PHYSICS 11 FORCES & NEWTON'S LAWS WORKSHEET 1

1. Phoebe Physics pulls a wagon with a force of 80 N.
   a) What is the net force if the force of friction between the wagon and the ground is 12 N?
   b) If she uses 80 N to pull the wagon through a mud puddle, and the net force on the wagon is 38 N, what friction force acts on the wagon?

2. How much force is required to keep a 780 N box moving at <u>constant</u> velocity across the floor if the friction force between the box and the floor is 160 N?

3. A rocket weighs 2.0×10^7 N. Its engines exert 2.5×10^7 N of force at lift-off. What is the net force applied to the rocket?

4. Two children having a disagreement pull on a sled in opposite directions. One pulls with a force of 200 N east, the other with a force of 175 N west. A friction force of 10 N exists between the sled and the surface. Determine the net force on the sled.

5. A heavy wagon is pulled along the sidewalk by a force of 12 N, with a 10 N force opposing the motion. The force of gravity on the wagon is 20 N.
   a) Draw a f.b. diagram showing <u>all</u> the forces acting on the wagon.
   b) Determine the net force on the wagon.

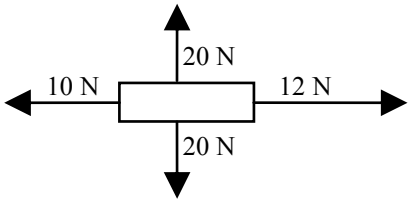
6. A 400 N force pulls due north on a crate. What other force must act on the crate if:
   a) the net force on the crate is 386 N due south?
   b) the net force on the crate is 152 N due north?

7. Hayley Davidson is riding her motorbike south along a flat, horizontal road. The total weight of Hayley and her hog is 1800 N. The engine exerts a 600 N force forward. The air resistance acting on Hayley and the bike is 200 N. The total friction between the tires and the road is 100 N.
   a) Draw a f.b. diagram for the system that includes Hayley and her motorbike.
   b) Calculate the net force on the system.

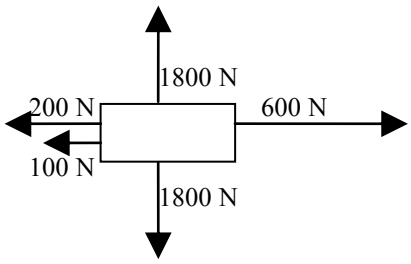
8. A textbook sitting on a table weighs 3.6 N. If you push straight down on the book with a force of 8.4 N, what is the normal force acting on the book?

1. a) 68 N b) 22 N 2. 160 N 3. 5.0×10^6 N 4. 15 N east 5 a) see below b) 2 N 6. a) 786 N south b) 248 N south 7. a) see below b) 300 N 8. 12 N up

5 a)



7 a)



PHYSICS & ENGINEERING 11 FORCES & NEWTON'S LAWS WORKSHEET 2

1. Determine the mass of the following:
   a) a 30.0 N cat. b) a 75.0 N dog.

2. What is the weight of a 750 kg Volkswagen:
   a) on the Earth's surface?
   b) on Mars, where g = 3.3 N/kg?

3. If a net force of 6.0 N acts on a 4.0 kg mass, what is its acceleration?

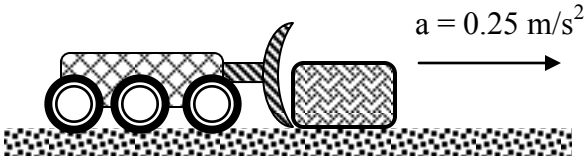
4. Referring to worksheet 1 of this section, determine the following:
   a) from question 1: i) the mass of the 20 N wagon.
      ii) the acceleration of the wagon.
   b) from question 2: i) the mass of Hayley + motorcycle.
      ii) the acceleration of bike and rider.

5. What is the net force acting on a car moving at a constant velocity of 55 km/h?

6. A model rocket weighs 4.5 N. Its engine exerts an upward thrust of 13.1 N at lift-off.
   a) What is the mass of the rocket?
   b) What is the acceleration of the rocket at lift-off?

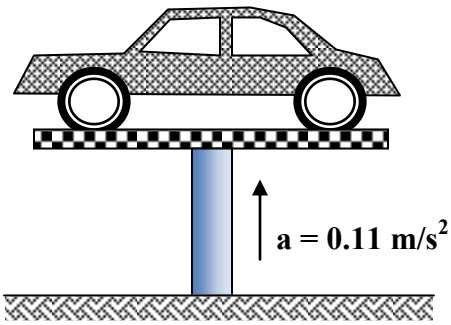
7. An elevator of mass 890 kg has an upward force of 1.10×10^4 N applied to it. Determine the following:
   a) the net force on the elevator.
   b) the acceleration of the elevator.

8. In a competition, a small robot accelerates forward at 0.25 m/s^2 as it pushes a wood block of mass 1.6 kg towards a basket. A friction force of 3.7 N exists between the block and floor.



   a) What is the net force acting on the block?
   b) What force is the robot applying to accelerate the block?

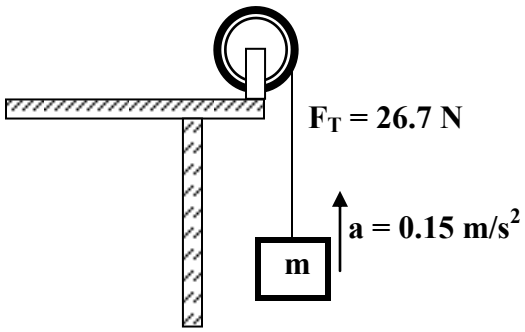
9. A hoist is used to lift a 780 kg car upward with an acceleration of 0.110 m/s^2.



   a) What is the net force acting on the car?
   b) What force was used to lift the car?

10. (Challenge) In an experiment, an electric motor is used to pull an unknown mass '**m**' directly upward. By repeating the experiment, students measure the average tension on the cable as 16.7 N, and an upward acceleration of the mass as 0.40 m/s^2.

    What is the magnitude of mass '**m**'?



1. a) 3.1 kg b) 7.7 kg 2. a) 7350 N b) 2480 N 3. 1.5 m/s^2 4. a) i) 2.04 kg ii) 0.98 m/s^2 b) i) 184 kg ii) 1.63 m/s^2
5. zero N 6. a) 0.46 kg b) 19 m/s^2 7. a) 2.23 x 10^3 N b) 2.56 m/s^2 8. a) 0.4 N b) 4.1 N 9. a) 86 N b) 7.73 x 10^3 N
10. 1.6 kg (NOT 1.7 kg!)

PHYSICS 11 FORCES & NEWTON'S LAWS WORKSHEET 3

1. A 2.5 kg block has a force of sliding friction between it and a level surface of 3.5 N. This block is pulled by an applied force of 14 N.
   a) Find the coefficient of sliding friction between block and surface.
   b) What is the unbalanced force as the block is moved?
   c) What is the acceleration of the block?

2. A 15 kg mass is accelerated at 2.0 m/s^2 along a horizontal table.
   a) What net force is acting on this mass?
   b) A friction force of 7.0 N acts on the mass above. What is the coefficient of sliding friction between mass and table?
   c) Given the friction force in b), what applied force is needed to accelerate this mass at 2.0 m/s^2?

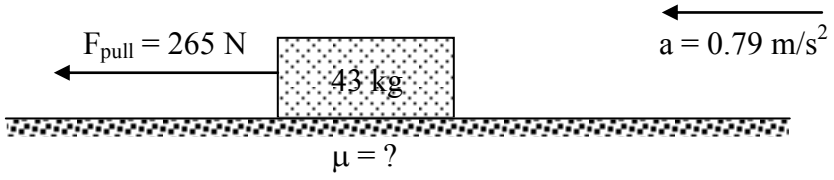
3. What is the coefficient of sliding friction if a force of 400 N is required to pull a 55 kg crate on a horizontal warehouse floor at constant speed?

4. A force of 10 N is used to pull a 2.3 kg block along a horizontal surface with a coefficient of friction of 0.25.
   a) Find the unbalanced force. b) Find the acceleration.

5. A 6.0 kg mass is pulled along a horizontal surface where the coefficient of friction is 0.20.
   a) What is the friction force acting on the mass?
   b) What force is needed to accelerate it at 0.68 m/s^2?

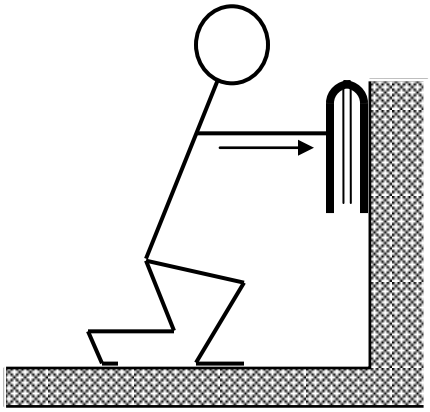
6. A 15 kg box is given an initial push so that it slides across the floor and comes to a stop. If the coefficient of friction is 0.30,
   a) find the friction force.
   b) find the acceleration of the box.
   c) how far will the box go if its initial speed is 3.0 m/s?

7. From the information given in the diagram below, find the coefficient of friction between the 43 kg box and the surface on which it is pulled. Note that the box is accelerating at 0.79 m/s^2.



8. A 140 kg stationary crate is pulled by a force of 390 N along a horizontal surface.
   a) The coefficient of static friction between crate and surface is $\mu_s = 0.25$. Is the applied force large enough to begin moving the crate? Use physics calculations to prove that it is.
   b) The coefficient of sliding friction between crate and surface is $\mu_k = 0.17$. Find the net force and the acceleration of the crate once it does move.
   c) If the acceleration occurs for 2.80 s, how far will the box move in this time?

9. A student pushes horizontally on a textbook of mass 0.250 kg and holds it stationary against the classroom wall.

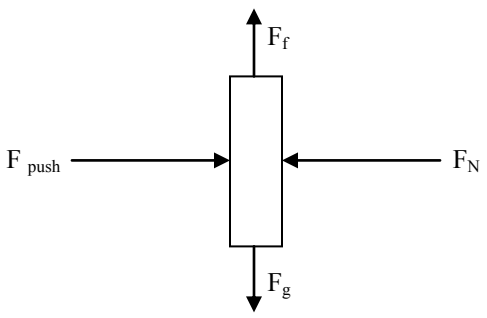


   a) Draw a free body diagram showing all the forces acting on the textbook.
   b) From your diagram, what is the friction force that holds the text in place?
   c) The coefficient of static friction between book and surface is 0.190. Use this and your f.b. diagram to determine the minimum force needed to hold the textbook in place. Note: in this case, use the standard formula for friction: $F_f = \mu F_N$

10. Given $\mu = 0.6$ for wet asphalt, $\mu = 0.006$ for ice, answer the following:
   a) On a rainy day, what is the maximum force that a wheelchair athlete, starting from rest, can apply to her tires to begin a road (asphalt) race without spinning out? Assume a total mass for athlete and chair of 80.0 kg.
   b) How would the answer to (a) change if the temperature outside was -5º C?

1. a) $\mu = 0.14$ b) 10.5 N c) 4.2 m/s^2 2. a) 30 N b) $\mu = 0.048$ c) 37 N 3. 0.74 4. a) 4.4 N b) 1.9 m/s^2
5. a) 12 N b) 16 N 6. a) 44 N b) 2.9 m/s^2 c) 1.5 m 7. $\mu = 0.55$ 8. a) static $F_f = 343$ N, less than 390 N, so yes
b) $F_{Net} = 157$ N, a = 1.12 m/s^2 c) 4.39 m 9. a) see below b) 2.45 N c) 12.9 N 10. a) 470 N b) 4.7 N

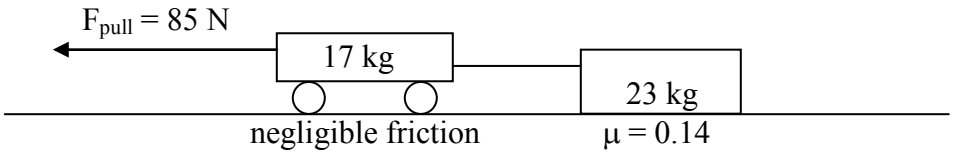
9a)



PHYSICS 11 FORCES & NEWTON'S LAWS WORKSHEET 4

1. Two boxes of mass 12 kg and 10 kg are resting on a frictionless surface and connected by a lightweight cord. The 12 kg mass is pulled by a force of 40 N. Calculate the acceleration of the system.

2. Find the acceleration of the system below:



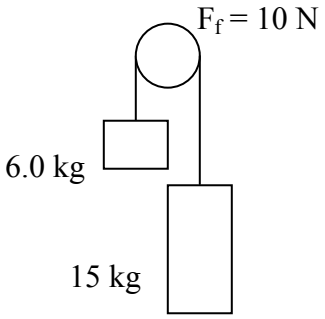
3. Three small children of mass 20.0, 24.0 and 16.0 kg hold hands and are pulled across a frozen pond (assume no friction) by a larger Physics 11 student who is on skates (physics students always help out those in need). The student pulls on rope attached to the 20.0 kg child with a force of 135 N. Calculate the acceleration of the group.

4. Three children argue over a 15 kg wagon, and a tug-of war breaks out. The largest child pulls on one side with a force of 35 N, while the other two pull from the other side <u>each</u> with a force of 30 N. If μ = 0.12 between wagon and ground, determine the resultant acceleration.

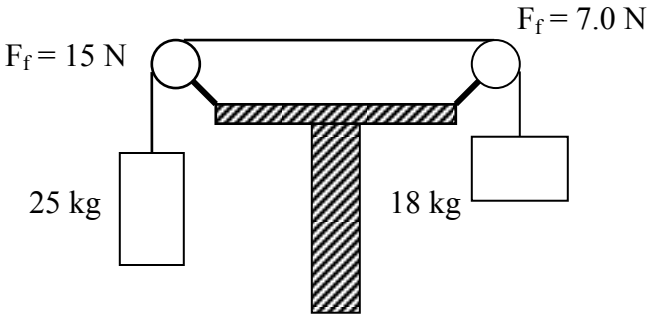
5. Can an applied force of 400 N move a 75 kg object sitting on a surface with μ_s = 1.2? Explain your answer.

6. Calculate the acceleration of the following systems:

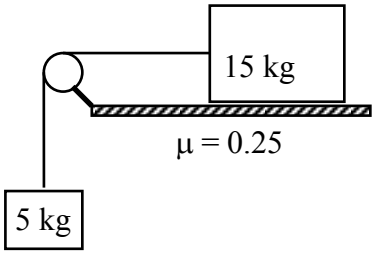
a)



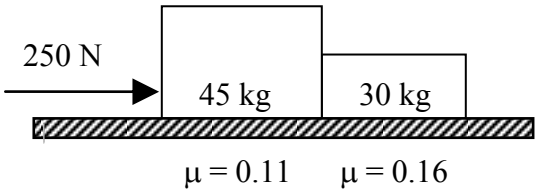
b)



c)



d)



1. 1.8 m/s^2 2. 1.3 m/s^2 3. 2.3 m/s^2 4. 0.49 m/s^2 in direction of two smaller kids 5. no; needs to overcome a friction force of 882 N 6. a) 3.72 m/s^2 b) 1.08 m/s^2 c) 0.61 m/s^2 d) 2.06 m/s^2