Mechanics 2 (FRB 104)

MODEL (1)

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Part (1)

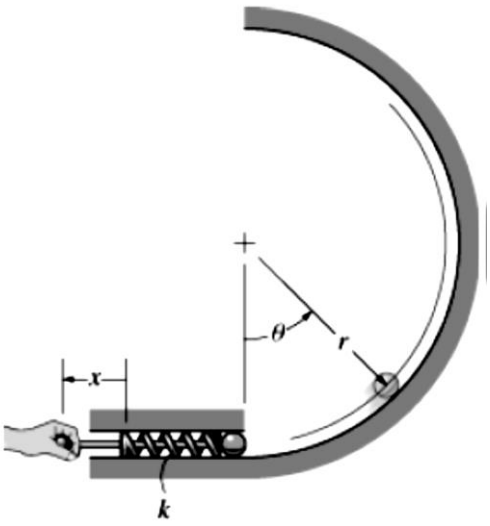
1) For a particle moving along a straight line. Determine:
   a) (v - t) and (a - t) relations for a given x(t)
   b) (v - t) and (x - t) relations for a given a(t)
   c) (v - x) and (x – t) relations for a given a(x)
   d) (v - x), (v – t) and (x - t) relations for a given a(v).
2) Give a solved numerical example for each of the four previous cases.

Part (2)

1) Define the Conservative forces (Give example).

2) Suggest a practical model that can be simulated using the principles conservation of energy

3) The ball of mass **M** of negligible size is fired up the vertical circular track using the spring plunger. The plunger keeps the spring compressed a distance δ when **x = 0**. Determine how far x it must be pulled back and released so that the ball will begin to leave the track when $\theta = \theta_1$



Mechanics 2 (FRB 104)

MODEL (2)

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Part (1)

1) Derive the basic equations for the velocity and acceleration of a particle that moves along a curved path using
   a) Rectangular components
   b) Tangential and normal components
   c) Radial and transverse components.

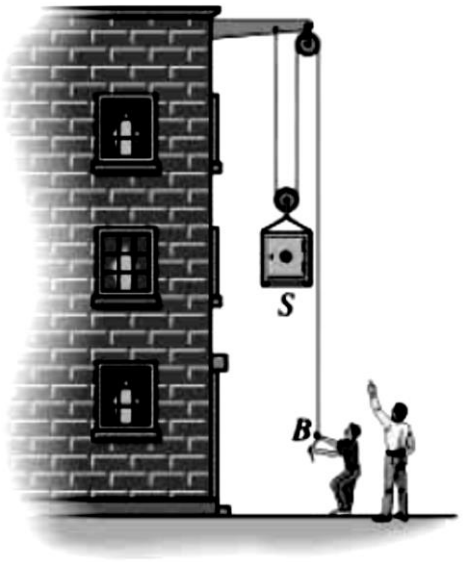
2) Give a solved numerical example for each type of the previous components.

Part (2)

1) Explain the principle of conservation of energy.

2) Suggest a practical model that can be simulated using the Second law of Newton's

3) The safe S has weight **Ws** and is supported by the rope and pulley arrangement shown. If the end of the rope is given to a boy **B** of weight $\mathbf{W_b}$, determine his acceleration if in the confusion he doesn't let go of the rope. Neglect the mass of the pulleys and rope.



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MODEL (3)

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Part (1)

1) Derive the basic equations that govern the motion of a projectile in two dimensions, when the air resistance is neglected.

2) Give suitable numerical solved example, for the following cases.

a) A projectile is projected in a horizontal direction from a given altitude to hit a target on the ground.

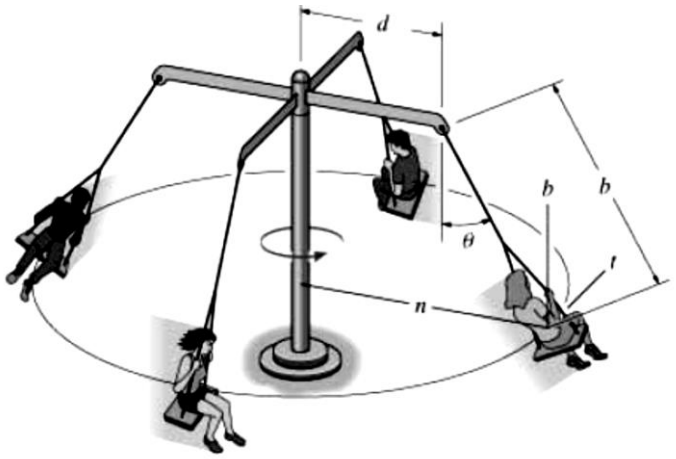
b) How to determine the firing angle of a projectile fired with a known initial velocity to hit a target with known location.

c) The range of a projectile projected on an inclined plane.

Part (1)

1) Suggest a practical model that can be simulated using the Second law of Newton's

2) Determine the constant speed of the passengers on the amusement-park ride if it is observed that the supporting cables are directed at angle **θ** from the vertical. Each chair including its passenger has a mass **mc**. Also, what are the components of force in the ***n, t***, and ***b*** directions which the chair exerts on a passenger of mass $\mathbf{m_p}$ during the motion?



Mechanics 2 (FRB 104)

MODEL (4)

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Part (1)

1) Write short notes about:

a) Newton's second law.

b) The equations of motion in different types of components.

c) The types of Forces acting on a body in any mechanical system.

d) The system of units used with the law.

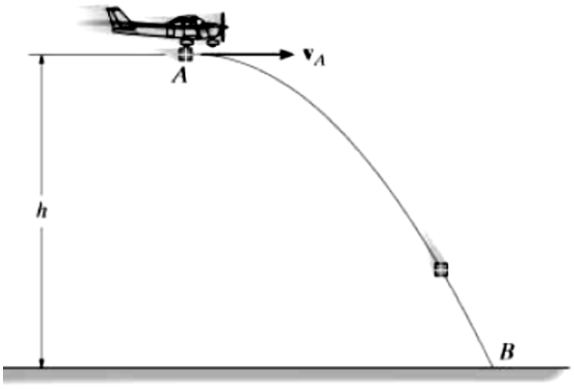
2) Explain in details the phenomenon of dry friction between two rubbing surfaces.

3) Give a solved numerical example for the motion of a block along a rough inclined

Part (2)

3) Suggest a practical model that can be simulated as a projectile

A package is dropped from the plane which is flying with a constant horizontal velocity $\boldsymbol{v_A}$. Determine the normal and tangential components of acceleration and the radius of curvature of the path of motion (**a**) at the moment the package is released at A, where it has a horizontal velocity $\boldsymbol{v_A}$, and (**b**) just before it strikes the ground at **B**.



Mechanics 2 (FRB 104)

MODEL (5)

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Part (1)

1) Define the work of force acting on a body.
2) Derive the expression for:
   a) The work of a constant force in rectilinear motion.
   b) The work of the force of gravity.
   c) The work of the force exerted by a spring.
3) Explain how to derive the principle of work and energy from Newton's second law
4) Suggest a practical model that can be simulated using the principle of conservation of energy

Part (2)

1) Deduce the principle of linear impulse and momentum
2) The boy A is moving in a straight line away from the building at a constant speed v_A. At what horizontal distance d must he be from **C** in order to make the catch if the ball is thrown with a horizontal velocity v_C ? Also determine the relative speed of the ball with respect to the boy **A** at the instant the catch is made.