Hints for solving Review problems:

Vectors:

1. Ed rides his bike 5.0 km east. He then gets on a ferry that takes him another 3.0 km north. When he gets off the ferry, he gets back on his bike and rides another 4.0 km east. What is his total displacement relative to his starting position?

Find components (East then West), then Pythagorean theorem and $\tan^{-1}(y/x)$

2. A Toyota Prius travels down the road with a velocity of 40.0 $km \cdot h^{-1}$ east, according to its speedometer. A Ducati Multistrada 1200 motorcycle is traveling in the same direction at a speed of 35.0 $m \cdot s^{-1}$. With what velocity will the Prius driver see the motorcycle approaching in his rear-view mirror? Once the Ducati has passed the car, he slows down to 30.0 $m \cdot s^{-1}$. With what velocity will he think the Prius is traveling relative to his motorcycle?

We talked about this one in class, but after converting to similar units, visualize yourself in the driver seat. It's a vector addition (or subtraction) problem, but it's a little easier to visualize this one.

Kinematics:

3. Carla goes on a walk toward a friend's house. She walks 4.5 km NE, and then turns a corner and runs 2.5 km due East. If her walk takes a total of 3 hours, what is her average speed? What is her average velocity?

Average speed = distance/time **Average velocity = displacement/time**

4. A Honda Civic accelerates from a velocity of 5.0 $m \cdot s^{-1}$ to a velocity of 11 $m \cdot s^{-1}$ at a uniform acceleration of 1.5 $m \cdot s^{-2}$. How long will the car be accelerating?

   Use the Kinematic equation that involves only initial velocity, final velocity, acceleration, and time.

5. A stone is thrown vertically upwards with an initial speed of 10.0 $m \cdot s^{-1}$ from a cliff that is 55.0 m high.
   a. After how much time does it reach the bottom of the cliff?
   b. What will the stone's velocity be the instant before it hits the ground?
   c. What is the total distance traveled by the stone?

Initial velocity is + 10.0 m/s; acceleration and displacement will be negative.
To find the total distance, determine the distance from release point (v = +10) to the maximum height (v=0), double that, then add 55.0 m.

6. Sketch position-time, velocity-time, and acceleration-time graphs for the following motion: A car stopped at a stop sign accelerates from rest at a constant rate of 1.5 $m \cdot s^{-2}$ for 5.0 s; for the next 10.0 s, the car travels at a constant velocity before requiring 3.0 s to come to a stop at the next stop sign.
    a. Based on your data and your graphs, explain how the graphs are related to each other
    b. What is the total distance that the car travels?
    c. With what velocity does the car travel forward during the time between t = 5.0 s and t = 13.0 s?
    d. What is the car's acceleration during the final 3.0 seconds?

Slope of a position-time graph = velocity…what do the slope and area under the line for a velocity-time graph mean? Use your graphs to find these answers if kinematic equations are giving you problems. They can be solved either way.

7. A hot air balloon is rising vertically at a constant speed of 5.0 $m \cdot s^{-1}$. A sandbag is released and hits the ground 12.0 s later.
    a. With what speed does the sandbag hit the ground?
    b. How high was the sandbag when released?

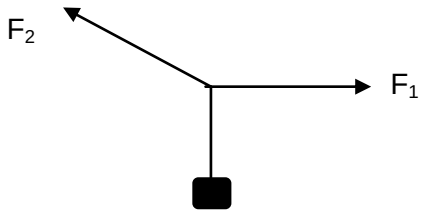
Unfortunately, it seems like the answers are a bit unrealistic…I apologize. Use kinematic equations and solve similarly to #5

Forces and Newton's Laws

8. A sign hangs from two cables, each attached to the ceiling at an angle of 37.0°. If the mass of the sign is 25.6 kg, what is the tension in each cable?

It's in equilibrium…find its weight and there are two cables supporting that weight…

9. A mass of 5.00 kg hangs attached to three strings as shown in the figure below:



If F_1 is completely horizontal, and if F_2 is directed at an angle 40.0° from the horizontal, what are the magnitudes of each of these forces?

You must use both the x and the y direction components for this. Solve for one of the unknown forces, then plug back into your other equation to solve the second.

10. A crate with a weight of 455 N is being pulled at a constant velocity by a force directed at 30.0° to the horizontal. The frictional force on the crate is 1163 N. What is the magnitude of the pulling force?

Not as hard as it first seems—you only really need to know the frictional force and the angle at which you're pulling to find this solution…we don't need to know the weight at all…

11. A mass of 2.00 kg is acted upon by two horizontal forces with magnitudes of 4.00 N and 10.00 N. What are the two possible accelerations of this mass?

Possibility #1: both forces are acting in the same direction
Possibility #2: the forces are acting in opposite directions
Use Newton's 2nd law of motion

12. Edgar, whose mass is 75.0 kg, stands on the floor of an elevator.

a. When the elevator is at rest, what is the force from the elevator floor pushing back up on Edgar?
b. When the elevator begins to move upward, accelerating at a rate of 4.0 $m \cdot s^{-2}$, with what force does the floor push up on Edgar?
c. When the elevator is moving at a constant speed, with what force will the floor be pushing on Edgar?
d. When the elevator comes to a stop at the top, it slows down at a rate of 3.5 $m \cdot s^{-2}$. With what force does the elevator floor push on Edgar?

Visualize yourself in the elevator when you check your work…make sure you would actually feel heavier for the questions you calculated a heavier apparent weight ☺

13. A small passenger car and a fully loaded truck collide head-on. Which vehicle experiences the greater force? Explain your answer.

Think about Newton's 3rd law of motion…

Momentum and Impulse

14. Two masses of 2.00 kg and 4.00 kg are kept on a frictionless horizontal table with a compressed spring between them. If the masses are released, the larger mass moves away with a velocity of 3.50 $m \cdot s^{-1}$. What is the velocity of the other mass?

This is an explosion…momentum must be conserved

15. Two cars, m_1 = 1210 kg and m_2 = 1420 kg collide head-on and experience a perfectly inelastic collision. The cars are coming at each other from opposite directions. Initially, the larger car has a speed of 8.0 $m \cdot s^{-1}$ and the smaller car has a speed of 12.5 $m \cdot s^{-1}$. With what final velocity will the cars move after the collision?

Perfectly inelastic collisions involve the two cars sticking together and moving away with one final velocity…make sure you define a positive and a negative direction.

16. A pitcher throws a baseball (m = 0.145 kg) at a speed of 38.0 $m \cdot s^{-1}$. If the catcher brings the ball to a stop in his mitt in a time of 0.0125 s, what force must be applied by the catcher's mitt? Qualitatively describe how the force applied by the catcher compares to the force applied by the pitcher to accelerate the ball to that speed.

Impulse-momentum theorem…

Work, Energy, and Power

17. A mass is being pulled along a level road by a rope attached to it in such a way that the rope makes an angle of 40.0° with the horizontal. The force in the rope is 20.0 N. How much work is done by this force to move the mass 8.00 m along the level road?

Use the work equation…

18. A box of books, m = 10.3 kg, rests on a shelf that is 2.23 m above the ground.

a. How much gravitational potential energy does this box of books have?
b. If the shelf were to suddenly break, and the box fell to the floor, how fast would it be moving the instant before it hit the ground?
c. Assume that when the box hits the ground, it crumples a distance of 15.8 cm. What force, exerted by the floor, was required to bring the box to a stop?

Conservation of energy…then work-kinetic energy theorem

19. What is the minimum power required to lift a mass of 51.5 kg up a vertical distance of 12.0 m in 5.00 s?

Power = Work / time = Force * distance / time …in this case, the force = weight…

20. A 0.50 kg battery-operated toy train moves with a constant velocity of 0.30 $m \cdot s^{-1}$ along a level track. The power of the motor in the train is 2.0 W and the total force opposing the motion of the train is 5.0 N.

a. What is the force that must be supplied by the motor in order to move the train?
b. What power is used to move the train at that constant velocity?
c. What is the efficiency of the train's motor?

Is the train accelerating? Or is it in equilibrium? Use the power/efficiency notes on the back of this packet to help you more with this one.