MCAT physics chapter concept checks

Chapter 1.1

1. If the newton is the product of kilograms and meters/second 2 , what units comprise the pound? slug \* ft / sec^2
2. Order the following units from smallest to largest: centimeter, angstrom, inch, mile, foot.

angstrom < centimeter < inch < foot < mile

Chapter 1.2

1. When calculating the sum of vectors A and B (A + B), we put the tail of B at the tip of A. What would be the effect of reversing this order (B + A)? since addition is commutative, the resultant is the same between the two resultants.
2. When calculating the difference of vectors A and B (A – B), we invert B and put the tail of this new vector at the tip of A. What would be the effect of reversing this order (B – A)? since subtraction is also not commutative the resultant has the same magnitude but oriented in the opposite direction.
3. How is a scalar calculated from the product of two vectors? How is a vector calculated?

Scalar: dot product produces a scalar result  
Vector: cross product produces a vector

1. True or False: If C = A × B, where A is directed toward the right side of the page and B is directed to the top of the page, then C is directed midway between A and B at a 45° angle.

False, performing the right hand rule we see that the resultant vector points out of the page towards the user at an unknown angle.

Chapter 1.3

1. What is the relationship between instantaneous velocity and instantaneous speed?   
   instantaneous velocity (vector) contains magnitude of the instantaneous velocity vector.
2. What is the relationship between average velocity and average speed?  
   average speed and average velocity may be unrelated because speed does not depond on displacement, but is the total distance / time. Eg mpg
3. True or False: Total distance traveled can never be less than the total displacement. True distance traveled can only be positive, and like the case of the earth’s rotation- total displacement is zero but distance traveled is large.
4. Provide a definition for displacement or velocity in terms of the other variable.   
   velocity is the rate of change [per unit time] of the displacement of an object. Displacement is a function of velocity acting over a period of time.

1.4   
1) When calculating frictional forces, how is directionality assigned?  
in the direction that opposes motion.

2) When no force is being applied, the velocity must be:  
0

3) True or False: The Earth creates a larger force on you than you create on the Earth.  
false, equal forces?

4) Name two forces in addition to mechanical manipulation (pushing or pulling forces created by contact with an object):

Stretching, gravity, friction. Electrostatic, magnetic, weak nuclear, strong nuclear force.   
  
1.5  
1) In your own words, provide a description of Newton’s laws of motion:

1. An object will stay in motion or at rest unless acted upon by a force.  
   2. Acceleration results from the sum of the force vectors.  
   3. For all actions there is an equal and opposite reaction to oppose the action.

2) During a test crash, a 500 kg car is driven at a constant velocity of 50 mph until it hits a wall without braking. Apply all three of Newton's laws to this situation.

1. F= ma =0 velocity was constant 50mph, so no acceleration and no net force.

2. F= ma = - 500kg (50mpg) the car was decelerating as it hit the wall  
3. Fab= -Fba = the wall opposed the force of the car with an equal but opposite force.

1.6  
1) How do the forces acting in free fall and projectile motion differ?  
both have gravity

2) At what angle of launch is a projectile going to have the greatest horizontal displacement? What angle will result in the greatest vertical displacement, assuming a level surface?

* Greatest horizontal displacement:   
  sin 45
* Greatest vertical displacement:   
  sin 45 but the displacement is 0.

3) What is the equation for centripetal acceleration?  
  
fc = mV^2/ r  
  
1.7   
1) Can a moving object be in equilibrium? Why or why not?  
yes at velocity = 0 or in translational or rotational equilibrium the angular velocity is constant .

2) If you have an object three times as heavy as you can lift, how could a lever be used to lift the object? Where would the fulcrum need to be placed?   
place a lever 1/3 times as long as you to provide the necessary torque to lift.