PHY 101 TEST1 UNION COUNTY COLLEGE

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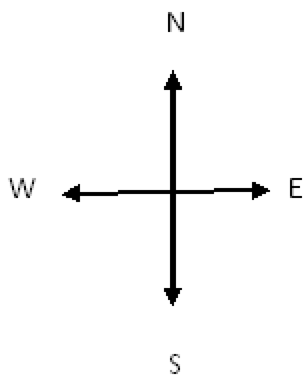
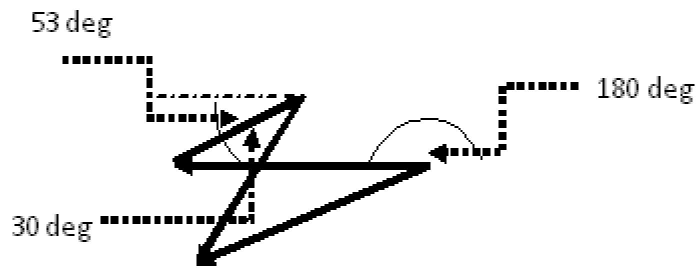
1) An airplane trip involves three legs with two stopovers. The first leg is due west for 620km; the second leg is 30°north of east for 440km: and the third leg is at 53° south of west for 550 km. The trip started at 3:15 PM and ended at 8:45 PM .

a) Draw a quick sketch of the **vector addition** to **determine** the **resultant.** Clearly show **compass directions** and the **angles of each displacement** and the **resultant.** **(5 pts)**





b) Determine the "x" and "y" components of each displacement and the resultant **(20 pts)**

Vector	Magnitude	Angle	X-component	Y-component
D1	$D_{.1} := 620km$	$\theta_{.1} = 180deg$	$D_{1x} := D_1 \cdot \cos(\theta_1)$ $D_{1x} = -620km$	$D_{1y} := D_1 \cdot \sin(\theta_1)$ $D_{1y} = 0km$
D2	$D_{.2} := 440km$	$\theta_{.2} = 30deg$	$D_{2x} := D_2 \cdot \cos(\theta_2)$ $D_{2x} = 381km$	$D_{2y} := D_2 \cdot \sin(\theta_2)$ $D_{2y} = 220km$
D3	$D_{.3} := 550km$	$\theta_{.3} = 233deg$	$D_{3x} := D_3 \cdot \cos(\theta_3)$ $D_{3x} = -331km$	$D_{3y} := D_3 \cdot \sin(\theta_3)$ $D_{3y} = -439km$
Resultant	$R := \sqrt{R_x^2 + R_y^2}$ $R = 611km$	$\theta := \operatorname{atan}\left(\left\|\frac{R_y}{R_x}\right\|\right)$ 3rd Q $\theta = 21deg$	$R_x := D_{1x} + D_{2x} + D_{3x}$ $R_x = -570km$	$R_y := D_{1y} + D_{2y} + D_{3y}$ $R_y = -219km$

c) Find the Average velocity **(8 pts)**

$R = 611km$ @ $\theta = 21deg$ SW

$\Delta t := 5.5hr$ $\quad V_{avg\_vel} := \frac{R}{\Delta t}$ $\quad V_{avg\_vel} = 111\frac{km}{hr}$ @ $\theta = 21deg$ SW

$\Delta t := 5.5hr$ $\quad V_{avg\_speed} := \frac{|D_1| + |D_2| + |D_3|}{\Delta t}$ $\quad V_{avg\_speed} = 293\frac{km}{hr}$

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d) Find the average speed **(2pts)**

$\Delta t := 5.5hr$

$V_{avg\_speed} := \frac{|D_1| + |D_2| + |D_3|}{\Delta t}$

$V_{avg\_speed} = 293 \frac{km}{hr}$

2) Convert, write in scientific notation and state number of "sig figs"

a) $35*10^{-2}$ km into millimeters **(5 pts)**

$35 \cdot 10^{-2} \cdot km \cdot \left(\frac{10^3 \cdot m}{1 \cdot km}\right) \cdot \frac{10^3 \cdot mm}{1 \cdot m} = 35 \cdot 10^{-2} \cdot 10^6 mm = 35 \cdot 10^4 cm = 3.5 \cdot 10^5 mm$

2sig fig

b) $0.0560\ cm^3$ to mm^3 **(5 pts)**

$0.0560 cm^3 = 0.0560 (cm) \cdot (cm) \cdot (cm) = 0.0560 \cdot (10^1 \cdot mm) \cdot (10^1 \cdot mm) \cdot (10^1 mm) = 5.60 \cdot 10^1 mm^3$

3 sig fig

3) A stone is thrown up off of a cliff with a speed of 10 m/s. It strikes the ground with a speed of 40m/s .

a) Find the height above the cliff the stone raises to. **(5 pts)**

UP is postive (+)

a	V_f	V_o	Δt	Δy
−9.8	0	10		?

$\Delta y_{max.} := \frac{V_F^2 - V_o^2}{2 \cdot a}$

$\Delta y_{max.} = 5.1\ m$

b) Find the displacement of the stone for the entire trip **(10 pts)**

UP is postive (+)

a	V_f	V_o	Δt	Δy
−9.8		10		−40

$\Delta Y := \frac{V_f^2 - V_o^2}{2 \cdot a}$

$\Delta Y = -77\ m$

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c) Find the average velocity **(5 pts)**

UP is postive (+)

a	V_f	V_o	Δt	Δy
−9.8		10		−40

$\Delta t := \frac{V_f - V_o}{a}$ $\Delta t = 5.1\ s$

$V_{ave\_velocity.} := \frac{\Delta Y}{\Delta t}$ $\boxed{V_{ave\_velocity.} = -15\ \frac{m}{s}}$

d) Find the average speed **(5 pts)**

the total distance is $d := 2 \cdot \Delta y_{max.} + |\Delta Y|$ $d = 86.7\ m$

$V_{average\_speed.} := \frac{d}{\Delta t}$ $\boxed{V_{average\_speed.} = 17\ \frac{m}{s}}$

4) A uniform acceleration of 2.0 m/s^2 due east is applied for 6s to a car moving with an initial velocity of 40m/s due west.

a) Find the final velocity of the car **(10 pts)**

East = positive (+)

a	V_f	V_o	Δt	Δx
+2	?	−40	6	

$V_f := a \cdot \Delta t + V_0$ $\boxed{V_f = -28\ \frac{m}{s}}$ (west)

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5) The distance required stopping a car traveling at 20m/s will be estimated. Assume the time between the driver first realizing the brakes should be applied and the actual application of the brakes (the reaction time) is 0.6s. Once the brakes are applied the car is subject to a constant acceleration of 7m/s².

a) How long does it take for the car to stop after the brakes are applied? **(5 pts)**

After the brakes are applied the car experiences constant accelerating and will come to a res

We know that $v_{02} := v_{f1}$

a_2	v_{f2}	v_{02}	Δx_2	Δt_2
-7	0	20		

$$\Delta t_2 := \frac{v_{f2} - v_{02}}{a_2} \qquad \boxed{\Delta t_2 = 2.857\,s}$$

during reaction time car is is traveling with constant velocity

a_1	v_{f1}	v_{01}	Δx_1	Δt_1
0	20	20		0.6

b) Find the total stopping distance? **(15 pts)**

during the reaction he will of move $\Delta x_1 := v_{01} \cdot \Delta t_1 \qquad \Delta x_1 = 12\,m$

during the he applies the brakes he will of move $\Delta x_2 := \dfrac{v_{f2}^{\,2} - v_{02}^{\,2}}{2 \cdot a_2} \qquad \Delta x_2 = 29\,m$

the total distance is stopping is $\Delta x_{total} := \Delta x_1 + \Delta x_2 \qquad \boxed{\Delta x_{total} = 41\,m}$

MIDAS GOLD: (point value 10% of original grade). A person in a balloon rising at a constant velocity of 10 m/s drops a rock. Give a brief description of its motion. Be sure to include initial velocity and value of acceleration.

The rock has a zero initial velocity with respect to the balloon (it is dropped), but has the same velocity of the balloon with respect to the ground. Vo =10m/s, up. Once it is dropped we assume it is in free fall and has an acceleration of, a=9.8m/s² m down. The motion of the rock is then equivalent to an object being thrown upward at a constant velocity. It will rise to a maximum height and then fall down to the ground below.