

(c) (3 marks) Calculate the tensions in the two massless ropes.

3. Fig. 2 shows a Big Wheel at a fairground. It has a radius of 3 m. Once it is loaded with passengers it is given a uniform angular acceleration for 20 s then runs at uniform angular speed for 2 minutes as main ride. It then slows down at a uniform rate over a further 10 s. During the main part of the ride, the wheel completes 1 revolution every 10 s.

(a) (6 marks) Find the total angle through which a passenger moves.

(b) (2 marks) Calculate the total linear distance the passenger travels during this time.

(c) (2 marks) Find the magnitude of the radial and tangential acceleration of a passenger at the top of the ride when it is travelling at maximum speed.

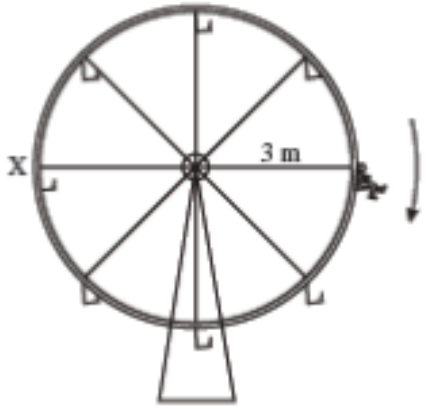

Fig. 2