Physics Department | **Physics 103** | **February 3, 1997**
Final Exam | **Time: 2 hours**

Name:_____

I.D. No._____

Section Eid ☐ Al-Kassab ☐

Remarks:

- All questions should be worked out.
- No make up of this exam without legal reason
- This exam will have a total grade of 200.

Page	Grade
1.	
2.	
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Total :

- A projectile has an initial velocity $\vec{v}_o = 26$ m/s and a projection angle of 48°.

(a) How much time takes the projectile to reach the maximum height?
(b) What is the velocity of the projectile(magnitude and direction) at its maximum height?.
(c) Find the coordinates of the projectile relative to the origin at the time $t = 2.1$ s.

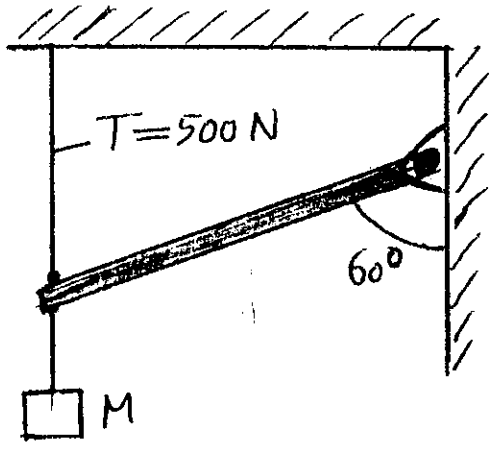
Solution :

- A truck starts from rest with an acceleration $a_T = 1.50$ m/s^2, while a car 150 m behind starts from rest with an acceleration $a_C = 2.0$ m/s^2.

(a) How long will it take before both the car and the truck are at the same position?.
(b) What is the distance traveled by each of them?.

Solution :

- A uniform beam of mass m = 20 kg and length L is hinged to vertical wall and supported at its other end by a wire (see Figure).



(a) What is the value of the mass M which is supported from the beam, if the tension in the wire is T = 500 N?

(b) What are the components of the reach force $\vec{R}$ at the hinge that acts on the beam?

Solution :

- A bullet of mass m =20 g is fired horizontally into a wooden block of mass M = 1.0 kg resting on a horizontal rough surface (coefficient of kinetic friction is μ = 0.25). The bullet goes through the block and comes out immediately with a speed of v_{bf} = 250 m/s. If the block moves a distance d = 5.0 m before it stops, the initial speed of the bullet v_{bi} was (in m/s) :

☐ 995 ☐ 525 ☐ 497 ☐ 450

show your solution here (crossing only does not count)

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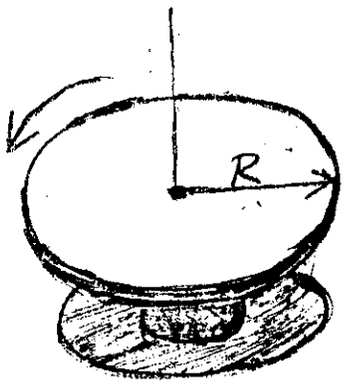
- A child of mass 22 kg stands halfway between the center and the edge of the carousel which is rotating at an angular speed of $\omega_0 = 1.8$ rad/s. The radius of the carousel is R = 3.0 m, and its moment of inertia is I = 610 kg m^2.



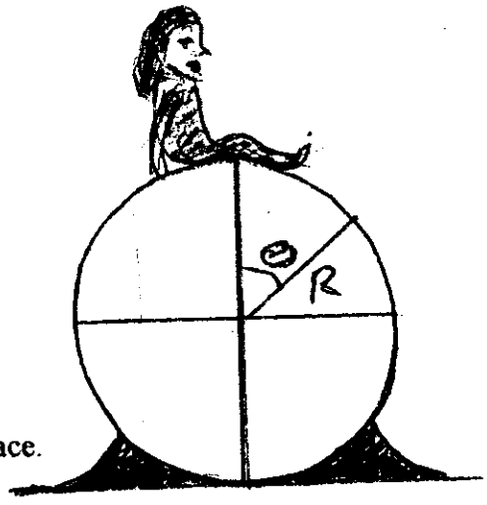
(a) What is the angular speed ω, after the child walks to its edge?

(b) What is the change in kinetic energy of the system (carousel + child) ?

Solution :

10

- A girl of mass m sits at the top of a cylindrical tank of radius R (see Figure). The surface of the tank is assumed to be smooth. The girl starts to slide from the top.



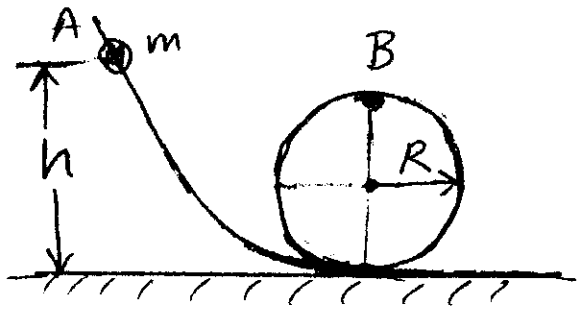
(a) At what angle θ will the girl loose contact with the surface ?

Hint: Normal force is zero, when no contact with the surface.

Solution :

20

- A particle of mass m = 5.0 g slides without friction around the track shown in the Figure. The particle is released from point A where h = 3.5 m. Suppose that the radius of the loop is R = 1.0 m.



(a) What is the velocity of the particle at point B ?.

(b) What is the normal force of the truck on the particle at point B ?.

Solution :

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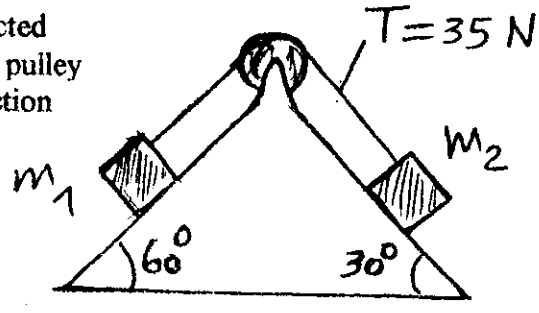
- Two masses m_1 = 4 kg and m_2 is unknown are connected by a string over a pulley as shown in the Figure. The pulley is of negligible mass and frictionless. Assume no friction between the blocks and the incline.



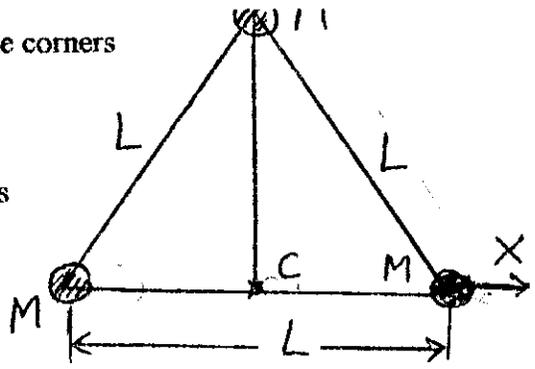
(a) Find the mass m_2 .

(b) Calculate the acceleration of the blocks (magnitude and direction).

Solution:

(2C)

- Three particles of equal masses M = 2 kg are placed at the corners of an equilateral triangle (see Figure) length L = 1 m.



(a) Find the moment of inertia of this system about the axis passing through the point C (see figure) which is perpendicular to the xy-plane .

(b) What is the moment of inertia about the x-axis?

Solution :

(2C)

- A constant horizontal force F = 10 N acts on a block placed on a frictionless horizontal surface. The block starts from rest and travels a distance d = 250 m in 5 seconds.

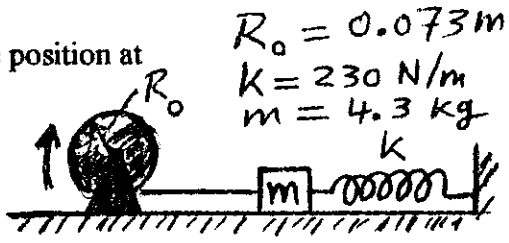
(a) What is the mass of the block ?

(b) If the force is removed at 5 seconds, how far will the block travel during the next 10 seconds?

Solution :

10

- The pulley in the Figure has a moment of inertia $I = 0.0165$ kg m^2, and rotates clockwise pulling the mass m, and the spring. When the spring is stretched by 0.052 m, the pulley is stopped, and then released.
  The speed of the block m, when it passes through the position at which the spring is unstretched is (in m/s):



☐ 1.52 ☐ 0.73 ☐ 0.38 ☐ 0.29

Show your solution here (crossing only does not count):

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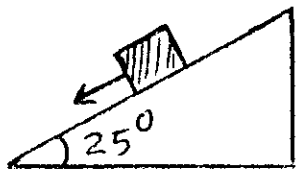
- A 250 kg crate is placed on an adjustable rough inclined plane. The crate slides down
  the incline with an acceleration $a = 0.70$ m/s^2 when the angle is $\theta = 25°$.

(a) What should be the angle of the incline, if the crate is to slide at constant speed?



Solution: