

Chapter 5 Newton's First Law of Motion

Example Problems

5.1 Mass and Weight

- Example 1:
 - One pound is equal to 0.454 kg, first calculate your mass in kilograms then find your weight in Newtons.

Write the formula and show your work

- Example 2:
 - An African elephant can reach a height of 13 feet and possess a mass of as much as 6000 kg. Determine the weight of an African elephant in Newtons.

What are the givens and unknowns?

Write the formula and show your work

$W =$

$m =$

$g =$

- Example 3:
 - A 5.0 kg mass hangs from a massless rope attached to the ceiling, find the tension in the rope.

What are the givens and unknowns?

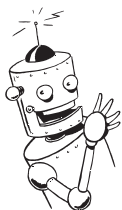
Write the formula and show your work

$W =$

$m =$

$g =$

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- Example 4:

- Your new motorcycle weighs 2450 N, what is its mass in kilograms?

What are the givens and unknowns?

Write the formula and show your work

$W =$

$m =$

$g =$

- Example 5:

- You are standing on a scale on the surface of the Earth and it reads 585 N. Calculate your mass and then calculate your weight on the moon where the acceleration of gravity is 1.62 m/s². What would your mass be on the moon?

What are the givens and unknowns?

Write the formula and show your work

$W =$

$m =$

$g =$

- Example 6:

- You travel to a distance planet and place a 58-kg monkey on a spring scale. If the scale reads 78.4 N, what is the acceleration due to gravity on this planet?

What are the givens and unknowns?

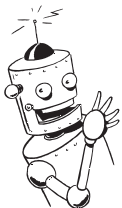
Write the formula and show your work

$W =$

$m =$

$g =$

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Student Problems

5.1 Mass and Weight

YOU MUST SHOW ALL WORK! (Formulas, plug in numbers, answer boxed, units)

- One pound is equal to 0.454 kilograms. Using your own weight in pounds calculate your mass in kilograms.

a) _____ ← units

- The acceleration of gravity on Earth varies depending upon your location. The average value for the acceleration of gravity at sea level is 9.8 m/s^2 . Using your mass in kilograms that you calculated above, calculate your weight in newtons using the average value for the acceleration of gravity.

What are the givens and unknowns?

Write the formula you are using

$W =$

$m =$

$g =$

Substitute the known values and solve.

a) _____ ← units

- Find the weight in newtons of a 5 kg mass on the surface of the Earth?

What are the givens and unknowns?

Write the formula you are using

$W =$

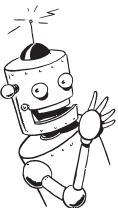
$m =$

$g =$

Substitute the known values and solve.

a) _____ ← units

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4. As you move away from the surface Earth the acceleration of gravity changes. At the top of Mt Everest the acceleration of gravity is only 98% of what it is at sea level or only 9.60 m/s². Calculate the weight in newtons of a 5 kg mass at the top of Mt Everest?

What are the givens and unknowns?

Write the formula you are using

W =

m =

g =

Substitute the known values and solve.

a) _____ ← units

5. Using your mass that you calculated in problem #1 and the acceleration at the top of Mt. Everest, calculate your weight in newtons if you were to stand at the top of Mt. Everest.

What are the givens and unknowns?

Write the formula you are using

W =

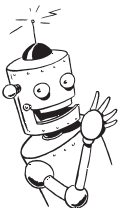
m =

g =

Substitute the known values and solve.

a) _____ ← units

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6. The acceleration of gravity on the moon is 16.5% of what it is on Earth or only 1.62 m/s². Calculate the weight in newtons of a 5 kg mass placed on a scale on the surface of the moon?

What are the givens and unknowns?

Write the formula you are using

W =

m =

g =

Substitute the known values and solve.

a) _____ ← units

7. Using your mass that you calculated in problem #1 and the acceleration on the surface of the moon, calculate your weight in newtons if you were to stand on the surface of the moon.

What are the givens and unknowns?

Write the formula you are using

W =

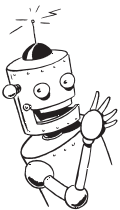
m =

g =

Substitute the known values and solve.

a) _____ ← units

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8. On the surface of Mars, a 5 kg mass is placed on a scale and it reads 18.5 N. What is the acceleration of gravity on Mars?

What are the givens and unknowns?

Write the formula you are using

$W =$

$m =$

$g =$

Substitute the known values and solve.

a) _____ ← units

9. Using your mass from problem #1, and the acceleration of gravity you just calculated for Mars, find your weight in newtons if you were to stand on the surface of Mars?

What are the givens and unknowns?

Write the formula you are using

$W =$

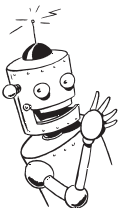
$m =$

$g =$

Substitute the known values and solve.

a) _____ ← units

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10. On the surface of Jupiter a 5 kg mass has a weight of 133.5 N, what is the acceleration of gravity on Jupiter?

What are the givens and unknowns?

Write the formula you are using

$W =$

$m =$

$g =$

Substitute the known values and solve.

a) _____ ← units

11. Using your mass from problem #1, and the acceleration of gravity you just calculated for Jupiter, find your weight in newtons if you were to stand on the surface of Jupiter?

What are the givens and unknowns?

Write the formula you are using

$W =$

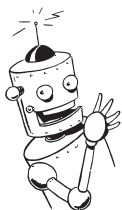
$m =$

$g =$

Substitute the known values and solve.

a) _____ ← units

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12. A McDonald's quarter pound burger weighs 1.97 N on the surface of the Earth? What is the mass of the quarter pound burger?

What are the givens and unknowns?

Write the formula you are using

W =

m =

g =

Substitute the known values and solve.

a) _____ ← units

13. In another part of the galaxy there is a planet that has a surface acceleration of 15.5 m/s². On this planet a rock is placed on a scale and the scale reads 100 N, what is the mass of the rock and what would be the mass of this rock if it was brought back Earth?

What are the givens and unknowns?

Write the formula you are using

W =

m =

g =

Substitute the known values and solve.

a) _____ ← units

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Example Problems

5.2 Hooke's Law

- Example 1:

- A monkey stretches a spring from its resting position a distance of 0.1 m. If the spring constant is $k = 2.5 \text{ N/m}$, what is the force being exerted on the rubber band?

What are the givens and unknowns?

Write the formula and show your work

$F =$

$k =$

$\Delta x =$

- Example 2:

-What force is necessary to stretch an ideal spring whose force constant is 120 N/m by an amount of 0.30 m ?

What are the givens and unknowns?

Write the formula and show your work

$F =$

$k =$

$\Delta x =$

- Example 3:

- A spring with a constant of 600 N/m is used on a scale for weighing fish. What is the mass of a fish that stretches the spring by 0.075 m from its normal length?

What are the givens and unknowns?

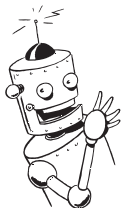
Write the formula and show your work

$F =$

$k =$

$\Delta x =$

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• Example 4:

- If a spring is stretched a distance of 0.25 m with a force of 20 N, what is the value of the spring constant k?

What are the givens and unknowns?

Write the formula and show your work

$F =$

$k =$

$\Delta x =$

• Example 5:

- A spring in a pogo stick is compressed 0.12 m when a 40 kg girl stands on the stick. What is the spring constant for the pogo stick spring?

What are the givens and unknowns?

Write the formula and show your work

$F =$

$k =$

$\Delta x =$

• Example 6:

- A mass of 3.5 kg is hanging from a spring which deforms by 0.212 m. What is the spring constant k?

What are the givens and unknowns?

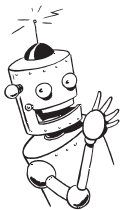
Write the formula and show your work

$F =$

$k =$

$\Delta x =$

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• Example 7:

- If the spring constant k of a pogo stick is 3500 N/m and the weight of the person on the pogo stick is 700 N, how much is the spring in the bottom of the pogo stick compressed?

What are the givens and unknowns?

Write the formula and show your work

$F =$

$k =$

$\Delta x =$

• Example 8:

- A spring ($k = 2.3 \text{ N/m}$) is attached to an object of mass = 10 kg. If the object is hung from the ceiling by this spring, how much would the spring be stretched?

What are the givens and unknowns?

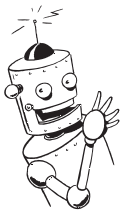
Write the formula and show your work

$F =$

$k =$

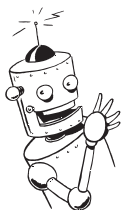
$\Delta x =$

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Student Problems

5.2 Hooke's Law

YOU MUST SHOW ALL WORK! (Formulas, plug in numbers, answer boxed, units)

14. The has a spring constant of 10. N/m. If you stretch the spring 0.30 m horizontally to the right, and hold it motionless, what force does the spring exert on your hand?

What are the givens and unknowns?

Write the formula you are using

$F =$

$k =$

$\Delta x =$

Substitute the known values and solve.

a) _____ b) _____

15. A spring with a spring constant of 400 N/m. A mass is suspended from the spring so that it stretches 0.08 m. Calculate the weight of the object.

What are the givens and unknowns?

Write the formula you are using

$F =$

$k =$

$\Delta x =$

Substitute the known values and solve.

a) _____ ← units

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16. A spring scale that has a spring constant of 2 N/m. When an object is placed on the scale the spring stretches 0.05 m, what is the weight and the mass of the object?

What are the givens and unknowns?

Write the formula you are using

$F =$

$k =$

$\Delta x =$

Substitute the known values and solve.

a) _____ b) _____

17. A spring with a spring constant of 400 N/m has a mass suspended on it end. The spring stretches 0.08 m. Calculate how much mass the spring is supporting.

What are the givens and unknowns?

Write the formula you are using

$F =$

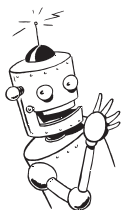
$k =$

$\Delta x =$

Substitute the known values and solve.

a) _____ ← units

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18. A spring has a spring constant of 0.4 N/m. What size mass should be added to stretch the spring exactly 1.5 meters?

What are the givens and unknowns?

Write the formula you are using

$F =$

$k =$

$\Delta x =$

Substitute the known values and solve.

a) _____ ← units

19. A 40 kg monkey stands on a pogo-stick and compresses it 0.12 m. What is the spring constant for the pogo-stick spring?

What are the givens and unknowns?

Write the formula you are using

$F =$

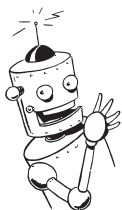
$k =$

$\Delta x =$

Substitute the known values and solve.

a) _____ ← units

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20. A 5.10 kg mass is placed on the end of a 0.20 m spring. The new length of the spring with the mass attached to its end is 0.25 m. Determine the spring constant.

What are the givens and unknowns?

Write the formula you are using

$F =$

$k =$

$\Delta x =$

Substitute the known values and solve.

a) _____ ← units

21. A 5-kg mass stretches a spring 0.9-m, how much more mass should be added to stretch the spring to exactly 1-m?

What are the givens and unknowns?

Write the formula you are using

$F =$

$k =$

$\Delta x =$

Substitute the known values and solve.

a) _____ ← units

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