Name: ____________________ **Section:** __________ **Score:** __________/20

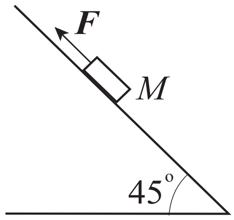
1. A person is on a scale in an elevator. The elevator accelerates and the reading on the scale is 10% larger than it was when the elevator was stationary.

(a) What is the acceleration of the elevator? Pay attention to its sign (the sign convention is upward +). [5]

(b) After the constant acceleration is over, the reading of the scale returns to the reading when the elevator is stationary. Has the speed of the elevator increased, decreased or remained unchanged? You must justify your answer. [5]

(**2** on the next page)

2. On an inclined surface with the coefficient $\mu_s = 0.5$ of static friction and the coefficient of kinetic friction $\mu_k = 0.3$ is a block of mass M kg as illustrated in the following figure.

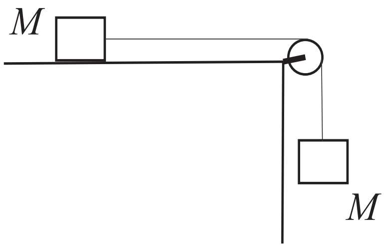


(a) What is the minimum magnitude of the force $\boldsymbol{F}$ required to keep the block from falling? Give the value of $|\boldsymbol{F}|/Mg$, where g is the acceleration due to gravity. [5]

(b) What is the magnitude of the acceleration a of the block if the force $\boldsymbol{F}$ is removed? [5]

Name: ____________________ **Section:** __________ **Score:** __________**/20**

1. There are two identical blocks of mass M. One is on the rough and horizontal table and is connected to the other mass via a massless string through a massless and frictionless pulley as shown below.



(a) The magnitude of the acceleration a of the hanging mass is $a = g/4$, where g is the acceleration due to gravity. Let the tension in the string be T. What is T/Mg? [5]

(b) What is the coefficient μ_k of kinetic friction between the mass on the table and the table surface? [2]

(**2** on the next page)

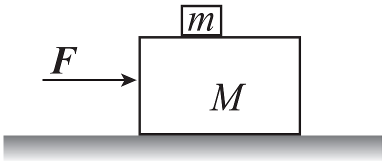
2. An elevator is initially going down at a speed 3m/s, and then decelerates uniformly in 2 seconds and comes to a halt. In the elevator stands a person of mass M (kg) on a scale.

(a) The scale reads M' (kg) during the deceleration. What is the ratio M'/M? [For the sign convention, choose the upward direction to be positive. Hint: Is the acceleration positive or negative?] [5]

(b) Unfortunately, the cable of the elevator snaps. What is the reading of the scale now? You must justify your answer. [5]

Name: ____________________ **Section:** __________ **Score:** __________/20

1. On a frictionless horizontal floor is a block of mass M, on which sits another mass of m as shown below. The value of m is actually one half of M (i.e., $m = M/2$). The top surface of mass M is horizontal but not smooth, and the coefficient of static friction between m and M is $\mu_s = 0.3$.

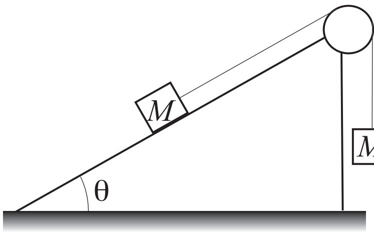


(a) When a horizontal force $\boldsymbol{F}$ is applied, the two masses move together with an acceleration of 1.0 m/s^2. Let the magnitude of the horizontal friction force acting of m be f. What is f/m $(= 2f/M)$? [5]

(b) What is the minimum magnitude of the force $\boldsymbol{F}$ required for the mass m to start to slide? You may assume $M = 12$ kg (so $m = 6$ kg).[(a) is a hint.][5]

(**2** on the next page)

2. On a frictionless slope that makes an unknown angle θ with the horizontal is a block of mass M, which is connected to another identical block of mass M with a massless string through a massless and frictionless pulley as illustrated below.

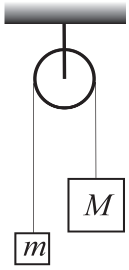


(a) For some positive θ can the magnitude of the acceleration of the hanging mass be smaller than $g/10$, where g is the acceleration of gravity? You must justify your answer. [5]

(b) Suppose the acceleration is $0.1g$. What is the ratio T/Mg, where T is the tension in the string? [5]

Name: __________________ **Section:** _________ **Score:** _________/**20**

1. Two masses m and M are connected with a massless string and hang from a massless and frictionless pulley as illustrated below. When the masses are gently released, the acceleration of M is $g/3$ downward, where g is the acceleration due to gravity.

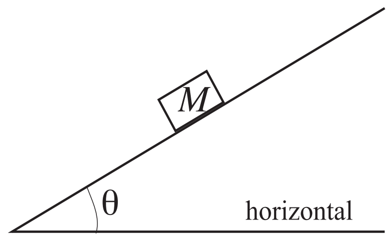


(a) What is the tension T in the string? Give the number T/Mg. [Hint: Pay close attention to the signs. As usual, no work, no credit!] [5]

(b) Find the ratio m/M. [5]

(**2** on the next page)

2. On a rough slope that makes an angle θ with the horizontal is a block of mass M as illustrated below.



(a) When the angle is θ (degrees), the block starts to slide in a lab on earth. What will happen if the same experiment is performed in a lab on the moon? [5]

(b) When $\theta = 30$ degrees, the block does not slide. What is the magnitude f of the friction force acting on the block on the earth? Find f/Mg. [5]