Physics 11 Unit 2 – Worksheet #5 - Newton's 2nd Law and Forces review

Name: _____ Solutions

1. Weight is measured in Newtons and also called Force of Gravity.

2. If you go to the moon, which changes, mass or weight? weight.

3. The two names for "g" are . . .

gravitational field strength and acceleration due to gravity

4. Write out Newton's three laws in your own words. If you can't remember them Google is your friend.

First Law: Objects in motion stay in motion, same speed and direction.
Objects in motion stay in motion.
(Applies when Fnet=0)

Second Law: The greater the force, the greater the acceleration. The greater the mass an object has the less the acceleration will be.
(Applies when Fnet is not = 0)

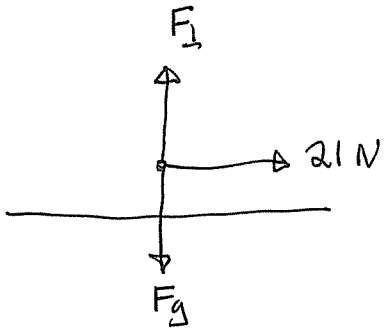
Third Law: For every applied force their in an reactionary force in the opposite direction applied by the second object (Applies always)

** many other variations of these wordings**

5. The coefficient of friction usually has a range of 0.01 to 0.9.

Slippery surfaces have a coefficient around 0.1 and grippy surfaces have a coefficient of around 0.8.

6. A 4.5 kg block sits on a flat frictionless table. The block is pulled to the right by a 21 N force. Find the acceleration of the block.

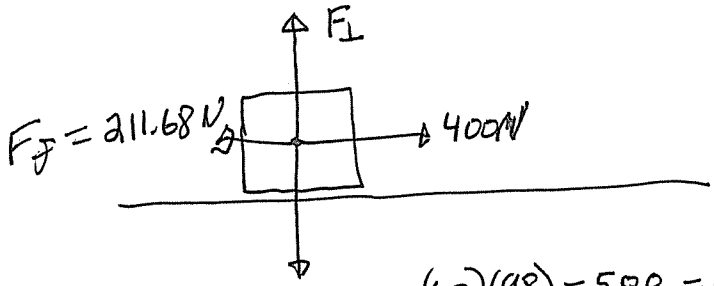


$F_g = F_L$

$F_{NET} = 21\ N$

$a = \frac{F_{NET}}{m} = \frac{21}{4.5} = 4.67\ m/s^2$

7. A 60 kg box sits on the floor. The coefficient of friction is 0.36
A 400 N horizontal force is applied to the box. Find the acceleration of the box.



① $F_g = mg = (60)(9.8) = 588 = F_L$

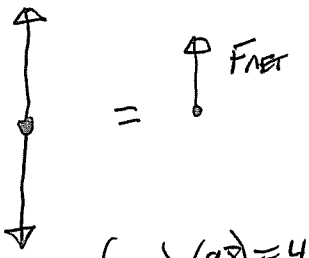
② $F_{f(MAX)} = \mu F_L = (.36)(588) = 211.68\ N$

③ $F_{NET} = 400 - 211.68 = 188.32$

④ $a = \frac{F_{NET}}{m} = \frac{188.32}{60} = 3.14\ m/s^2$

8. A 500 kg rocket sitting on the launch pad has a thrust of 16,000 N. Find the acceleration of the rocket.

Thrust = 16,000 N



① $F_g = mg = (500)(9.8) = 4900N$

② $F_{NET} = Thrust - F_g$

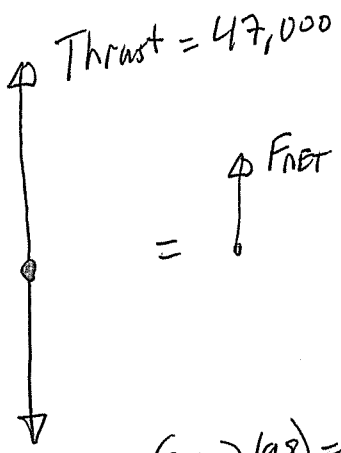
$= 16,000 - 4900$

$= 11,100\ N$

③ $a = \frac{F_N}{m} = \frac{11,100}{500}$

$= 22.2\ m/s^2$

9. A 2500 kg rocket sitting on the launch pad has a thrust of 47,000 N. Find the acceleration of the rocket.

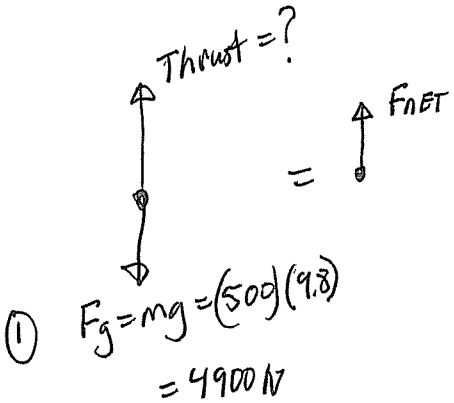


① $F_g = mg = (2500)(9.8) = 24{,}500\ N$

② $F_{NET} = Thrust - F_g$
$= 47{,}000 - 24{,}500$
$= 22{,}500$

③ $a = \frac{F_{NET}}{m} = \frac{22{,}500}{2500} = 9\ m/s^2$

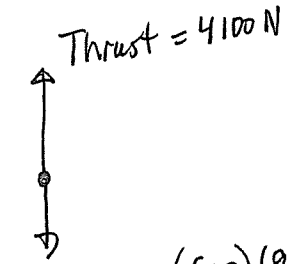
10. A 500 kg rocket (near the surface of the Earth) has an acceleration of 67 m/s^2. Find the required thrust.



① $F_g = mg = (500)(9.8)$
$= 4900\ N$

② $F_{NET} = Thrust - F_g$
$ma = Thrust - 4900$
$(500)(67) = Thrust - 4900$
$33{,}500 = Thrust - 4900$
$Thrust = 38{,}400\ N$

11. A 500 kg rocket (near the surface of the Earth has a thrust of 4100 N. Find the acceleration of the rocket.

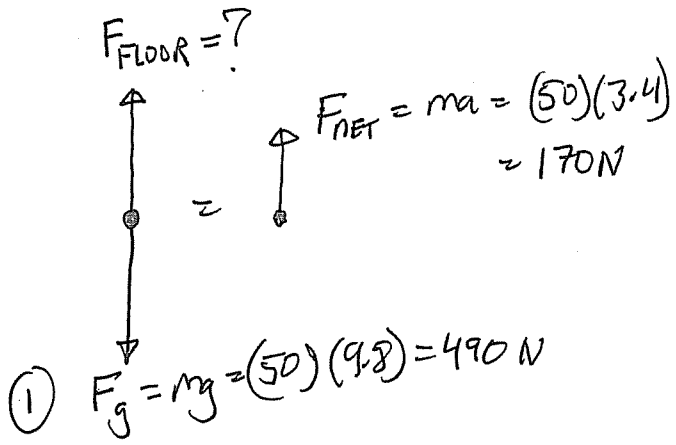


$F_g = mg = (500)(9.8)$
$= 4900\ N$

② $F_{NET} = 4900 - 4100 = 800\ N$ (down)

③ $a = \frac{F_{NET}}{m} = \frac{800}{500} = 1.6\ m/s^2$ (down)

12. A 50 kg girl riding in an elevator is accelerating up at 3.4 m/s^2. Find the force required from the floor to cause this acceleration.

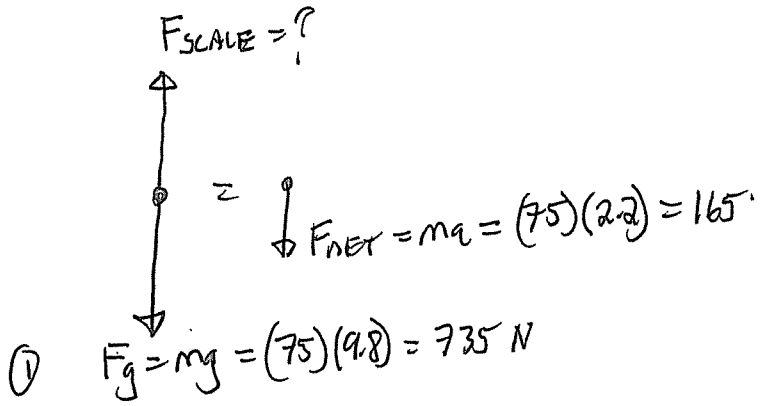


② $F_{NET} = F_{FLOOR} - F_g$

$170 = F_{FLOOR} - 490$

$F_{FLOOR} = 660\ N$

13. A 75 kg person riding in an elevator is accelerating down at 2.2 m/s^2. What would a scale under the persons feet read?



② $F_{NET} = F_g - F_{SCALE}$

$165 = 735 - F_{SCALE}$

$F_{SCALE} = 735 - 165$

$= 570\ N.$

14. A seat belt is rated for 10,000 N breaking strength. What is the maximum acceleration of a 95 kg human possible without breaking the seatbelt?

$a = F/m = \frac{10,000}{95} = 105\ m/s^2 = 10.7\ g$ ← not good enough!

$\div 9.8$

Harder problems

15. A 76 kg person is travelling in a car at 120 km/hr. If the seatbelt can exert 11,000 N of force before failing, what is the shortest time distance the car can stop in without the seatbelt failing?

$33.\overline{3}$ m/s.

① $a = F_N/m = \frac{11{,}000}{76} = 144.74 \text{ m/s}^2$

② $V_i = 33.\overline{3}$ m/s $\quad V_f = 0 \quad a = -144.75 \quad d = ?$

$V_f^2 = V_i^2 + 2ad$

$0 = (33.\overline{3})^2 + 2(-144.75)d$

$d = 3.84$ m.

16. The coefficient of friction between the road and the tires of a 2200 kg car is 0.65
What is the maximum acceleration of the car?

① $F_g = mg = (2200)(9.8) = 21{,}560$

$F_g = F_L$

② $F_f = \mu F_L = (.65)(21{,}560) = 14{,}014$

③ $a = \frac{F_{NET}}{m} = \frac{F_f}{m} = \frac{14{,}014}{2200} = 6.37 \text{ m/s}^2$

OR, in this case.

$a = \frac{F_{NET}}{m} = \frac{F_f}{m}$

$= \frac{\mu F_L}{m} = \frac{\mu F_g}{m}$

$= \frac{\mu mg}{m} = \mu g$