Name: _____ Period: _____ Date: _____

Unit Topic: Motion Grade Level: 9

Key Learning: The motion of an object is affected by forces and is predictable based on certain scientific laws.

Unit Essential Question: How do forces affect the motion of an object?

Concept: Representing Motion	**Concept: Force and Motion**

Lesson Essential Questions:	**Lesson Essential Questions:**
1. How can we convert between motion units? 2. How can scientific graphs be used to describe the motion of an object? 3. How can equations be used to describe the motion of an object?	4. How do forces affect the motion of an object? 5. How do Newton's Laws of Motion allow us to make predictions and draw conclusions dealing with the motion of an object?

Vocabulary:	**Vocabulary:**
Directly Proportional Inversely Proportional Speed Vector Velocity Acceleration	Force Newton Friction Mass Inertia Static Equilibrium Dynamic Equilibrium Free Fall Newton's First Law Newton's Second Law Newton's Third Law

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Objectives

In order to demonstrate one's competence in this area, the student will be able to:

Section 1 Representing Motion

1. Define all vocabulary terms
2. Apply concepts of unit conversion and scientific notation.
3. Describe the motion of an object based on a correctly drawn graph of distance versus time.
4. Describe the motion of an object from data tables representing time and distance or velocity.
5. Draw a graph to represent the motion of an object from given data or a description of the motion.
6. Given appropriate information, calculate the speed, velocity, and acceleration of an object including unit labels.

Section 2 Force & Motion

1. Define all vocabulary terms
2. Explain what the Equilibrium Rule, $\Sigma F = 0$, means for objects in static and dynamic equilibrium.
3. Draw and use free body diagrams to determine the forces acting on objects in static equilibrium, dynamic equilibrium and when objects are accelerating.
4. Distinguish between force and net force and calculate individual forces and the net force acting on an object.
5. Describe how the net force on an object affects motion.
6. Explain Newton's first law of motion and the concept of inertia for both moving and stationary objects.
7. Explain Newton's second law of motion in terms of acceleration, net force, and mass.
8. Use Newton's second law to describe and calculate the forces and acceleration of objects in free fall and at terminal velocity.
9. Use Newton's second law to calculate the force, mass and acceleration of an object.
10. Explain force, in terms of interaction, using Newton's third law of motion.

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1. Fill in the blanks with the correct value:

a) 1 day= _____ hours
b) 1 hour = _____ minutes
c) 1 minute = _____ seconds
d) 1 mile = _____ feet
e) 1 foot = _____ inches
f) 1 meter = _____ centimeters
g) 1 meter = _____ millimeters
h) 1 kilometer = _____ meters
i) 1 inch = _____ centimeters
j) 1 mile = _____ kilometers

Solve the following and show all work

2. 640 cm = _?_ ft 2_____

3. 9,000 min = _?_ days 3_____

4. 26 mi = _?_ m 4_____

5. 0.25 km/hr = _?_ km/s 5_____

6. 125 m/s = _?_ km/s 6_____

7. 35 miles/hour = ? feet/second 7_____

8. Complete the chart by changing the numbers between scientific notation and standard form:

Scientific Notation	Standard Form
2.6×10^{6}	
	0.000000684
9.3×10^{-9}	
	93,202,000,000

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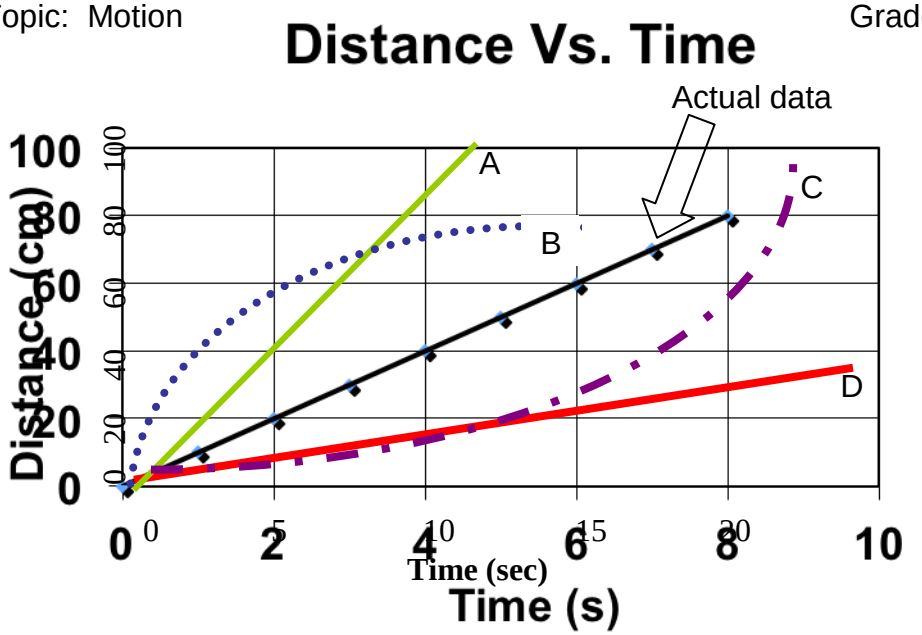

1. Describe the motion of the car that would create each line on the graph. (Terms you may use are constant speed, faster car, slower car, speeding up, slowing down.)

A_____

B_____

C _____

D_____

2. Calculate the slope for the line created using "Actual data" indicated by the arrow above. Show work and include a label.

Slope: _____

3. How far would the car that produced line A travel in 5 seconds? Explain your answer.

4. Approximately how long would it take the car that produced line D to travel 20 cm? Explain your answer.

5. How long would it take the car that produced actual data line to travel 60 cm? Explain your answer.

6. If The car that produced the **actual data** line, were in a race with the car that made line **A** and the car that made line **D**, which would finish first, second and third? Explain your answer.

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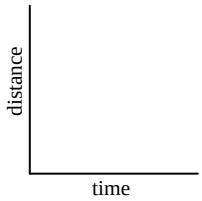
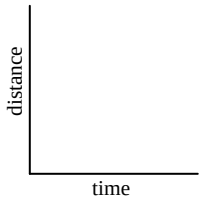
1. Sketch a graph on the provided axes to represent the motion for each of the following descriptions:

   a. A student walks to school at a slow, steady speed. When he gets close to the building he sees his friends and speeds up. He comes to a quick stop once he reaches his friends.



   b. A dog chases a cat around a fenced in yard. He continues at the same speed even as he goes around the corners.



2. Identify what the abbreviation stands for and the quantity that is labeled by each unit:

label	Write what the abbreviation stands for	What does the abbreviation measure? (distance, speed, time or acceleration)
mi/hr		
m		
in		
m/s/s		
min		
ft		
Km/hr/s		
cm		
hr		
km		
mi		
m/s		

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Speed, Velocity and Acceleration Calculations

1. A cat moves 60 meters in 10 seconds. What is the speed of the cat?

2. A car travels 50 miles/hour for 3 hours. How far does the car travel?

3. How long does it take a person running 5 meters/second to run 400 meters?

4. What is the acceleration of an object that speeds up from 20 miles/hour to 50 miles/hour in 5 seconds?

5. A car traveling at 40 miles/hour quickly comes to rest in 2 seconds. What is the acceleration of the car?

6. A car travels at a constant speed due North and covers 84 miles in 4 hours. What is the car's velocity? What is the car's acceleration?

7. A truck covers 120 kilometers in 1.5 hours. What is the truck's speed in **miles/hour?**

8. A turtle covers 2 feet in 1 minute. What is the turtle's speed in **miles/hour?**

9. Describe the motion of the objects below based on the data from the charts.

Time (s)		Distance (cm)
0		0
1		5
2		10
3		15

Time (s)		Distance (cm)
0		0
10		5
20		15
30		25

Time (s)		Velocity (cm/s)
0		0
1		0.5
2		1.0
3		1.5

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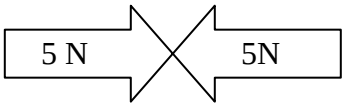
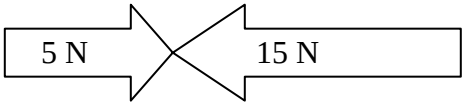
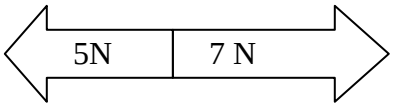
1. Determine the net force for each of the following:

a. 

ΣF = _____

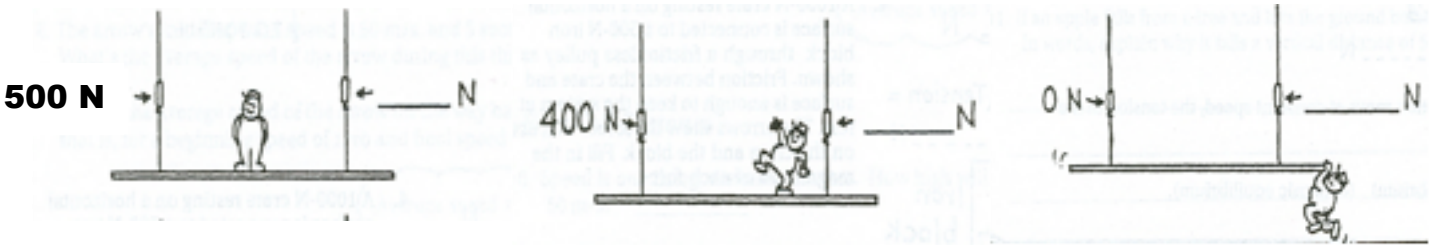
b. 

ΣF = _____

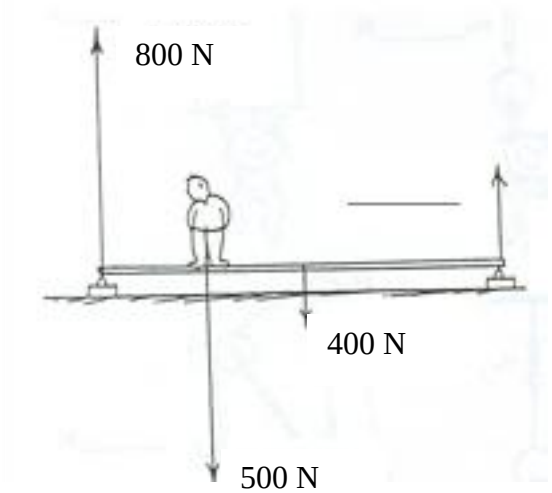
c. 

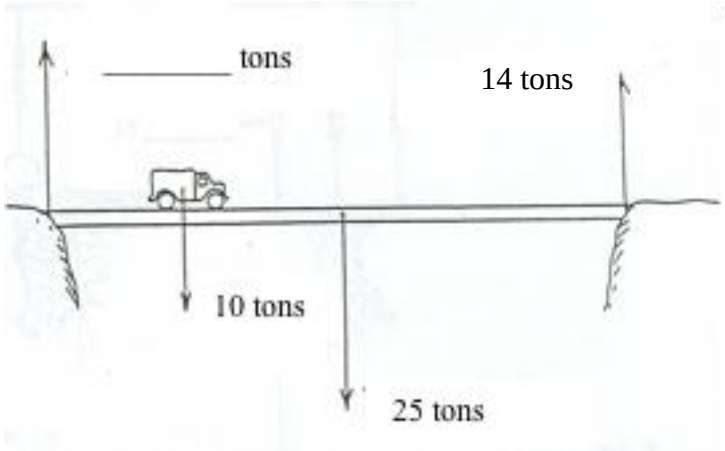
ΣF = _____

2. If Burl is standing in the middle of the staging in the first picture, write the scale readings for the other scales.



3. Fill in the blanks using the information provided.





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Section 2: Force and Motion

	Static Equilibrium	Dynamic Equilibrium	Accelerating
Net Force			
Motion of Object			
Example			

1. Draw a free body diagram for an object sitting at rest on a table. Label your forces.

2. Draw a free body diagram for an object being pulled across the floor at constant velocity to the right. Label your forces.

3. What is maintaining the motion of each of the two objects described above? _____

4. Draw a free body diagram for an object accelerating across the floor to the right. Label your forces.

5. Why is this object accelerating? _____

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A stack of books sits at rest on the floor. It exerts a force of 200 N on the floor.

1. What is the support force exerted by the floor? How do you know?

2. What is the net force on the books? How do you know?

3. What type of equilibrium is this?

4. If a student pushes on the books with a force of 250 N and they don't move, what is the magnitude of the friction? How do you know?

5. What type of equilibrium is this?

6. If a student pushes on the books with a force of 500 N and they move at a constant velocity, what is the magnitude of the friction? How do you know?

7. What type of equilibrium is this?

If the mass of the stack of books is 20 kg and the sliding friction is 300 N,

8. What is the (a) net force and (b) acceleration if the student pushes with a force of 320 N?

9. What is the (a) net force and (b) acceleration if the student pushes with a force of 360 N?

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Force, Mass and Acceleration Calculations

1. What net force is needed to accelerate a box at 10 m/s^2 if it has a mass of 5 kg?

2. What acceleration is produced by a 410 N net force toward the right acting on a 20 kg object?

3. A 120-kg skydiver jumps from a plane. The force of gravity acting on the skydiver is 1200 N at that moment and there is no air resistance. Draw a free body diagram for the skydiver. Calculate the acceleration of the skydiver.

4. Because there is no air resistance acting on the skydiver, she is in _____.

5. The 120-kg skydiver has been falling for several seconds. The force of gravity acting on the skydiver remains at 1200 N; however, she is now experiencing a force of 300 N in air resistance. Draw a free body diagram for the skydiver. Calculate the acceleration of the skydiver.

6. The 120-kg skydiver has been falling for several more seconds. The force of gravity acting on the skydiver remains at 1200 N; however, she is now experiencing a force of 1200 N in air resistance. Draw a free body diagram for the skydiver. Calculate the acceleration of the skydiver.

7. Because the air resistance is now equal to the force of gravity, the skydiver is at _____

   _____.

8. What type of equilibrium is the skydiver in? _____

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Laws of motion

1. In your own words, state Newton's first law of motion:

2. In your own words, state Newton's second law of motion:

3. In your own words, state Newton's third law of motion:

4. Determine which of Newton's laws of motion each of the following examples best illustrates:
    a. Inertia
    b. Force = mass x acceleration
    c. For every action force there is and equal and opposite reaction force.
    d. A small pitched rock accelerates greater than a large pitched rock.
    e. A cannon recoils when it is shot.
    f. A person standing in a stationary bus will fall backwards if the bus suddenly starts to move.
5. Which of Newton's Law(s) describe forces on a single object?
6. Which of Newton's Law(s) describe forces acting between two objects?
7. What does Newton's third law of motion tell us about the forces experienced by two objects involved in a collision?
8. How can Newton's second law of motion be used to predict the acceleration of objects involved in a collision?

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Steps to solve a word problem:

1) Read the problem. Reread the problem.
2) Draw a picture representing what is happening in the problem.
3) Identify the KNOWN information in the problem. What type of variable does each number represent?
4) Identify the UNKNOWN information. What variable will you be solving for?
5) Identify the equation that relates the KNOWN variables to the UNKNOWN variable.
6) Solve for the unknown.
7) Check your answer. Is the number reasonable? Did you include units?

Equations:

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Define each of the following vocabulary terms in your own words. You may use pictures and/or examples in your definition.

Directly Proportional

Inversely Proportional

Speed

Vector

Velocity

Acceleration

Force

Newton

Friction

Mass

Inertia

Static Equilibrium

Dynamic Equilibrium

Free Fall

Newton's First Law

Newton's Second Law

Newton's Third Law