Mr. Derek Stice - Physics NTI Lessons
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**Day 6: Draw a free body diagram for the following situations.**

1. A book is at rest on a tabletop.
2. A gymnast holding onto a bar, is suspended motionless in mid-air. The bar is supported by two ropes that attach to the ceiling.
3. An egg is free-falling from a nest in a tree. Neglect air resistance.
4. A flying squirrel is gliding (no wing flaps) from a tree to the ground at constant velocity. Consider air resistance.
5. A rightward force is applied to a book to move it across a desk with a rightward acceleration. Consider frictional forces. Neglect air resistance.
6. A rightward force is applied to a book to move it across a desk at constant velocity. Consider frictional forces. Neglect air resistance.
7. A college student rests a backpack upon his shoulder. The pack is suspended motionless by one strap from one shoulder.
8. A skydiver is descending with a constant velocity. Consider air resistance.
9. A force is applied to the right to drag a sled across loosely packed snow with a rightward acceleration. Neglect air resistance.
10. A football is moving upwards towards its peak after having been booted by the punter. Neglect air resistance.
11. A car is coasting to the right and slowing down. Neglect air resistance.

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**Day 7: Apply Newton's Second Law to complete the table and answer the questions that follow. SHOW YOUR WORK.**

| | Net Force (N) | Mass (kg) | Acceleration (m/s/s) |
|---|---|---|---|
| 1. | 10 | 2 | |
| 2. | 20 | 2 | |
| 3. | 20 | 4 | |
| 4. | | 2 | 5 |
| 5. | 10 | | 10 |

6. Determine the accelerations that result when a 12-N net force is applied to a 3-kg object and then to a 6-kg object.

7. A net force of 15 N is exerted on an encyclopedia to cause it to accelerate at a rate of 5 m/s/s. Determine the mass of the encyclopedia.

8. Suppose that a sled is accelerating at a rate of 2 m/s/s. If the net force is tripled and the mass is doubled, then what is the new acceleration of the sled?

9. Suppose that a sled is accelerating at a rate of 2 m/s/s. If the net force is tripled and the mass is halved, then what is the new acceleration of the sled?

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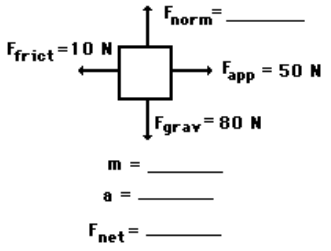
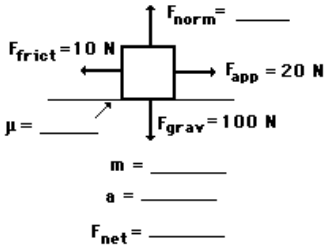
**Day 8: On your OWN PAPER, answer the following problems. SHOW YOUR WORK**

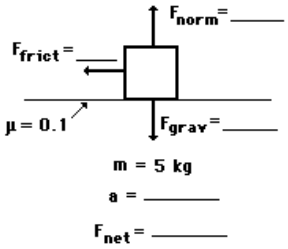
1. An applied force of 50 N is used to accelerate an object to the right across a frictional surface. The object encounters 10 N of friction. Use the diagram to determine the normal force, the net force, the mass, and the acceleration of the object. (Neglect air resistance.)




2. An applied force of 20 N is used to accelerate an object to the right across a frictional surface. The object encounters 10 N of friction. Use the diagram to determine the normal force, the net force, the coefficient of friction (μ) between the object and the surface, the mass, and the acceleration of the object. (Neglect air resistance.)




3. A 5-kg object is sliding to the right and encountering a friction force that slows it down. The coefficient of friction (μ) between the object and the surface is 0.1. Determine the force of gravity, the normal force, the force of friction, the net force, and the acceleration. (Neglect air resistance.)

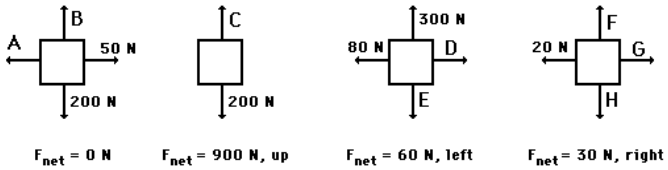



4. Edwardo applies a 4.25-N rightward force to a 0.765-kg book to accelerate it across a tabletop. The coefficient of friction between the book and the tabletop is 0.410. Determine the acceleration of the book.

5. In a physics lab, Kate and Rob use a hanging mass and pulley system to exert a 2.45 N rightward force on a 0.500-kg cart to accelerate it across a low-friction track. If the total resistance force to the motion of the cart is 0.72 N, then what is the cart's acceleration?

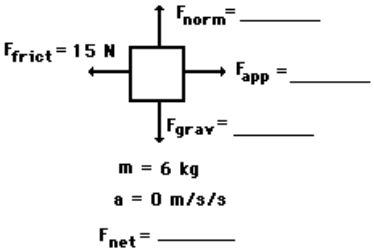
**Day 9: On your OWN PAPER, work out the following problems. SHOW YOUR WORK**

Questions 1 – 4: Free-body diagrams for four situations are shown below. The net force is known for each situation. However, the magnitudes of a few of the individual forces are not known. Analyze each situation individually and determine the magnitude of the unknown forces.

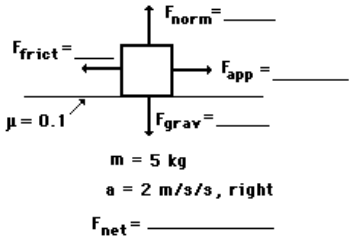



$F_{net}$ = 0 N | $F_{net}$ = 900 N, up | $F_{net}$ = 60 N, left | $F_{net}$ = 30 N, right

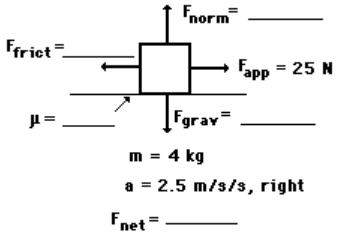
5. A rightward force is applied to a 6-kg object to move it across a rough surface at constant velocity. The object encounters 15 N of frictional force. Use the diagram to determine the gravitational force, normal force, net force, and applied force. (Neglect air resistance.)




9. A rightward force is applied to a 5-kg object to move it across a rough surface with a rightward acceleration of 2 m/s/s. The coefficient of friction between the object and the surface is 0.1. Use the diagram to determine the gravitational force, normal force, applied force, frictional force, and net force. (Neglect air resistance.)




10. A rightward force of 25 N is applied to a 4-kg object to move it across a rough surface with a rightward acceleration of 2.5 m/s/s. Use the diagram to determine the gravitational force, normal force, frictional force, net force, and the coefficient of friction between the object and the surface. (Neglect air resistance.)




6. A rightward force is applied to a 10-kg object to move it across a rough surface at constant velocity. The coefficient of friction between the object and the surface is 0.2. Use the diagram to determine the gravitational force, normal force, applied force, frictional force, and net force. (Neglect air resistance.)

7. In a Physics lab, Ernesto and Amanda apply a 34.5 N rightward force to a 4.52-kg cart to accelerate it across a horizontal surface at a rate of 1.28 m/s/s. Determine the friction force acting upon the cart.

8. Lee Mealone is sledding with his friends when he becomes disgruntled by one of his friend's comments. He exerts a rightward force of 9.13 N on his 4.68-kg sled to accelerate it across the snow. If the acceleration of the sled is 0.815 m/s/s, then what is the coefficient of friction between the sled and the snow?

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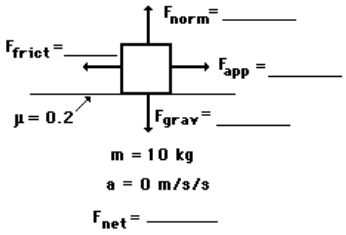
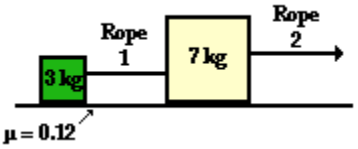
**Day 10: On your OWN PAPER, work out the following problems. SHOW YOUR WORK**

1. A truck hauls a car cross-country. The truck's mass is $4.00 \times 10^3$ kg and the car's mass is $1.60 \times 10^3$ kg. If the force of propulsion resulting from the truck's turning wheels is $2.50 \times 10^4$ N, then determine the acceleration of the car (or the truck) and the force at which the truck pulls upon the car. Assume negligible air resistance forces.

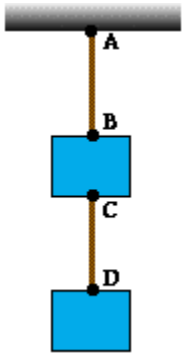



2. A 7.00-kg box is attached to a 3.00-kg box by rope 1. The 7.00-kg box is pulled by rope 2 with a force of 25.0 N. Determine the acceleration of the boxes and the tension in rope 1. The coefficient of friction between the ground and the boxes is 0.120.




3. A tractor is being used to pull two large logs across a field. A chain connects the logs to each other; the front log is connected to the tractor by a separate chain. The mass of the front log is 180 kg. The mass of the back log is 220 kg. The coefficient of friction between the logs and the field is approximately 0.45. The tension in the chain connecting the tractor to the front log is 1850 N. Determine the acceleration of the logs and the tension in the chain that connects the two logs.

4. Two boxes are held together by a strong wire and attached to the ceiling of an elevator by a second wire (see diagram). The mass of the top box is 14.2 kg; the mass of the bottom box is 10.4 kg. The elevator accelerates upwards at 2.84 m/s2. (Assume the wire is relatively massless.)




(a) Find the tension in the top wire (connecting points A and B).

(b) Find the tension in the bottom wire (connecting points C and D).