Physics 112 Course Review #2 Acceleration

1. Define acceleration. How do the units reflect this definition?

Acceleration measures the change in velocity over time of a moving object the units reflect the definition because they include units of velocity(m/s) and time (s) ie(m/s²

2. Describe a situation where an object can have:

   a. A constant speed but be experiencing a non-zero acceleration.

   an object travelling in a circle. The speed is constant however because the object is changing directions it has an acceleration.

   b. An instantaneous velocity of zero but be accelerating.

   Throwing an object into the air and when it is at its highest point the instantaneous velocity is zero, but it is changing directions so it is accelerating

3. A car accelerates from 25 m/s [E] to 5 m/s [W] in 35 seconds.

   a. Calculate the acceleration of the car. { $\vec{a}$ = -0.86 m/s²}

$v_o = 25$ m/s [E]
$v_f = 5$ m/s [W] (-5)
$t = 35$ s

$$\vec{a} = \frac{\vec{v_f} - \vec{v_o}}{t}$$
$$\vec{a} = \frac{-5 - 25}{35}$$
$$\vec{a} = -0.86 \text{ m/s}^2 \text{ [E]}$$

   b. Calculate the displacement of the car during the above acceleration. {$\vec{d}_f$ = 348 m}

$v_o = 25$ m/s (E)
$v_f = -5$ m/s (E)
$t = 35$ s
$a = -0.86$ m/s²
$d_o = 0$ m

$$d_f = d_o + v_o t + \tfrac{1}{2} a t^2$$
$$d_f = 0 + (25)(35) + \tfrac{1}{2}(-0.86)(35)^2$$
$$d_f = 0 + 875 + -526.75$$
$$d_f = 348.25 \text{ m (E)}$$

4. A person is standing atop a cliff that is 125 m high and drops a rock to the water below.

   a. Calculate the time it takes for the rock to hit the water below. {t = 5.04 s}

$d_f = 0$ m
$d_o = 125$ m
$v_o = 0$ m/s
$a = -9.81$ m/s²
$t = ?$
$v_f = 0$ m/s

$$d_f = d_o + v_o t + \tfrac{1}{2} a t^2$$
$$0 = 125 + (0)(t) + \tfrac{1}{2}(-9.81)(t^2)$$
$$0 = 125 + -4.905 t^2$$
$$-125 = -4.905 t^2$$
$$25.48 = t^2$$
$$\sqrt{25.48} = t$$
$$\boxed{t = 5.04 \text{ s}}$$

   b. Calculate the velocity as it enters the water. {$\vec{v}_f$ = -49.5 m/s}

$v_o = 0$ m/s
$v_f = ?$
$a = -9.81$ m/s²
$d_o = 125$
$d_f = 0$

$$v_f^2 = v_o^2 + 2a(d_f - d_o)$$
$$v_f^2 = (0)^2 + 2(-9.81)(0 - 125)$$
$$v_f^2 = 0 + (-19.62)(-125)$$
$$v_f^2 = 2452.5$$
$$v_f = \sqrt{2452.5}$$
$$v_f = 49.5 \text{ m/s down so } -49.5 \text{ m/s}$$

   c. Calculate the velocity of the rock 65 m above the water. {$\vec{v}_f$ = -24.3 m/s}

$d_o = 125$ m
$d_f = 65$ m
$v_o = 0$ m/s
$v_f = ?$
$a = -9.81$ m/s²

$$v_f^2 = v_o^2 + 2a(d_f - d_o)$$
$$v_f^2 = (0)^2 + 2(-9.81)(65 - 125)$$
$$v_f^2 = 0 + (-19.62)(-60)$$
$$v_f^2 = 1177.2$$
$$v_f = \sqrt{1177.2}$$
$$v_f = 34.3 \text{ m/s down so } -34.3 \text{ m/s}$$

5. Standing on the ground a person throws a ball. It leaves his hand with an upward velocity of 17 m/s.

a. Calculate the length of time the ball will be traveling upwards. {t = 1.73 s}

$a = -9.81 m/s^2$
$v_o = 17 m/s$
$v_f = 0 m/s$
$t = ?$

$a = \frac{v_f - v_o}{t}$

$-9.81 = \frac{0 - 17}{t}$

$-9.81 = \frac{-17}{t}$

$\frac{-9.81t}{-9.81} = \frac{-17}{-9.81}$

$t = 1.73 s$

b. Calculate the ball's maximum height. {$\vec{d}_f$ = 14.7 m}

$v_f = 0 m/s$
$v_o = 17 m/s$
$a = -9.81 m/s$
$d_o = 0$
$t = 1.73 s$

$d_f = d_o + v_o t + \frac{1}{2}at^2$

$d_f = 0 + (17)(1.73) + \frac{1}{2}(-9.81)(1.73)^2$

$d_f = 0 + 29.41 + -14.68$

$d_f = 14.7 m$

c. Calculate the velocity of the ball when it is 5 m above the ground. {$\vec{v}_f$ = ± 13.8 m/s}

$v_o = 0$
$a = -9.81 m/s$
$d_f = 5 m$
$d_o = 14.7 m$

$v_f^2 = v_o^2 + 2a(d_f - d_o)$

$v_f^2 = (0)^2 + 2(-9.81)(5 - 14.7)$

$v_f^2 = 0 + (-19.62)(-9.7)$

$v_f^2 = 190.314$

$v_f^2 = \sqrt{190.314}$ $v_f = \pm 13.8 m/s$

d. Calculate the position above the ground when the ball traveling at 4.5 m/s upwards. {$\vec{d}_f$ = 13.7 m}

$v_o = 17 m/s$
$v_f = 4.5 m/s$
$d_o = 0$
$d_f = ?$
$a = -9.81$

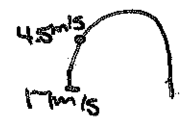
$v_f^2 = v_o^2 + 2a(d_f - d_o)$

$-289 \quad (4.5)^2 = (17)^2 + 2(-9.81)(d_f - 0)$

$20.25 = 289 + -19.62d_f \quad -289$

$\frac{-268.75}{-19.62} = \frac{-19.62d_f}{-19.62}$

$\vec{d_f} = 13.7 m$



6. A plane changed its velocity from 150 m/s [S] to 415 m/s [N]. The acceleration was a constant 15.0 m/s².

a. Calculate the time it took for the plane to change its velocity. {t = 37.7 s}

$v_o = 150 m/s (S) (-150)$
$v_f = 415 m/s (N)$
$a = 15 m/s^2$
$t = ?$

$a = \frac{v_f - v_o}{t}$

$15 = \frac{415 - (-150)}{t}$

$15 = \frac{565}{t}$

$\frac{15t}{15} = \frac{565}{15}$

$t = 37.7 s$

b. Calculate the time it took for the plane to return to its starting point. {t = 4.47 s}

c. Calculate the displacement of the plane in that time. {$\vec{d}_f$ = 5000 m} use 37.7s ∴

$v_f = 415$
$v_o = -150$
$a = 15 m/s^2$
$t = 37.7 s$
$d_o = 0$
$d_f = ?$

$d_f = d_o + v_o t + \frac{1}{2}at^2$

$d_f = 0 + (-150)(37.7) + \frac{1}{2}(15)(37.7)^2$

$d_f = 0 + (-5655) + 10660$

$d_f = 5000 m$

d. Calculate the distance the plane traveled in that time. {d = 6500 m} use 37.7s ∴

distance ~~north~~

$v_o = 0$
$v_f = 415$
$a = 15$
$d_o = 0$
$d_f = ?$

$v_f^2 = v_o^2 + 2a(d_f - d_o)$

$(415)^2 = (0)^2 + 2(15)(d_f - 0)$

$172225 = 0 + 30d_f$

$\frac{172225}{30} = \frac{30d_f}{30}$

$d = 5741 m$

distance south

$v_o = 0$
$v_f = -150$
$a = 15$
$d = 0$
$d_f = ?$

$v_f^2 = v_o^2 + 2a(d_f - d_o)$

$(-150)^2 = 0^2 + 2(15)(d_f)$

$\frac{22500}{30} = \frac{30d_f}{30}$

$d_f = 750 m$

total = 5741 + 750
d = 6500 m