Unit 03 – 1D Forces Review Sheet:

Unit 03 Objectives:

- I can explain the concept of inertia and how it relates to an object's ability to move
- I can identify different forces and if they are balanced or unbalanced
- I can determine if an object is experiencing a balanced or unbalanced force by looking at a velocity-time graph
- I can describe how forces relate to motion
- I can apply newton's third law to net force statements
- I can apply newton's third law to changes of acceleration
- I can create a free body diagram for a physical situation
- I can use free body diagrams and newton's second law to solve for mass, force and acceleration of a system.

1. Determine if the object in the following situations is in mechanical equilibrium. If it is, decide if it is in static or dynamic equilibrium.

Situation:	Is it in Equilibrium	Type of Equilibirum
a. A ball rolling at a constant velocity of 10 m/s	(Yes) → No	Static (Dynamic)
b. A runner at the end of the 100 m sprint running at a constant speed of 9.5 m/s.	(Yes) → No	Static (Dynamic)
c. A chandelier hanging from the ceiling	(Yes →) No	(Static) Dynamic
d. The space shuttle during the first 15 seconds of launch as it accelerates away from the Earth.	Yes → (No)	Static Dynamic

2. A car travels North on I-5 along a straight line path at 65 mph. Determine if the following statements are true or false.

Situation	True	False
a. Has a net force acting towards the north		X
b. Has zero acceleration	X	
c. Is moving in a vacuum		X
d. Has no forces acting on it		X

3. A car is travelling at a constant speed of 65 mph to the east. If the engine exerts 5000 N of force, what is the sum of the forces due to air resistance and friction acting on the car? Give magnitude and direction. 5000 N west

4. A box is stationary and has a maximum value of static friction of 30 N. How much force must be applied to the box to start it in motion?

   A. Less than 30 N
   B. (More than 30 N) ← required to start moving
   C. 30 N ← required to keep moving @ constant velocity
   D. 0 N

5. A 10 kg box is sitting on a table.
   A. What is the weight of the box? (10)9.8 = 98 N
   B. What is the normal force from the table on the box? 98 N

6. Two athletes are playing tennis. One athlete swings his racket and hits the ball. Is the force of the ball on the racket, *greater than, less than, or* (equal to,) the force of the racket on the ball? Explain. Forces are the same, acceleration

7. The other athlete swings her 500 g racket and hits the 100 g ball. Is the magnitude of the acceleration of the ball, (greater than,) *less than, or equal to,* the magnitude of the acceleration of the racket? Explain.

   ↳ less mass, accelerates more!

8. Draw the free body diagrams for the following situations
   A. A rocket in space accelerating to the right.
   B. A ball as after it has been thrown travelling straight up.
   C. A skier traveling down a rough mountain slope.

A. F_a →

B. F_g ↓

C. F_N ↗, F_g ↓

9. What is the net force required to accelerate a 1500 kg car 5 m/s/s? $(1500)(5) = 7500\,N$
10. A child pulls her 4 kg little red wagon along the floor with a 20 N horizontal force to the left. The wagon accelerates at 1.5 m/s/s. What is the force of friction on the wagon? $F_{net} = 4(1.5) = 6\,N = F_A - F_f$ → $F_f = 14\,N$
11. Mr. Koll's car stalled in the Wilsonville High School Parking lot. Three students and Mr. Koll got the car moving. They know the car's mass is 1400 kg and all together they applied a 600 N horizontal force to the car. They know the force of friction between the tires and the pavement is 120 N.
    a. What is the magnitude and direction of the gravitational force? $(1400)(9.8) = 13720\,N$ down
    b. What is the magnitude and direction of the normal force? $13720\,N$ up
    c. What is the acceleration of the car? $F_{net} = 600 - 120 = 1400a$ → $a = 0.34\,m/s^2$
12. Jake is the WHS 70 kg center. He accelerated at 2 m/s/s into an 85 kg lineman, Joe. Once Jake hit Joe, Jake continued to apply the same force.
    a. What is the force Jake Applied to Joe? $(70)(2) = 140\,N$
    b. What is the force Joe applied to Jake? $140\,N$
13. Jake is in his car driving home. He applies a 2000 N Force at many points during his trip. Rank the following situations from least to greatest based on the net force on the car. **Explain using words and numerical values**
    I. The car is moving with a constant acceleration of 10 m/s² $F_{net} = 10m$
    II. The car is moving with a constant acceleration of 3 m/s² $F_{net} = 3m$
    III. The car is moving at a constant velocity of 35 m/s $F_{net} = 0$
    IV. The car is stopped. $F_{net} = 0$

Between each _____ write =, <, >)

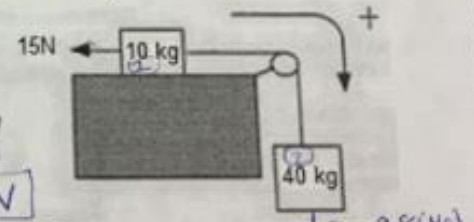
Rank Least IV = III < II < I greatest

Or ALL of the forces are the same _____

Or there is not enough information to rank the forces. _____

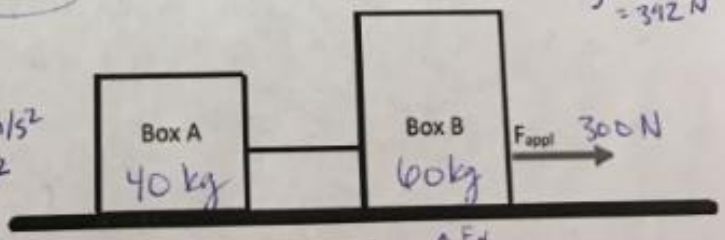
EXPLAIN: Cases III + IV have no acceleration. So no net force.
I has a greater net force than II because it has a greater acceleration.

14. Given the pulley system to the right, the 40 kg box is pulling the 10 kg box to the right along a rough surface. A 15 N frictional force is acting on the 10 kg box.
    (a) Determine the acceleration of the system. System → $F_{net} = F_g - F_f = ma$; $392 - 15 = 50a$; $a = 7.54\,m/s^2$
    (b) Determine the tension in the rope. Box 1: $F_T - F_f = ma$; $F_T - 15 = 10(7.54)$ → $F_T = 90.4\,N$



$F_g = 9.8(40) = 392\,N$

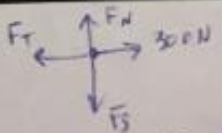
15. Two boxes are being pulled to the right on a frictionless table: Box A is 40 kg, Box B is 60 kg. A 300 N force is applied to Box B which accelerates the system to the right.
    A. What is the acceleration of the system? $3\,m/s^2$
    B. What is the acceleration of Box A? $3\,m/s^2$
    C. What is the tension in the Rope between Box A and Box B? $120\,N$



$F_{net} = ma = F_a$

$(40+60)a = 300$

$a = 3\,m/s^2$



$F_{net}: 300 - F_T = 60(3)$

$300 - F_T = 180$

$F_T = 120\,N$