

1. A car of mass  $M$  starts at rest and undergoes a constant acceleration of  $5 \text{ m/s}^2$  for 20s.

a. Draw a graph of  $a(t)$ ,  $v(t)$ , and  $x(t)$ .

b. What is the K.E. of the car at 20s.

c. What is the work done by the engine on the car?

d. What is the avg output of the car engine?

\*bonus. When is the engine power output the highest over the 20s interval

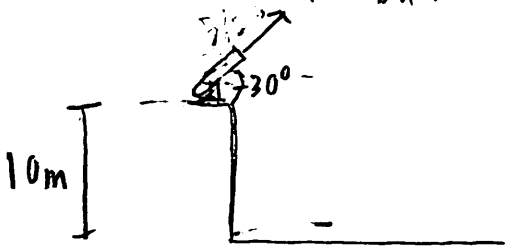
2. A cannon fires a 1 kg cannon ball at 5 m/s at  $30^\circ$  angle at 10m above the ground.

a. What is velocity of the cannon ball when it strikes the ground?

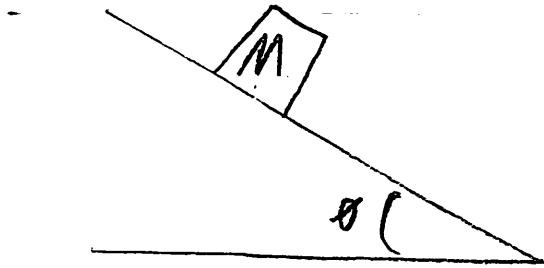
b. How much work does gravity input on the cannon ball?

c. What is avg gravity inputs on the cannon ball

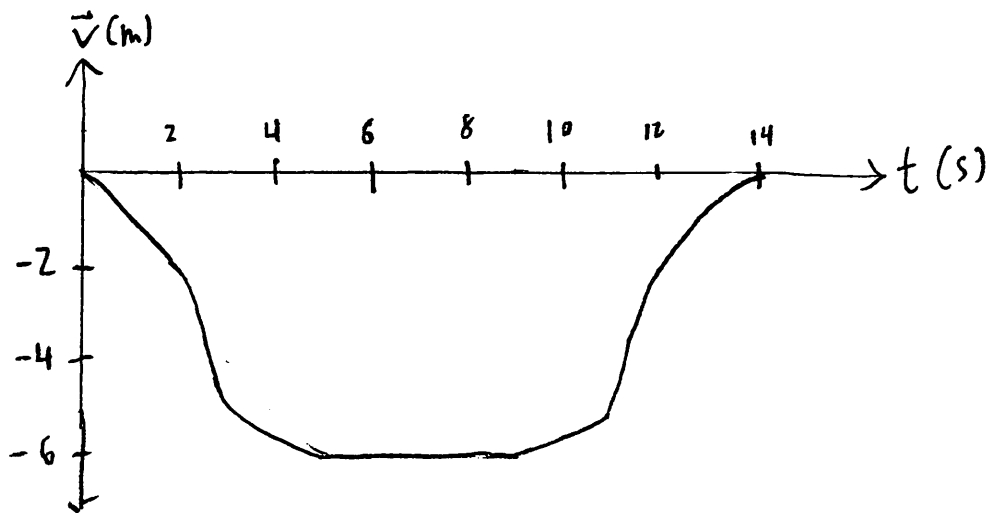
d. The cannon's mass 10kg, what is its acceleration after firing the cannon ball.



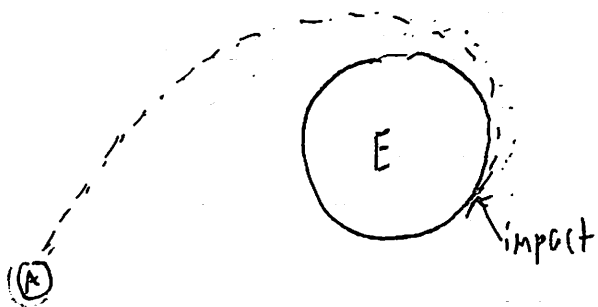
3.  $\mu = 0.2$ , if you slowly increase the angle of the ramp, at what angle does the box of mass  $M$  begin to slide?



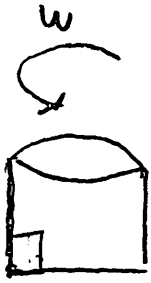
4. An elevator is going down floors. A graph of its velocity is shown below. Draw a graph of the normal force felt by a person in the elevator over the same time interval. Assume the person's mass is  $60 \text{ kg}$  and  $g = -10 \text{ m/s}^2$



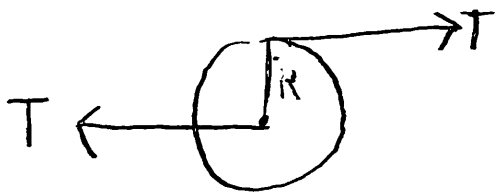
5 An astroid is in a spiraling collision trajectory with Earth. Before impact how is the angular momentum and K.E. of the system changing with time?



- 6 A block of mass  $M$  is in a spinning cylinder of radius  $R$ . At what angular velocity does the cylinder have to be spinning so that the mass feels a  $g$ -force of  $3g$  from the side wall.



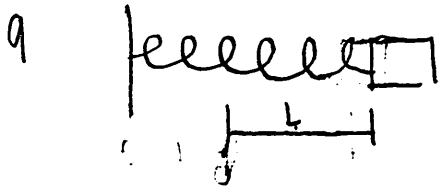
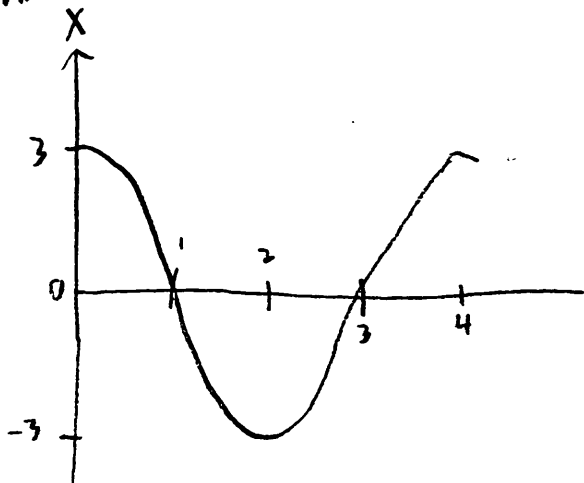
- 7 A wheel with a radius equal to  $R$  and a moment of Inertia equal to  $I$ , has two strings pulling on it with a force of equal magnitude equal to  $T$ .



- What is the net force on the wheel?  
What is the net torque on the wheel?  
What is the  $\alpha$  of the wheel.

8 The Moment of inertia of a ring of radius  $R$  around its center is  $I_0$ . If I glue a bead of mass on the ring what is the new moment of Inertia around the Rings center.

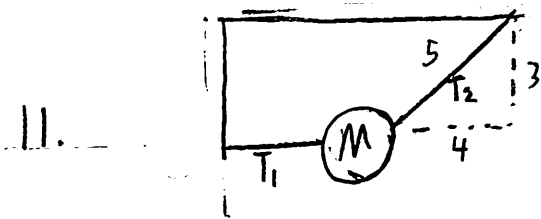
write eqn equation for  $x(t)$ , the simple harmonic motion graphed below



A spring is stretched and oscillates over the distance  $L$  shown above.

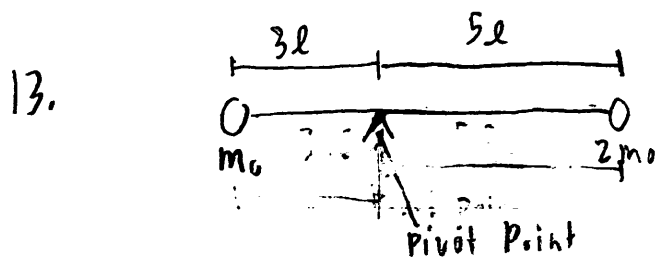
Where is the magnitude of acceleration at its max and min  
Where is the magnitude of velocity at its max and min.

- 10 If  $a(t) = 3t$ , and  $v(0) = 0$  and  $x(0) = 0$ .  
What does  $x(3)$  equal?



If  $M = 20 \text{ kg}$  and hanging in equilibrium, at what tension is string 1 and string 2?

12. In a simple pendulum, what variable does not effect the period time  $g, m, \text{ or } l$ ?

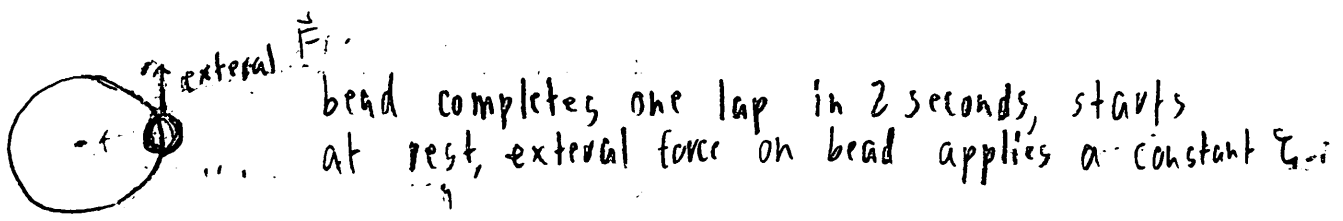


(rod weight negligible)

- Calculate the moment of Inertia of the rod mass system
- Calculate the torque gravity provides on the rod mass system
- Calculate its angular acceleration when it begins to rotate

14 A bead on a looped <sup>wire</sup> starts at rest and undergoes a constant angular acceleration. In 2 seconds it completes one rotation around the loop.

- a. What is the angular acceleration of the bead?
- b. What happens to the magnitude of the bead's radial acceleration, acceleration towards the center, over the 2 second interval?



15. Connect <sup>the</sup> linear symbols with <sup>their</sup> rotational symbols counterpart

- (displacement)  $\vec{r}$   
 $\Delta$   
 $\vec{M}$   
 $\vec{F}$   
 $m\vec{v}$

- $I\vec{\omega}$   
 $\vec{L}$   
 $\vec{\tau}$   
 $\vec{\theta}$