

Wkst – Newton's 2nd Law

Name:

Complete the following problems for extra practice before the test. Follow the 3-step process to earn full credit. Fold the paper along the black line – answers are to the right to check your work.

Formula
$A = \frac{F}{m}$

1. Your bicycle has a mass of 9.1 kilograms. You accelerate at a rate of 1.79 m/s². Calculate the net force that is accelerating the bicycle.
F = 16.29 N
2. The Space Shuttle has a liftoff mass of 2,041,000 kg and accelerates at a rate of 16 m/s². Calculate the force (thrust) that is accelerating the Space Shuttle.
3,265,600 N
3. A runner has a mass of 89 kilograms. He produces a force of 84 Newtons between the ground and his running shoes. How fast does he accelerate?
0.94 m/s²
4. A rocket accelerates at 56 m/s² with the force (thrust) of 44,800 N. What is the mass of the rocket?
800 kg
5. Calculate the acceleration of a car if the force on the car is 450 Newtons and the mass is 1300 kilograms.
0.35 m/s²
6. An unbalanced 16 N force is applied to a 2.4 kg mass. What is the acceleration of the mass?
6.6 m/s²
7. A shot-putter exerts an unbalanced force of 140 N on a shot giving it an acceleration of 19 m/s². What is the mass of the shot?
7.36 kg

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Formula
$A = \frac{F}{m}$

1. Your bicycle has a mass of 9.1 kilograms. You accelerate at a rate of 1.79 m/s². Calculate the net force that is accelerating the bicycle.

$$a = \frac{F}{m} \quad 1.79 \text{ m/s}^2 = \frac{F}{9.1 \text{ kg}} \quad 9.1 \times 1.79 = \frac{F}{9.1} \times 9.1$$

$$F = 16.29 \text{ N}$$

1.
F = 16.29 N

2. The Space Shuttle has a liftoff mass of 2,041,000 kg and accelerates at a rate of 16 m/s². Calculate the force (thrust) that is accelerating the Space Shuttle.

$$a = \frac{F}{m} \quad 16 \text{ m/s}^2 = \frac{F}{2,041,000 \text{ kg}} \quad 2,041,000 \times 16 = \frac{F}{2,041,000} \times 2,041,000$$

$$F = 32,656,000 \text{ N}$$

2.
3,265,600 N

3. A runner has a mass of 89 kilograms. He produces a force of 84 Newtons between the ground and his running shoes. How fast does he accelerate?

$$a = \frac{F}{m} \quad a = \frac{84 \text{ N}}{89 \text{ kg}} \quad a = .94 \text{ m/s}^2$$

3.
0.94 m/s²

4. A rocket accelerates at 56 m/s² with the force (thrust) of 44,800 N. What is the mass of the rocket?

$$a = \frac{F}{m} \quad 56 \text{ m/s}^2 = \frac{44,800 \text{ N}}{m} \quad m \times 56 = \frac{44,800}{56} \times m$$

$$56m = 44,800$$

$$\frac{56m}{56} = \frac{44,800}{56}$$

$$m = 800 \text{ kg}$$

4.
800 kg

5. Calculate the acceleration of a car if the force on the car is 450 Newtons and the mass is 1300 kilograms.

$$a = \frac{F}{m} \quad a = \frac{450 \text{ N}}{1300 \text{ kg}} \quad a = .35 \text{ m/s}^2$$

5.
0.35 m/s²

6. An unbalanced 16 N force is applied to a 2.4 kg mass. What is the acceleration of the mass?

$$a = \frac{F}{m} \quad a = \frac{16 \text{ N}}{2.4 \text{ kg}} \quad a = 6.6 \text{ m/s}^2$$

6.
6.6 m/s²

7. A shot-putter exerts an unbalanced force of 140 N on a shot giving it an acceleration of 19 m/s². What is the mass of the shot?

$$a = \frac{F}{m} \quad 19 \text{ m/s}^2 = \frac{140 \text{ N}}{m} \quad m \times 19 = \frac{140}{19} \times m$$

$$19m = 140$$

$$\frac{19m}{19} = \frac{140}{19}$$

$$m = 7.36 \text{ kg}$$

7.
7.36 kg

F = ma Calculations

1. An unbalanced force of 25.0 N in an Easterly direction is applied to a 12.0 kg mass. What will be the acceleration of the mass?
2. An unbalanced 16.0 N force is applied to a 2.0 kg mass. What is the acceleration of the mass?
3. A shot-putter exerts an unbalanced force of 140 N on a shot giving it an acceleration of 19.0 m/s^2 . What is the mass of the shot?
4. An object moving with a constant velocity has an unbalanced force applied to it. If the unbalanced force is -20.0 N and the mass of the object is 3.75 kg , what is the acceleration of the object while this force is acting?
5. How much force is needed to keep a 20.0 N stone from falling?
6. A racing car undergoes a uniform acceleration of 8.00 m/s^2 . If the unbalanced force causing the acceleration is $6,000.0 \text{ N}$, what is the mass of the racing car?
7. An economy car has a mass of 800 kg . What is its weight?
8. A small yacht weighs $14,700 \text{ N}$. What is its mass?
9. A 7.5 kg object is placed on a spring scale on the surface of the planet Nerdo. If the spring scale reads 78.4 N , what is the acceleration of gravity on Nerdo?
10. A car has a mass of 1200.0 kg . How much would the car weigh on the moon where the gravitational acceleration is 1.60 m/s^2 ?

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F = ma Calculations

1. An unbalanced force of 25.0 N in an Easterly direction is applied to a 12.0 kg mass. What will be the acceleration of the mass?

$$a = \frac{F}{m} \quad \frac{25.0 \text{ N}}{12.0 \text{ kg}} = 2.1 \text{ m/s}^2$$

2. An unbalanced 16.0 N force is applied to a 2.0 kg mass. What is the acceleration of the mass?

$$a = \frac{F}{m} \quad \frac{16 \text{ N}}{2 \text{ kg}} = 8 \text{ m/s}^2$$

3. A shot-putter exerts an unbalanced force of 140 N on a shot giving it an acceleration of 19.0 m/s². What is the mass of the shot?

$$a = \frac{F}{m} \quad 19.0 \text{ m/s}^2 = \frac{140 \text{ N}}{m}$$
$$m \cdot 19 = \frac{140}{19} \times m$$
$$m = 7.37 \text{ kg}$$

4. An object moving with a constant velocity has an unbalanced force applied to it. If the unbalanced force is -20.0 N and the mass of the object is 3.75 kg, what is the acceleration of the object while this force is acting?

$$a = \frac{-20.0 \text{ N}}{3.75 \text{ kg}} = -5.3 \text{ m/s}^2$$

5. How much force is needed to keep a 20.0 N stone from falling?

Need a friction force greater than 20 N

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6. A racing car undergoes a uniform acceleration of 8.00 m/s². If the unbalanced force causing the acceleration is 6,000.0 N, what is the mass of the racing car?

$$a = \frac{F}{m} \quad 8 \text{ m/s}^2 = \frac{6,000 \text{ N}}{m}$$

$$m \cdot 8 = \frac{6,000 \text{ N}}{8} \times 8$$

$$m = \frac{6,000}{8}$$

$$= 750 \text{ kg}$$

7. An economy car has a mass of 800 kg. What is its weight? * gravity = 9.8 m/s²

$$a = \frac{F}{m} \quad 9.8 \text{ m/s}^2 = \frac{F}{800 \text{ kg}}$$

$$800 \times 9.8 = \frac{F}{800} \times 800$$

$$7840 \text{ N} = F$$

8. A small yacht weighs 14,700 N. What is its mass?

$$a = \frac{F}{m} \quad 9.8 \text{ m/s}^2 = \frac{14,700 \text{ N}}{m}$$

$$m \cdot 9.8 = \frac{14,700}{9.8} \times 9.8$$

$$m = 1500 \text{ kg}$$

9. A 7.5 kg object is placed on a spring scale on the surface of the planet Nerdo. If the spring scale reads 78.4 N, what is the acceleration of gravity on Nerdo?

$$a = \frac{F}{m} \quad a = \frac{78.4 \text{ N}}{7.5 \text{ kg}}$$

$$a = 10.5 \text{ m/s}^2$$

10. A car has a mass of 1200.0 kg. How much would the car weigh on the moon where the gravitational acceleration is 1.60 m/s²

$$a = \frac{F}{m} \quad 1.6 \text{ m/s}^2 = \frac{F}{1200 \text{ kg}}$$

$$1200 \times 1.6 = \frac{F}{1200} \times 1200$$

$$F = 1920 \text{ N}$$