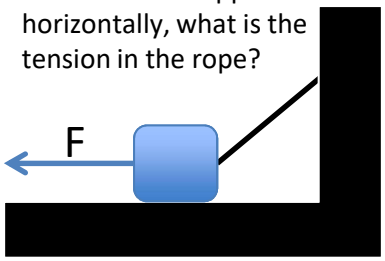
Sorting Task

Dynamics

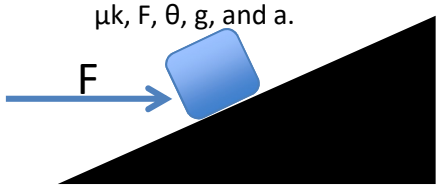
A

A 100kg mass is sitting on a frictionless horizontal surface. It is tied to the wall with a rope, which makes an angle of 40 above the horizontal. If the a force of 50N is applied horizontally, what is the tension in the rope?



B

A mass is sitting on an incline, where friction is not negligible. The mass is being pushed up the incline by a horizontal force. If the block is accelerating up the ramp, find an expression for the normal force, in terms of m, μk, F, θ, g, and a.



C

A 100 kg lawn mower is being pushed with a force directed at 40° below the horizontal. Treat the lawnmower as if it was sliding, and assume the coefficient of kinetic friction is 0.3 between the lawnmower and the ground, what force must the person apply to keep the lawnmower moving at constant speed?

Which two of the three problems shown here are most similar to each other?

Explain why these two are similar to one another:

D

A chair and passenger on the « Paratrooper » carnival ride have a combined mass of 85kg. The 2.5 m rope supporting them makes an angle of 30° with the vertical. The ropes are hanging from the supporting platform above which has a radius of 4 m. How many revolutions does the ride complete per minute?

E

Ice skaters going over a circular bump, risk losing contact with the ice iff they go too fast. In terms the mass of the skater and the radius of curvature of the bump, derive an expression for the critical speed at which they lose contact with the ice.

F

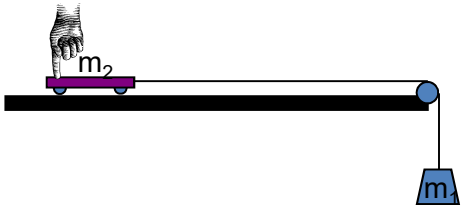
Olympic indoor cyclists are constantly riding on a banked curve. What forces are causing the centripetal acceleration?

Which two of the three problems shown here are most similar to each other?

Explain why these two are similar to one another:

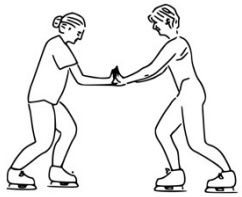
G

A cart with mass m_2 is connected to a mass m_1 using a string that passes over a frictionless pulley, as shown below. Initially, the cart is held motionless. What is the tension in the string?



H

Two friends, each wearing frictionless roller-skates, are initially at rest, holding hands. If the 50kg friend pushes off with a force of 100 N, what will be the acceleration of the 40kg friend?



I

A 10kg window pane is struck by a 100g baseball. The window breaks. What is the ratio of the force of the baseball exerted on the window, to the force of the window on the baseball?

a) Greater than 1
b) Less than 1
c) Equal to 1

Which two of the three problems shown here are most similar to each other?

Explain why these two are similar to one another:

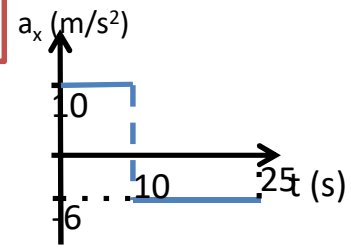
Now, of the six problems you selected above, select the four that are most similar to each other:

Provide a rationale for your selection:

Sorting Task

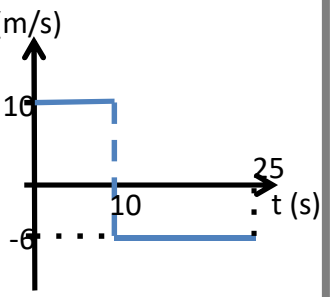
Kinematics

A



A particle is moving in the positive x direction at a speed 5 m/s. At t=0 s, it is subject to forces which accelerate it according to the graph shown. If the particle was at position x = -5m at t = 0 s, find the object's position at t = 25 s.

B



A particle is moving along the x-axis. Its velocity varies according to the graph shown. If the particle was at position x = -5m at t = 0 s, find the object's position at t = 25 s.

C

A bottle rocket is launched from a ditch 5m below the ground level. The rocket is accelerating at 10 m/s² for 10 s, at which point the fuel runs out. What is the maximum height reached by the rocket above ground level ? (neglect the effects of air resistance)

Which two of the problems shown here are most similar to each other?

Explain why these two are similar to one another:

D

A particle starts at the origin, and has an initial velocity of (-5 **î** + 2 **ĵ**) m/s. The particle's acceleration is constant, given by **a**(t) = 3 **î** m/s².How far is the particle from the origin after 10 s?

E

A stone is thrown off of a building 10m above the ground. The initial speed is 15m/s, directed 60° above the horizontal. What is the magnitude and direction of the speed of the stone as it strikes the ground?

F

A particle starts at the origin and has an initial velocity of (-5 **î** + 2 **ĵ**) m/s. The particle's acceleration is changing, given by **a**(t) = (3t) **î** m/s². How far is the particle from the origin after 10 s?

Which two of the three problems shown here are most similar to each other?

Explain why these two are similar to one another:

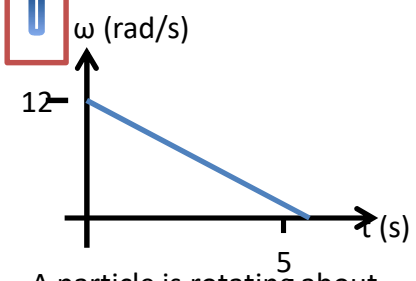
G

A wheel of radius 30 cm is spinning at 24 rad/s. The brakes are applied, resulting in a constant decceleration, and the wheel comes to a stop after completing 10 revolutions. How much time did it take for the wheel to come to a stop?

H

A wheel is spinning at a constant rate of 24 rad/s. What is the radial acceleration of a point at the rim of the wheel, 10 cm away from its axis of rotation?

I



A particle is rotating about the origin, and its angular velocity varies according to the graph shown. Determine the number of revolutions completed between t= 0 s and t=5 s.

Which two of the problems shown here are most similar to each other?

Explain why these two are similar to one another:

Now, of the six problems you selected above, select the four that are most similar to each other:

Provide a rationale for your selection: