Unit 3 – Dynamics
Physics 30S
Homework Answers

Teulon Collegiate Institute
Mrs. Kornelsen

Grade 11 Physics – Newton's First Law

1. (a) The force was exerted on the car and the car will stop moving first.
   (b) The driver continues to move because it has inertia, it is in motion and there was no force acting to make it change its motion. They will hit the windshield at 100km/h.
   (c) The person was in motion and will continue in motion, unless there is a net force opposing that motion. The seatbelt will apply a force that will oppose its motion and make it stop.

2. Whiplash occurs because the person's head is at rest, before the car was struck. When the car was struck, that makes the person's body move forward. Although our heads are attached to our bodies, our neck doesn't force our head to stay in exactly the same place as our bodies. When our body moves forward, due to the impact, our head stays at rest, which makes it seem like our neck "snapped back".

3. The net force is zero, because it is moving at a constant velocity.

4. The wallet will continue moving in a straight line at a constant velocity, because the car has changed directions, this is straight out the window.

5. (a) The net force is zero. The normal force opposes the force of gravity.

   (b) Yes, there is a net force, we know this because the velocity is changing. The thrust of the engine is bigger.

   (c) There is no net force on the rocket (there is no force of gravity on it). It will continue moving at a constant speed forever (or until it encounters another planet or star).

6. (a) The velocity is changing because the direction is changing.
   (b) Yes there is a net force, because the velocity is changing.

7. If the piece is stuck in the throat, it will remain there (at rest) until there is a net force causing its velocity to change. By striking them on the back, you are applying a force that may cause the food's velocity to change (and come out of their throat).

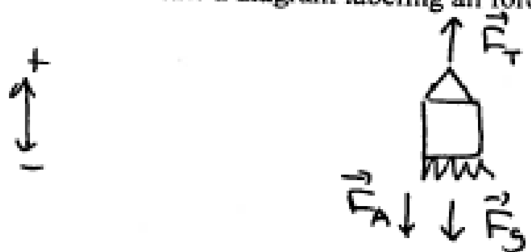
8. (a) The car will continue in motion, through the traffic light.
   (b) The truck will not turn the corner, it will continue moving straight, at the same velocity it was moving.
   (c) The passenger will continue moving forward at the same velocity the car had been moving, until a force makes it stop (the windshield).
   (d) The coffee will stay where it was, which would be above the cup, which could result in spilling. The question is different because the force is in a different direction that the motion of the person.

9. The unbalanced force (or net force) is zero for (b) and (d). All of those situations, the object is at rest, or moving at a constant velocity.

10. (a) The ball is speeding up, the unbalanced force comes from the force of gravity pulling it down the hill.
    (c) The unbalanced force also comes from the force of gravity, causing the boulder to speed up.
    (e) This is a tricky one. Although it is staying at the same location above the Earth, the satellite is still moving in a circle, which means its velocity is changing in the forces are not balanced. The reason it's moving in a circle is because of the force of gravity.

Grade 11 Physics – Writing Equations for Net Force Questions

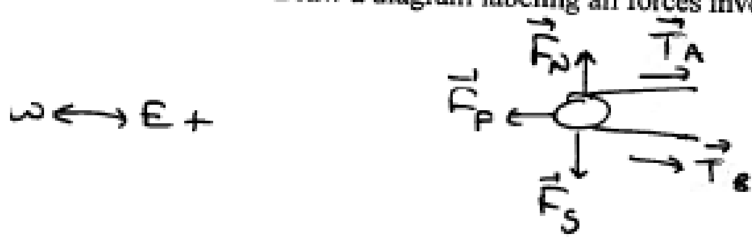
1. A rocket moves upwards, the engine applying a thrust, F_T, upward. Air resistance is acting on the rocket, F_A, downward.
    a. Draw a diagram labeling all forces involved.



    b. Write an equation for the net force on the box.

$$\vec{F}_{Net} = \vec{F}_T - \vec{F}_A - \vec{F}_S$$

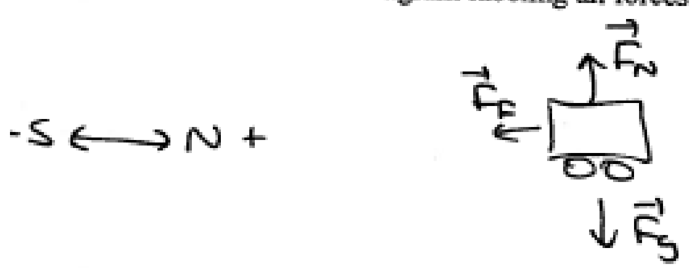
2. You want to remove a large rock from the garden. You wrap two ropes around it, and you and your friend each pull one rope East. You pull with a force, T_A, and your friend with a force, T_B.
    a. Draw a diagram labeling all forces involved.



    b. Write an equation for the net force on the rock.

$$\vec{F}_{Net} = \vec{T}_A + \vec{T}_B - \vec{F}_F$$

3. A car skids to a stop on the highway.
    a. Draw a diagram labeling all forces involved.



    b. Write an equation for the net force on the car.

$$\vec{F}_{Net} = -\vec{F}_F$$

Grade 11 Physics – Newton's Second Law Answers

1. (a) 3.90×10^2N [Right]
   (b) 6.0×10^1N [Left]

2. 24N [East]

3. 21.8N [North]

4. 16.9N [West]

5. 1.6N [South]

6. 0.158 m/s^2 [East]

7. 0.45 N [North]

8. 0.300 m/s^2 [East]

9. 130 N [East]

10. (a) 4 m/s^2 [up]
    (b) 1070 m/s = 1000m/s [up]

11. (a) 0.663 m/s^2 [North]
    (b) 453 s

12. 1200 s

13. 0.30 N [West]

14. 14 300 N [North]

15. (a) 1.1 m/s^2 [East]
    (b) 1.2 m/s^2 [East]

16. 4600 N [North]

(more indepth answers on #5-16 on next page)

Grade 11 Physics – Newton's Second Law Solutions

5. $F_{net} = m\,a$ $F_{net} = 2.0\text{ kg }(0.8\text{ m/s}^2) = 1.6\text{ N}$

6. Since friction has been balanced by another force, the unbalanced (net) force is 0.60N $F_{net} = m\,a$ $0.60 = 3.8\,a$ $a = 0.158\text{ m/s}^2$

7. Friction is the net force causing the acceleration.
$F_{net} = m\,a$ $F_{net} = 3.0\text{ kg }(-0.15\text{ m/s}^2) = -0.45\text{ N}$ where the negative sign must be taken to mean that the force is acting in a direction opposite to the motion.

8. The net force on you is the *sum* of the two forces. Since they act in opposite directions, we add them like this: $F_{net} = 40\text{ N} + (-25\text{ N}) = 15\text{ N}$ (positive means the net force is acting in the same direction as the pull you experience.
$F_{net} = m\,a$ $15 = 50.0\,a$ $a = 0.30\text{ m/s}^2$

9. This time, F_{net} must be 50.0 (2.0) = 100 N
This net force is the sum of $F_{applied}$ and $F_{friction}$ acting in opposite directions.
i.e. : $F_{net} = 100\text{ N} = F_{applied} + (-30.0\text{ N})$ $F_{applied} = 130\text{ N}$

10. a) $a = F_{net} \div m = 4\text{ m/s}^2$
b) $v = v_o + a\,\Delta t = 830 + 4(60) = 1070\text{ m/s}$

11. a) $a = F_{net} \div m = 53\,000 \div 80\,000 = 0.6625\text{ m/s}^2$
b) $\Delta t = \Delta v \div a = 300 \div 0.6625 = 453\text{ s}$

12. Acceleration of the booster will be $100\,000\text{ N} \div 400\,000\text{ kg} = 0.25\text{ m/s}^2$
To increase in velocity by 300 m/s will require $\Delta t = \Delta v \div a = 300 \div 0.25 = 1200\text{ s}$

13. Acceleration is $1.2\text{ m/s} \div 8.0\text{ s} = 0.15\text{ m/s}^2$
Since friction is the only force causing this acceleration, it is the net force by itself.
$F_f = F_{net} = m\,a = 2.0\text{ kg }(0.15\text{ m/s}^2) = 0.30\text{ N}$

14. Acceleration is $30\text{ m/s} \div 4.2\text{ s} = 7.14\text{ m/s}^2$
As in #9, friction is the only force causing this acceleration, and so, it is the net force.
$F_f = F_{net} = m\,a = 2000\text{ kg }(7.14\text{ m/s}^2) = 14\,280\text{ N}$

15. a) The net force will be 1600 N + (-300 N) = 1300 N
So, $a = F_{net} \div m = 1300\text{ N} \div 1200\text{ kg} = 1.08\text{ m/s}^2$
b) Now, the net force will be 1600 N + (-150 N) = 1450 N
So, $a = F_{net} \div m = 1450\text{ N} \div 1200\text{ kg} = 1.21\text{ m/s}^2$

16. The net force must be $2000\text{ kg} \times 2.0\text{ m/s}^2 = 4000\text{ N}$ to cause this acceleration.
$F_{net} = F_{applied} + F_{resistance}$ $4000 = F_{applied} + (-600\text{ N})$ $F_{applied} = 4600\text{ N}$

Grade 11 Physics – Newton's Third Law

1. She is sliding forward, if she throws the nuts forward, she's applying a force forward on the nuts, and Newton's third law states that the nuts exert an equal force back on her. If he throws the nuts with enough force, she should be able to stop.

2. (a) Normal force. It is 400N (you push down on the ground with 400N, so the ground pushes back on you with an equal force)
   (b) The Earth remains stationary because it has a very large mass. The small force you apply will only produce an extremely tiny acceleration, so small it wouldn't be noticeable.

3. You apply a force of 30N [South], so the force applies an equal force in the opposite direction: 30N [North]. You don't accelerate as a result because your mass is so big, in reality, you accelerate a very small amount, but it isn't noticeable.

4. 1.33m/s^2 [West]

5. (a) Newton's 3rd law: When the gun is fired, the gun exerts a force forward on the bullet, since the mass of the bullet is small, it has a large acceleration. Newton's 3rd law states that the bullet applies an equal force on the gun in the opposite direction. This means that the gun accelerates backward, toward you because of that force and leaves a bruise.

   (b) Newton's 2nd law: Since the mass of the rock is much greater than the soccer ball, it would look like the rock doesn't accelerate. Actually, since the rock has so much mass, the acceleration is very small (so small you wouldn't notice it).

   (c) Newton's 1st law: The child is in motion, moving 1.5m/s [East] when the skateboard stops, the force from the rock is not applied to the child, so the child continues to move at 1.5m/s [East], which would look like they are flying forward off the skateboard.

   (d) Newton's 3rd law: even though one is going faster than the other, they would both experience the same force, but in opposite directions. Depending on the mass of the cars, one may accelerate more than the other because of that force.

(e) Newton's 2nd law: If you try to push the car filled with all your friends, the mass of the car has increased. You can still only push with the same force. Since the car now has more mass, it would accelerate less (this would mean to push it with the same acceleration as when it's empty, you would have to increase your force).

Grade 11 Physics – Mass and Weight Answers

1. $-3.84 m/s^2$

2. (a) 4900N [up]
   (b) 7100N [up]
   (c) $14 m/s^2$ [up]

3. (a) 9.8N [up]
   (b) 3.2N [up]
   (c) 5.8N [up]

4. (a) 784N
   (b) 944N
   (c) 544N
   (d) 784N

5. $3.33 m/s^2$ [up]

6. $-1.3 m/s^2$

7. (a) 2.1m/s
   (b) 4.3m/s
   (c) $1.5 m/s^2$
   (d) 7.7N [down]

8. (a) 5.88N [down]
   (b) 14.1N [up]
   (c) $23.3 m/s^2$ [up]

Grade 11 Physics – The Force of Friction

1. 0.22
2. The stopping force is friction, which is 9500N
3. 0.025
4. It requires 350N of force to start moving (350.35N before sig figs). If this force continued, there would be an acceleration of $1.3 m/s^2$.
5. $6.5 m/s^2$ [West]
6. 0.77
7. 0.39
8. 29.4N
9. 18.6kg
10. $4.5 m/s^2$ [South]
11. 3568N [East]
12. 0.034

Grade 11 Physics – Tension

1. 1800N [East]
2. 150N [North]
3. 9.4N [West]
4. 401N [up]
5. 0.13

Grade 11 Physics – Terminal Velocity and Drag Forces

1. 6.2m/s^2 [down]
2. (a) 160N [East]
   (b) 0.27m/s^2 [East]
3. 3.9m/s^2
4. 0.0735
5. 0.94m/s^2
6. 100m/s^2 [down]