1) What is the resultant of a pair of 5 unit vectors at right angles to each other?

Use Pythagorean Theorem: $\sqrt{5^2 + 5^2} = 7$

2) What are some examples of Projectile Motion?

Cannonball being fired, Basketball, football, baseball or any other type of ball being thrown or kicked, Bullet that is fired, ect…

3) A ball is dropped from a hot air balloon at the exact same time as an identical ball is thrown horizontal from the balloon with a velocity of 20 m/s, which hits the ground first (ignore air resistance)?

The two will hit at the exact same time.

4) In question 3, how far horizontally is the ball after 3 seconds (ignore air resistance)?

$$v = \frac{d}{t}\ So\ \ d = v\ x\ t\ \ Plug\ in\ numbers\ \ \ 60m = 20\frac{m}{s} x\ 3\ s$$

5) In question 3, how far vertically will the ball have dropped after 3 seconds?

$$d_y = v_i t + \frac{1}{2}at^2 \ \ \rightarrow\ \ \left(0\frac{m}{s} x\ 3s\right) + \left(\frac{1}{2}9.8\frac{m}{s^2}\ x\ 3^2\right) =\ 132.3m$$

6) How does "hang time" compare from someone that simply jumps up to that of someone that runs and jumps up with the same vertical component take off speed?

The hang time will be the same. The d_x will be much greater for the one that runs however.

7) What is V_y & acceleration at the apex (top) of a projectiles trajectory?

$$v_y = 0\ ;\ a_g =\ 9.8\ m/s^2$$

8) What angle will give you the greatest range for projectile motion?

$$45^0$$

9) A ball thrown in the air will never go as far as physics ideally would predict, why?

This is due to air resistance.

10) A ball is thrown at an angle of 50 degrees to the horizon at a velocity of 30 m/s. What is the velocity and angle the ball is traveling at when it lands (ignore air resistance)?

$$The\ same\ as\ it\ was\ thrown\ 30\frac{m}{s}\ 50^0 to\ the\ horizon.$$

11) What is the resultant of a 3 unit vector and 4 unit vector at right angles to each other?

Use Pythagorean Theorem: $\sqrt{3^5 + 4^2} = 5$

12) A jetliner flying at 450 mph relative to the air around it encounters a strong head wind of 50 mph (relative to the ground). How fast does the shadow of the plane move across the ground?

450mph – 50mph = 400 mph

13) Does the angle in which an object is launched change the acceleration it encounters due to gravity?

No the angle does not change the a_g because you will treat each component separate.

14) You're driving behind a car and wish to pass, so you turn to the left and pull into the passing lane without changing speed. Why does the distance increase between you and the car you're following?

Since you are moving forward while traveling to the side you have formed a triangle. You actually traveled the hypotenuse of the triangle (increasing the displacement you would have traveled), if your car was going the same speed, the distance between you and the car in front of you has increased.

15) A projectile is launched straight up at 141 m/s. How fast is it moving at the top of its trajectory? Suppose it is launched upward at 45 degrees above the horizontal plane. How fast is it moving at the top of its curved trajectory?

For the object launched straight up, the velocity at the top of the path would have been 0m/s. For the object that was launched at 45^0 it would have been 141m/s cos 45^0 = 99.7 m/s

16) Compare and contrast vectors and scalars?

Vectors have direction and magnitude, while scalars only have magnitude.

17) When you jump up, your hang time is the time your feet are off the ground. Does hang time depend on your vertical component of velocity when you jump, your horizontal component of velocity, or both? Defend your answer.

Your hang time only depends on the vertical component since the time you are in the air depends only on the initial velocity in the y direction and gravity. The v_x is a factor that helps determine how far horizontal you will go, but still depends on hang time.

18) We think of something falling it gets closer to the ground. Yet satellite in circular orbit does not get closer to the ground, because Earth curves as much as the satellite's trajectory does. So how can we say it falls? (Hint: compare the position of the satellite with the imaginary line it would follow if there were no gravity. Does it fall beneath this line?)

The satellite "falls" at the same rate as the curvature of the Earths is.

19) A ball is thrown up at a velocity of 15 m/s, when it is caught, how fast is it traveling?

The speed will be the same only in opposite direction (neglecting air resistance) so -15 m/s

20) A projectile is launched horizontally and hits the ground 0.4 seconds later. If it had been launched with a much higher speed in the same direction, would it have taken the same amount of time, a longer amount of time or a shorter amount of time? Explain your answer.

Rearranging the equation $v_f = v_i + at$ and solving for t we find $t = \frac{vf-vi}{a}$ knowing that at the top of the trajectory v_f will be 0 then the equation becomes $t = \frac{-vi}{a}$ since vi and t are direct relationships, you know if v_i increases so will t.

21) The speed of falling rain is the same 10 m above ground as it is just before it hits the ground. What does this tell you about whether or not the rain encounters air resistance?

The rain has reached its terminal velocity. This is the point that the force due to gravity equals the force due to air resistance.