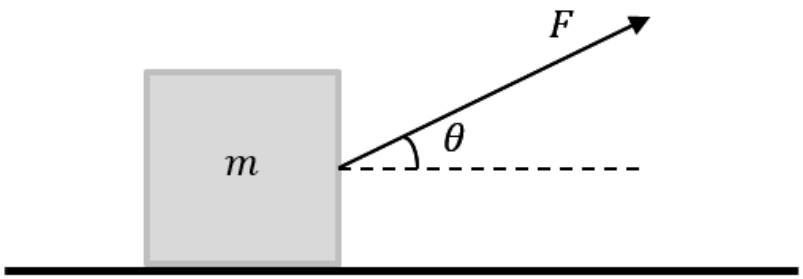
Problem 1.

A block with mass m is located on a horizontal table. The coefficient of kinematic friction between the block and the table is μ_k. The block is pulled with constant force F angled θ with respect to the horizon.



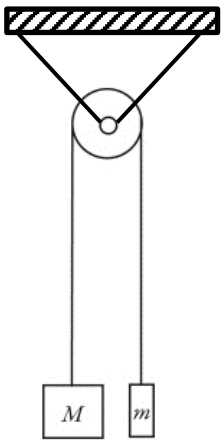
a) Draw a force diagram for the block accelerating towards right.
b) Find an expression for the acceleration of the block, as it accelerates towards the right.

The block is now polled with a force F, so it travels with constant velocity.

d) Find an expression for the force F
e) Determine the angle θ_{min}, so the force F is as small as possible.

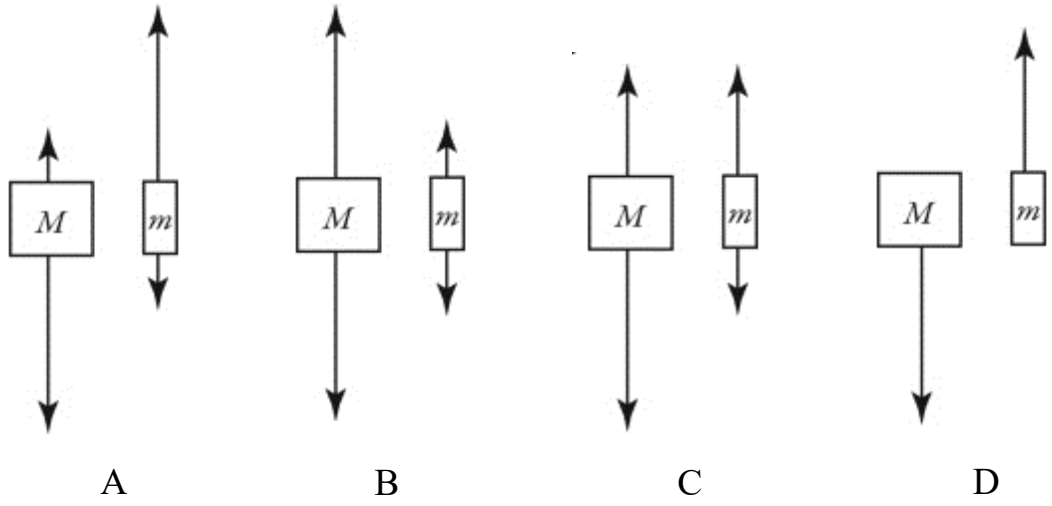
Problem 2.

Two different masses ($M > m$) are connected by a rope which passes over a frictionless, massless pulley. When the system is released from rest, the masses begin to accelerate. The system is shown in the figure to the right.



Shown below are four different pairs of force diagrams for the two masses.

Which pair of force diagrams best describes the moving masses?

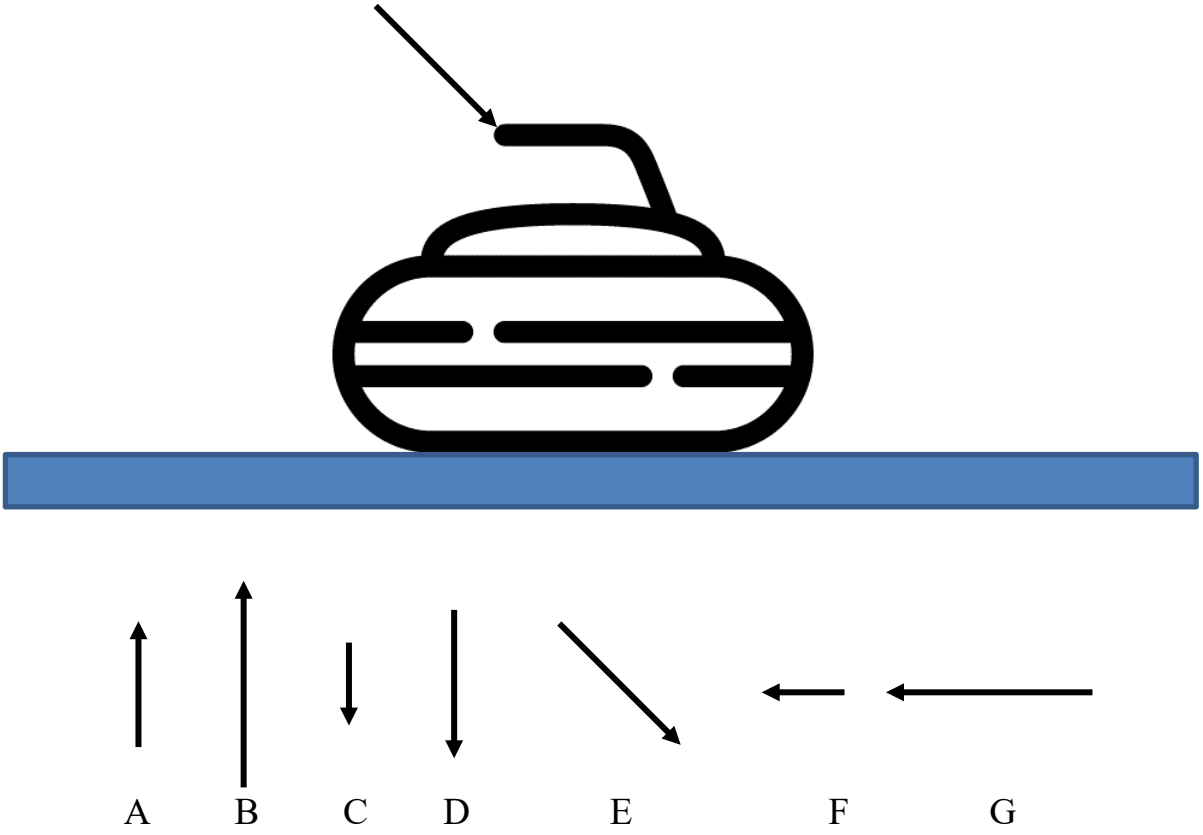


A B C D

A) A
B) B
C) C
D) D
E) Do not know

Problem 3.

A curling stone is affected by a slanted, downwards force from a player as shown in the figure below. The curling stone slides and accelerates to the right over a rough surface with $\mu_k < 1$.

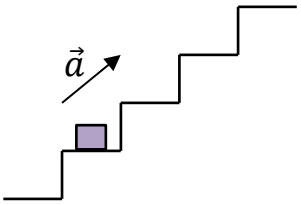


Which of the above forces should be included in a force diagram for the curling stone in the situation described? The direction and magnitude of the forces should be considered.

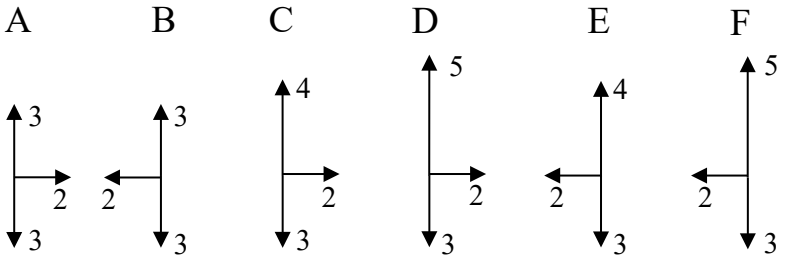
A) A
B) B
C) C
D) D
E) E
F) F
G) G
H) Do not know

Problem 4.

A block is transported upwards on an escalator (see the figure to the right). The acceleration of the blocks and the escalator both have the magnitude a and angle $45°$ above the horizontal. The block does not move relative to the escalator.



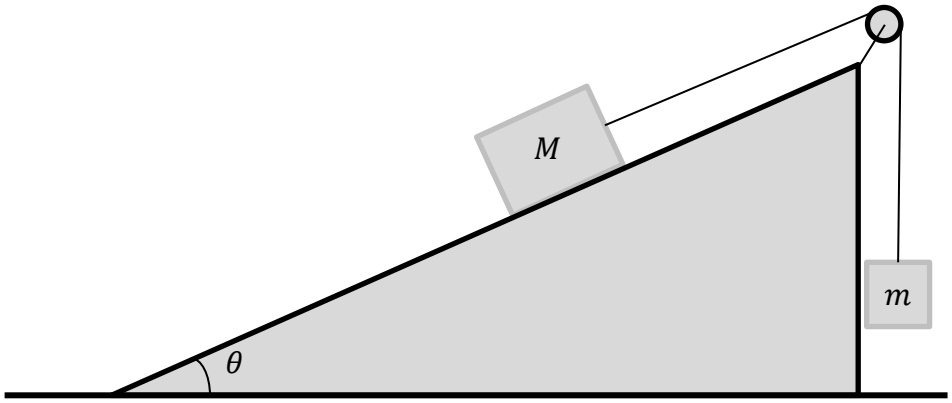
Which of the force diagrams of the block below are most correct regarding the direction and magnitude of the forces? The numbers in the figure indicate the magnitude of the forces in Newton.



A) A
B) B
C) C
D) D
E) E
F) F
G) Do not know

Problem 5.

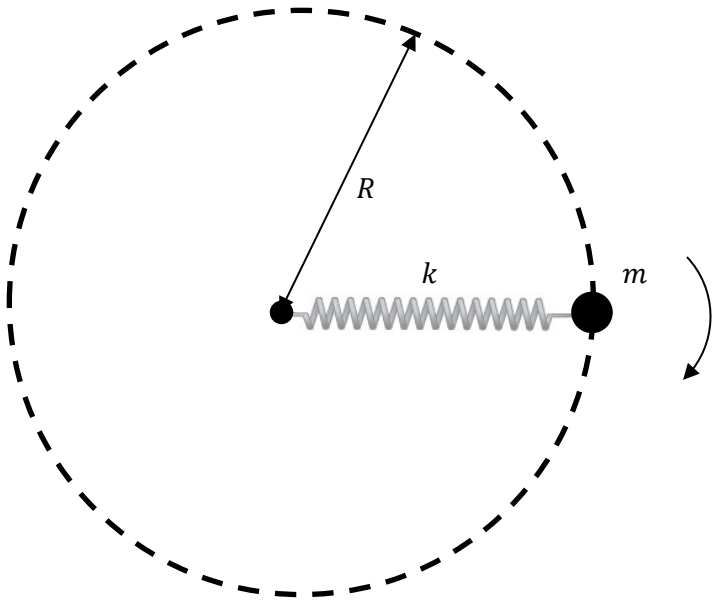
A block with mass M is placed on a smooth slope. The slope angle is θ above the horizontal. A rope goes from the block and over a massless, frictionless pulley. The other end of the rope is fixed to the second block with mass m. The system is released from rest, and the block on the slope begins to accelerate downwards.



a) Determine the acceleration of the blocks and the magnitude of the tension.
b) Determine the acceleration of the blocks if the slope has a rough surface. The kinematic coefficient of friction between the block and the slope is μ_k.

Problem 6.

A particle with mass $m = 200$ g, is hooked onto one end of a massless spring. The other end of the spring can freely rotate around an axis. Gravity and friction are neglected. The particle moves in a uniform circular motion with period of rotation $T = 3.14$ s. The radius of the movement is $R = 1.0$ m. The spring constant is $k = 5.0$ N/m. The situation is shown in the figure below, from the top.

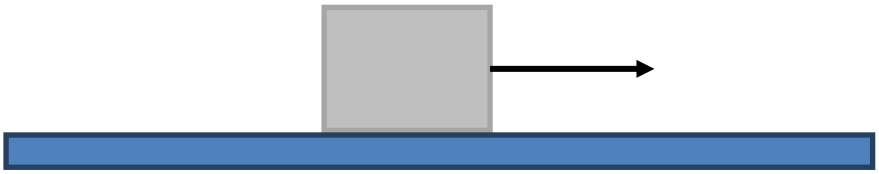


Which of the following distances is closest to the un-stretched length of the spring?

A) 0.16 m
B) 0.20 m
C) 0.84 m
D) 0.92 m
E) 1.16 m
F) Don't know

Problem 7.

A block with mass m is dragged over a rough horizontal surface. When the force pulling the block has the magnitude F, the block moves with constant velocity.



a) Which of the following statements regarding the friction force is correct?

A) The friction force is greater than F.
B) The friction force is smaller than F
C) The friction force has magnitude F.
D) The friction force cannot be determined as the friction coefficient μ_k is unknown.
E) Don't know

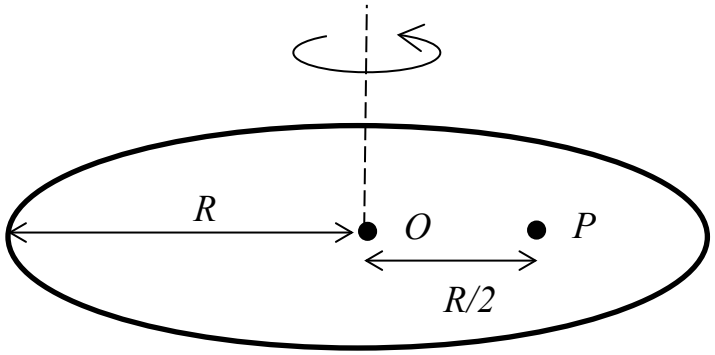
b) The block is now pulled with a force of magnitude $3F$ in the same direction as the previous problem.

What is the acceleration of the block?

A) $a = 0\ \mathrm{m/s^2}$
B) $a = \frac{F}{m}$
C) $a = \frac{2F}{m}$
D) $a = \frac{3F}{m}$
E) Don't know

Problem 8.

A homogeneous cylindrical disc with mass M and radius R rotates with angular velocity ω with respect to the center of mass O as shown in the figure. A small coin with mass m is situated in the point P in a distance $r = \frac{R}{2}$ away from O. At small angular velocities, the coin does not move with respect to the disk due to static friction. The gravitational acceleration is g, and the coefficient of static friction is μ_s. The period of rotation for the disk is T.



What is the period of rotation, T, when the coin begins to slide with respect to the disk??

A) $T = 2\pi\sqrt{\frac{R}{2\mu_s g}}$

B) $T = 2\pi\sqrt{\frac{2RM}{2\mu_s g m}}$

C) $T = 2\pi\sqrt{\frac{R}{\mu_s g}}$

D) $T = 2\pi\sqrt{\frac{2R}{\mu_s g}}$

E) Don't know