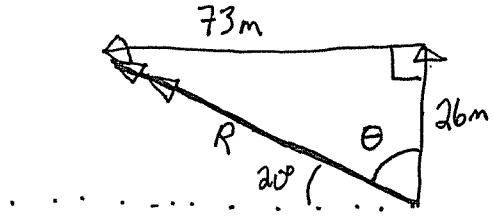
KEY

Physics 12 Unit 1 Worksheet #3

Name: _____ Date: _____

Vectors

1. A bird flies 26 m North1 then 73 m West. Find the resultant displacement (magnitude and direction).

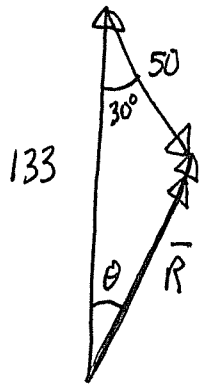


use pythagoras to find magnitude.
$R^2 = 73^2 + 26^2$ $R = 77.491\ m$

$\tan\theta = \frac{opp}{adj} = \frac{73}{26} = 2.8077$ $\tan^{-1}$ → $\theta = 70°$ W of N

OR 20° N of W

2. A Plane travels 133 km North, than 50 km 30 degrees East of South. Find the resultant displacement.



$\frac{\sin\theta}{50} = \frac{\sin 30}{93.117}$

$\sin\theta = 0.26848$

$\sin^{-1}$ → $\theta = 15.6°$

15.6° E of N

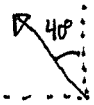
Use cosine law to find magnitude.

$R^2 = a^2 + b^2 - 2ab\cos\theta$

$= 133^2 + 50^2 - 2(133)(50)\cos 30°$

$R = 93.117\ Km$

3. A child walks 25 m 50 degrees N of W and then 38 m South. Find the resultant displacement.



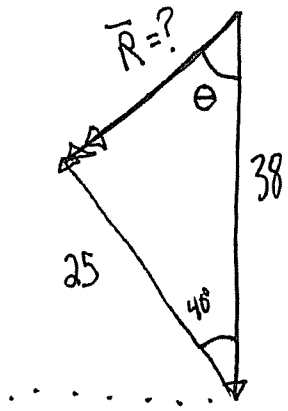
40° W of N

$\frac{\sin\theta}{25} = \frac{\sin 40°}{24.769}$

$\sin\theta = 0.64878$

$\theta = 40.450$

40° W of S



cosine law to find magnitude

$R^2 = a^2 + b^2 - 2ab\cos\theta$

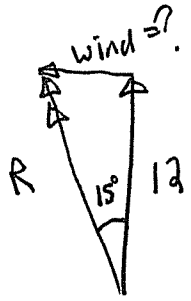
$= 38^2 + 25^2 - 2(38)(25)\cos 40°$

$R = 24.769\ m$

KEY

Kinematics C1 Relative Velocity

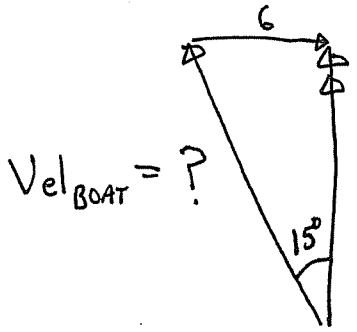
4. A bird flies at 12 m/s directly North relative to the ground but a wind is blowing from the East. The birds resultant direction is 15 degrees W of N. What is the wind speed?



$\tan 15 = \frac{opp}{adj} = \frac{wind}{12}$

$12 \times \tan 15 = V_{wind} = 3.21 m/s$

5. A boat is pointed 15 degrees up stream. The current of the river is 6 m/s. What does the velocity of the boat relative to the water need to be so that the boat travels directly across the river and does not drift down stream at all?



$\sin\theta = \frac{opp}{hyp}$

$\sin 15 = \frac{6}{?}$

$? = \frac{6}{\sin 15} = 23.2 m/s = V_{BOAT}$

Kinematics C2 Motion in 1D and 2D

6. A car travels at 55 km/hr for 40 mins (0.66̄ hrs) and then travels 60 km in 30 mins (0.5 hr). Find the average velocity for the whole trip.

$d_1 = v \cdot t = 55 \times 0.66\bar{6} hr = 36.663 Km$

$V_{AVG} = \frac{d_{TOT}}{t_{TOT}} = \frac{d_1 + d_2}{t_1 + t_2} = \frac{36.663 + 60}{.66\bar{6} + 0.5} = 80.1 m/s$

7. A car is travelling at 120 km/hr and want to speed up to 135 km/hr. How much distance does it need if it can accelerate at 1.3 m/s^2?

$V_i = 33.\bar{3} m/s \quad V_f = 37.5 m/s$

$V_f^2 = V_i^2 + 2ad$

$(37.5)^2 = (33.\bar{3})^2 + 2(1.3)(d)$

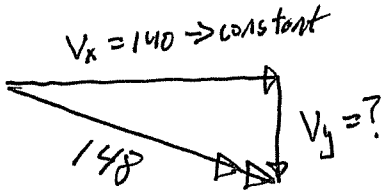
$d = 113.5$

$d = 114 m$

KEY

8. A bullet is fired at 140 m/s straight off a cliff, we will assume infinite height. At what time is the velocity of the bullet 148 m/s?

① What does V_y have to be so that $V_R = 148$



$148^2 = 140^2 + V_y^2 \quad V_y = 48$

② @ what time does $V_y = 48$ m/s ?

$V_i = 0 \quad V_f = 48 \quad a = 9.8 \quad t = ?$

$V_f = V_i + at \quad 48 = 0 + 9.8(t)$ $\boxed{t = 4.8976 = 4.90 \text{ sec}}$

9. A bullet is fired at 280 m/s at an angle of 35 degrees above the horizon. Find the range and max height of the bullet.

① $V_x = 280 \cos 35 = 229.36 \text{ m/s}$

$V_y = 280 \sin 35 = 160.60 \text{ m/s}$

② ↕ Hang time $V_f = -V_i = -160.60 \text{ m/s}$

$V_f = V_i + at \rightarrow t = \frac{-2V_i}{9.8} = \boxed{32.776 \text{ sec}}$

③ Range ↔ $d_x = V_x \cdot t = (229.36)(32.776) = \boxed{7517 \text{ m.}}$

④ ↕ MAX HEIGHT $V_f = 0$ @ top $V_i = 160.60$ m/s $a = -9.8$ $d = ?$

$V_f^2 = V_i^2 + 2ad \quad \boxed{d = 1316 \text{ m}}$ max height.

A Level.

MET 5

10. A car traveling at 18 m/s can accelerate at 2.4 m/s^2 and want to pass a truck travelling at 17 m/s. If an on coming car is 350 m away and travelling at ~~110 km/hr~~ 30.55 should the drive pass?

① ? How much time does the pass car have before the on coming car is in the passing lane! → ← means closing speed of 47.5 m/s
(17 m/s, 30.55)

$$t = \frac{d}{v} = \frac{350\,m}{47.5\,m/s} = 7.368\ sec.$$

② To get around the truck, the car making the pass needs to cover approx 20m more distance than the truck.

$d_{TRUCK} = V_{TRUCK} \cdot t$ $\quad d_{CAR} = d_{TRUCK} + 20m = V_{CAR}t + \frac{1}{2}at^2$.

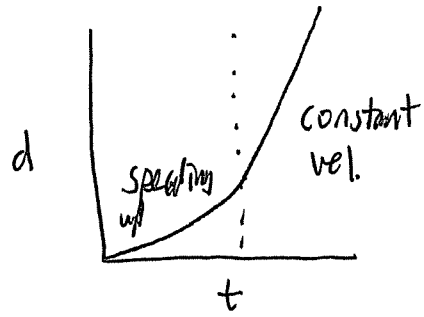
$d_t = (17)(7.3)$

$d_t = 124\,m$ — ? so did the car travel @ least 144m?

$d_{CAR} = V_i t + \frac{1}{2}at^2 = (18)(7.3) + \frac{1}{2}(2.4)(7.3)^2 = 195m.$

so YES, pass

11. a) Draw a d vs t graph for a car that accelerates up to its top speed and then stays at that speed.



slope = vel

b) Draw a v vs t graph for the same car.