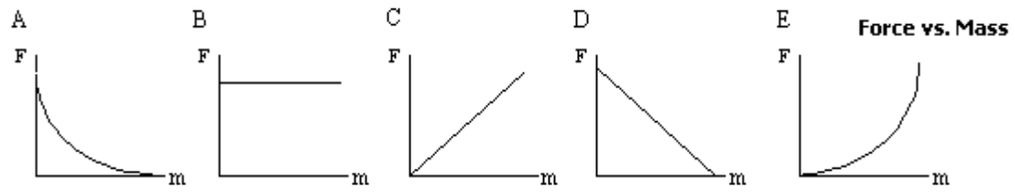
Physics 2204
Assignment 4
Newton's Laws and Newton's Law of Universal Gravitation
Outcomes 325-5 and 325-8

Name:_____

1 Which of the following graphs best represents the relationship between the gravitational force, *F*, that Earth exerts and the mass, *m*, of an object sitting at Earth's surface, that the force is exerted upon?



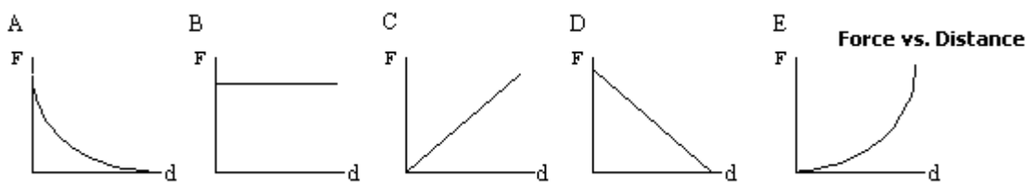
2 What is true about the gravitational field strength of Earth?

A) it has a value of 9.8 N/kg [down] at all locations on its surface
B) it is greater at the equator than at the poles
C) it is greatest at the peak of Mount Everest, the highest elevation
D) it is largest at the poles

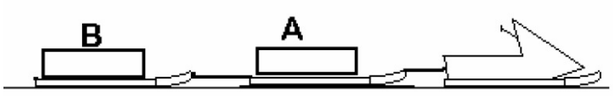
3 According to Newton's law of universal gravitation, which of the following is true regarding the gravitational force of attraction between two objects?

A) half as strong if they're moved twice as far apart
B) twice as strong if they're moved half as far apart
C) four times as strong if they're moved twice as far apart
D) four times as strong if they're moved half as far apart

4 Which of the following graphs best depicts the relationship between the gravitational force, *F,* that two masses exert on one another and the distance, *d*, which separates their centres of mass?



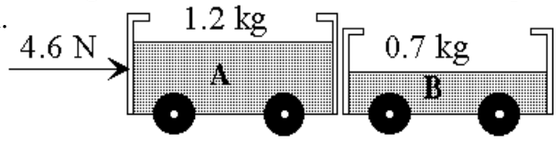
5 A 256 kg Skidoo is hauling a tandem load of firewood as shown in the diagram. Sled A and its firewood has a mass of 200.0 kg while sled B and its firewood has a mass of 100.0 kg. The skidoo pulls with a force of 1.80×10^3N [R]. The **Skidoo** and **each of the sled's** experience a frictional force of 165 N



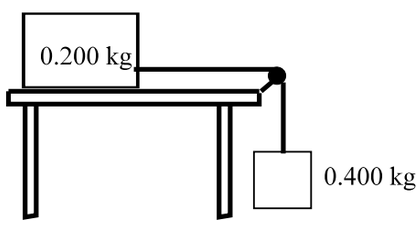
A) What will be the acceleration of sled A? (Draw an FBD for the system)

B) With what force does sled B pull back on sled A? (tension in line connecting B and A)

6 Two dynamics carts are resting side by side as shown, on a level, frictionless surface. A force of 4.6 N is applied to the larger of the two. Use the information provided to find the force that cart B exerts on cart A.



7. A 0.400 kg mass is attached to a 0.200 kg mass as shown in the diagram.



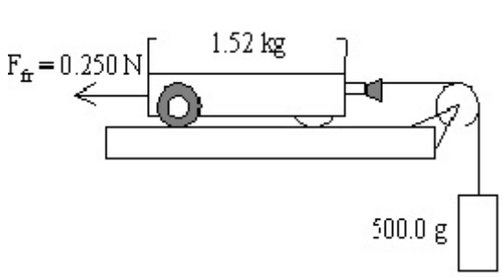
A) Draw a FBD for each mass.

B) Assuming no friction, what is the acceleration of system?

C) What is the tension in the string?

8 A cart with a total mass 1.52 kg is being dragged across a desk by a 500.0 g mass hung over a pulley. Frictional forces account for 0.250 N.

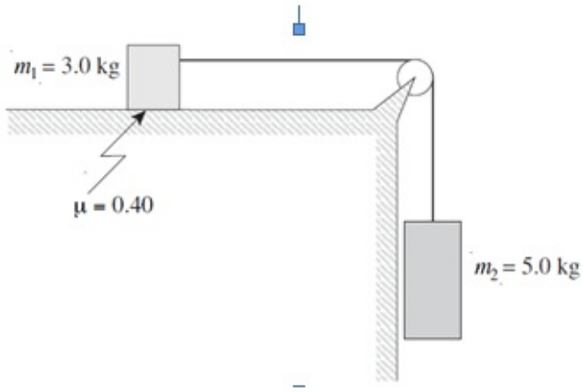
A) Draw a free body diagram for each mass.



B) Calculate the acceleration of the system.

C) What is the tension in the string joining the two carts?

9 The coefficient of friction between the 3.0 kg block and the surface is 0.40. The pulley is frictionless.

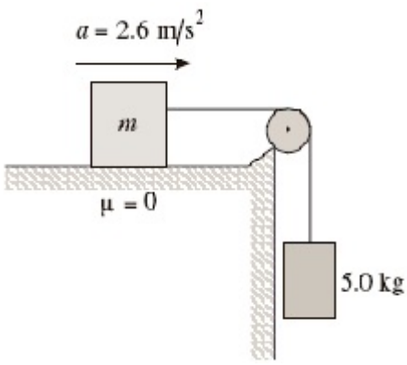


A) Draw a FBD for each mass.

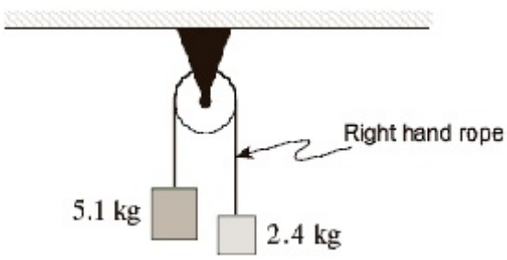
B) What is the acceleration of the system

C) What is the tension in the string?

10 A block of mass *m* on a frictionless surface is attached to a hanging 5.0 kg mass as shown below. The system accelerates at 2.6 m/s^2. What is the mass of the block?



11 A frictionless pulley is set up with two hanging masses as shown below.

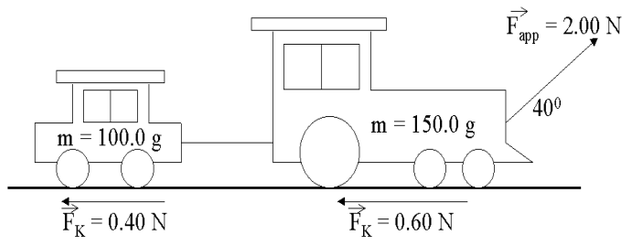


A) Draw a free body diagram for each mass.

B) What is the acceleration of the system?

C) What is the tension in the right hand rope while the masses move freely?

12 A boy pulls a toy train (consisting of an engine and a caboose) along a rough floor, exerting 2.00 N of force as indicated in the diagram. A frictional force of 0.60 N acts on the engine and a frictional force of 0.40 N acts on the caboose.



A) Draw free-body diagrams of both the engine and caboose.

B) Determine the acceleration of the entire train.

C) Calculate the tension in the string between the engine and the caboose.

13 The gravitational force of attraction between two unknown masses is 4.3 N. Determine the gravitational force of attraction in each situation below. Treat each situation as a new situation.

A) One of the masses is doubled but the distance between them remains the same.

B) One of the masses is tripled and the other is halved but the distance between them remains the same.

C) The masses are kept constant but the distance between them is reduced to one-third of the original distance.

D) One mass is quadrupled and the distance between the masses is doubled.

E) One mass is tripled, the other mass is reduced to one-quarter of the original mass and the distance between the masses is doubled.

14 What is the gravitational force of attraction between a 25 kg table and a 11 kg chair whose centres are separated by 25 cm?

15 The gravitational force of attraction between a 340 kg mass and a 210 kg mass is 7.6×10^{-7} N. How far apart are the centres of the two masses?

16 Two identical masses are separated by 45 cm. The gravitational force of attraction between them is 4.3×10^{-9} N. What is the mass of each object?

17 A person stands on a set of bathroom scales which have been calibrated in Newtons. The scales read 500 N. (Assume three significant digits.)

A) What would the reading be if the same person stood on the scales on a planet where the gravitational field strength, *g*, is 14 N/kg?

B) If this planet had a mass of 7.0 10^{24} kg, what would its radius be?

C) What would this person weigh at an altitude of 2.8 10^{6} m above the planet's surface?

18. Two identical boulders are placed 20.0 m apart and the force of gravitational attraction between them is found to be 2.00×10^{-7} N. What is the mass of the boulders?

19 A person stands on a set of bathroom scales which have been calibrated in Newtons. The scales read 500 N. (Assume three significant digits.)

A) What would the reading be if the same person stood on the scales on a planet where the gravitational field strength, *g*, is 14 N/kg? (Remember mass does not change)

B) If this planet had a mass of 7.0×10^{24} kg, what would its radius be?
(Your answer from part A is your force of gravity.)

C) What would this person weigh at an altitude of 2.8×10^{6} m above the planet's surface?