**Phys 218 Fall 2014 Ch 1-3 Review**

**Problem 1** – Find the magnitude and direction of the sum $R$ of the three vectors shown in the figure.

$R = A + B + C$

The vectors have the following magnitudes: $A = 5.0\, \text{m}$, $B = 9.5\, \text{m}$, and $C = 6.0\, \text{m}$.

Express the direction of the vector sum by specifying the angle it makes with the positive $x$-axis, with the counterclockwise angles taken to be positive.

![Vector Diagram](image)

**Problem 2** - $x(t) = t^4 - 2t^2 + 3$ (in SI units) describes the position of a particle moving along a line.

(a) What is the *average velocity* between 0 and 2 s?

(b) What is $v(t)$

(b) What is the acceleration at $t = 3$ s?

**Problem 3** - A rocket is launched from rest on the ground with a constant upward acceleration of $5\, \text{m/s}^2$. 6 s after the launch the rocket’s engine shuts down. What is the maximum height reached by the rocket? (Neglect air resistance.)

**Problem 4** - A ball is dropped (from rest) from a window at height $h$ and is seen to reach the ground in a certain time. The ball-dropper then climbs to a height $2h$ but wants the ball to reach the ground in the original time. Find the velocity $v_0$ that must be given to this ball to achieve the goal.
Problem 5 - A basketball player releases the ball from a height $h_1$ at an angle $\theta$ and initial velocity $v_0$ in an attempt to put the ball into the basket which is at height $h_2$ and a horizontal distance $d$. Calculate the distance $d$ if the ball is to make it into the basket. (find in terms of $h_1$, $h_2$, $\theta$, and $v_0$)

Problem 6 - A daring 510N swimmer dives off a cliff with a running horizontal leap, as shown. What must her minimum speed just as she leaves the top of the cliff, $v_0$, so that she will miss the ledge at the bottom, which is 1.75m wide and 9.00m below the top of the cliff.

Problem 7 - A jet plane comes in for a downward dive. The bottom part of the path is a quarter circle having a radius of curvature of 350 m. According to medical tests, pilots lose consciousness at an acceleration of 5.50 $g$.
(a) At what speed (in m/s) will the pilot black out for this dive?
(b) At what speed (in mph) will the pilot black out for this dive?

Problem 8 – Passengers on a carnival ride move at constant speed in a horizontal circle of radius 14.0 m, making a complete circle in 10.0 s.
(a) What is their acceleration?
(b) Draw the acceleration vector at each point (A, B, C, D).
(c) How would your answer in (b) change if the speed were not constant? (Explain in words and/or drawing)
Problem 9 - A plane is flying north at \(200\,\text{m/s}\) in gale-force winds of \(35.0\,\text{m/s}\) which are blowing in a direction \(30.0^\circ\) south of east. How far off course are they in the east-west direction after \(2.00\,\text{hrs}\)? (P=plane, A=air, E=earth)

![Diagram of plane and wind vectors]

Problem 10 – In a triathlon, a contestant swims from start to finish in a time \(T\). In order to do so, the contestant has to swim against the flow of the river which has a constant speed \(V\) relative to ground as shown. What is the \(x\)-component of the swimmer’s velocity, \(v_x\), with respect to the water?

![Diagram of swimmer's path]

Problem 11 – A rocket starts from rest and moves upward from the surface of the earth. For the first \(10.0\,\text{ss}\) of its motion, the vertical acceleration of the rocket is given by \(a_y(t) = (2.80\,\text{m/s}^3)t\), where the +y-direction is upward. 
(a) What is the height of the rocket above the surface of the earth at \(t = 10.0\,\text{s}\)?
(b) What is the speed of the rocket when it is \(325\,\text{m}\) above the surface of the earth?

Problem 12 – The acceleration of an object is given by \(a(t) = 2.0\,\text{m/s}^2 + (.75\,\text{m/s}^3)t\) while moving in the \(x\)-direction. If its initial position is \(x = 3.0\,\text{m}\) and its initial velocity is zero, find the velocity and position when \(t = 2.5\,\text{s}\).