Underline given values with units. Circle the unknown. Show your work by writing out the formulas, then substituting values into the formulas.

Name:_____

Newton's Second Law of Motion - Worksheet

1. A little boy pushes a wagon with his dog in it. The mass of the dog and wagon together is 45 kg. The wagon accelerates at 0.85 m/s^2. What force is the boy pulling with?

F = m a = (45 kg) (0.85 m/s/s) = 38.25 Newtons

2 Sig Figs: F = 38 N

2. A 1650 kg car accelerates at a rate of 4.0 m/s^2. How much force is the car's engine producing?

3. A 68 kg runner exerts a force of 59 N. What is the acceleration of the runner?

4. A crate is dragged across an ice covered lake. The box accelerates at 0.08 m/s^2 and is pulled by a 47 N force. What is the mass of the box?

5. 3 women push a stalled car. Each woman pushes with a 425 N force. What is the mass of the car if the car accelerates at 0.85 m/s^2?

6. A tennis ball, 0.314 kg, is accelerated at a rate of 164 m/s^2 when hit by a professional tennis player. What force does the player's tennis racket exert on the ball?

7. In an airplane crash a woman is holding an 8.18 kg baby. In the crash the woman experiences a horizontal de-acceleration of 88.2 m/s^2. How many g's is this de-acceleration? How much force must the woman exert to hold the baby in place?

8. When an F-14 airplane takes-off an aircraft carrier it is literally catapulted off the flight deck. The plane's final speed at take-off is 68.2 m/s. The F-14 starts from rest. The plane accelerates in 2 seconds and has a mass of 29,545 kg. What is the total force that gets the F-14 in the air?

9. A sports car accelerates from 0 to 60 mph, 27 m/s, in 6.3 seconds. The car exerts a force of 4106 N. What is the mass of the car?

10. A sled is pushed along an ice covered lake. It has some initial velocity before coming to a rest in 15 m. It took 23 seconds before the sled and rider come to a rest. If the rider and sled have a combined mass of 52.5 kg, what is the magnitude and direction of the stopping force? What do "we" call the stopping force?

11. A car is pulled with a force of 10,000 N. The car's mass is 1267 kg. But, the car covers 394.6 m in 15 seconds.
    (a) What is expected acceleration of the car from the 10,000 N force?
    (b) What is the actual acceleration of the car from the observed data of x and t?
    (c) What is the difference in accelerations?
    (d) What force caused this difference in acceleration?
    (e) What is the magnitude and direction of the force that caused the difference in acceleration?

12. A little car has a maximum acceleration of 2.57 m/s^2. What is the new maximum acceleration of the little car if it tows another car that has the same mass?

13. A boy can accelerate at 1.00 m/s^2 over a short distance. If the boy were to take an energy pill and suddenly have the ability to accelerate at 5.6 m/s^2, then how would his new energy-pill-force compare to his earlier force? If the boy's earlier force was 45 N, what is the size of his energy-pill-force?

14. A cartoon plane with four engines can accelerate at 8.9 m/s^2 when one engine is running. What is the acceleration of the plane if all four engines are running and each produces the same force? a = 4 (8.9 m/s/s) = 35.6 m/s/s

15. While dragging a crate a workman exerts a force of 628 N. Later, the mass of the crate is increased by a factor of 3.8. If the workman exerts the same force, how does the new acceleration compare to the old acceleration? 1st acc: a = (628N)/m 2nd accel: a = (628N)/3.8m
The 2nd accel will be 3.8 times smaller than the first acceleration since mass increased by a factor of 3.8.

16. A rocket accelerates in a space at a rate of "1 g." The rocket exerts a force of 12,482 N. Later in flight the rocket exerts 46,458 N. What is the rockets new acceleration? What is the rocket's new acceleration in "g's?" Find the rocket mass: m = F/a = (12,482 N) / (9.8 m/s/s) = 1273 kg
a = F / m = (46458 N) / (1273 kg) = 36.495 m/s/s a = (36.495 m/s/s)/(9.8 m/s/s) = 3.7 g

17. A race car exerts 19,454 N while the car travels at a constant speed of 201 mph, 91.36 m/s. What is the mass of the car?

The acceleration of the car is 0 since the velocity is constant.

m = F/a = 19454N / 0 = 0 kg But that doesn't make sense - the car must have mass.

We cannot determine the mass without more information.