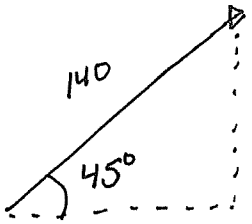
Physics 12 Unit 1 Worksheet #1

KEY

Name: _____ Date: _____

Vectors

1. A woman walks 140 m North East. How far did she walk North?



North = distance north = $140 \sin 45$

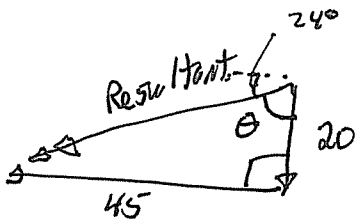
$= 98.995$

$= 99.0$ m

2. A dog walks 20 m South then 45 m West. Find the resultant displacement (magnitude and direction).

$R^2 = 20^2 + 45^2$

$R = 49.244$ m.



$\tan\theta = \frac{opp}{adj} = \frac{45}{20}$

$\tan\theta = 2.25$

$\tan^{-1}$

$\theta = 66°$ W of S

OR

24° S of W.

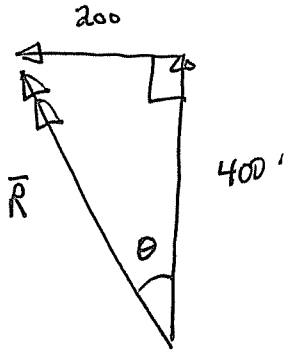
3. Plane travels 500 km North, than 200 km West, than 100 km South. Find the resultant displacement.

$= 400$ km North

$200^2 + 400^2 = R^2$

$R = 447$ km.

26.6° W of N



$\tan\theta = \frac{opp}{adj} = \frac{200}{400} = 0.5$

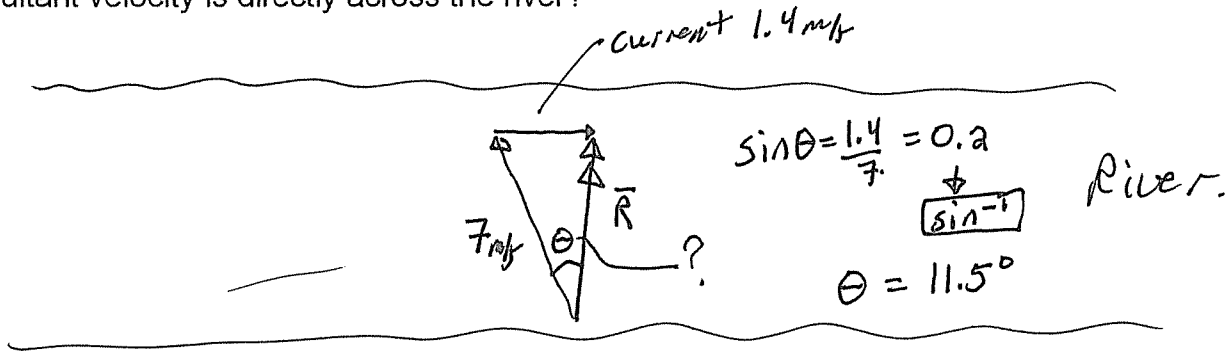
$\tan^{-1}$

$\theta = 26.6°$

KEY

Kinematics C1 Relative Velocity

1. A boat has a velocity of 7 m/s relative to the water. The current of the river it is crossing is 1.4 m/s. What angle/direction does the boat need to travel so that it's resultant velocity is directly across the river?

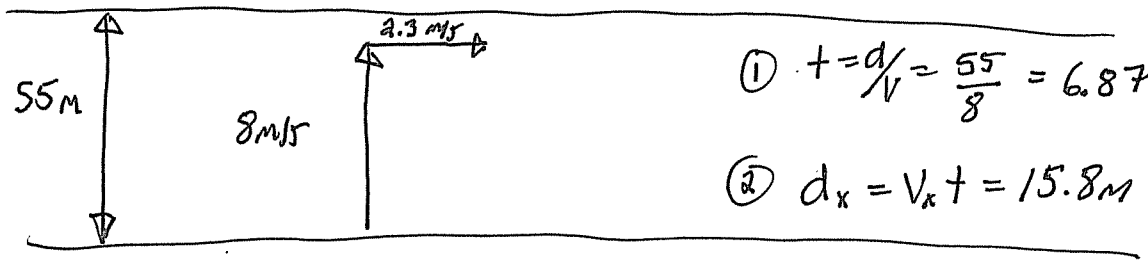


$\sin\theta = \frac{1.4}{7} = 0.2$

$\sin^{-1}$

$\theta = 11.5^\circ$

2. A boat is travelling across a river with a velocity of 8 m/s relative to the water. The current in the river is 2.3 m/s. If the boat heads straight across the river, how far down stream does the boat land?



① $t = d/v = \frac{55}{8} = 6.875 \text{ sec}$

② $d_x = v_x t = 15.8 \text{ m}$

Kinematics C2 Motion in 1D and 2D

1. How long would it take to travel to 480 km to Vancouver if you travel at 87 km/hr?

$$t = \frac{d}{v} = \frac{480}{87} = 5.52 \text{ hours.}$$

2. How much distance does it take a car to stop if the car is travelling at 60 km/hr and it can de accelerate at 6.1 m/s^2?

$16.\bar{6}$ m/s.

$v_f^2 = v_i^2 + 2ad$

$0 = (16.\bar{6})^2 + 2(6.1)d$

$d = 22.8 \text{ m.}$

KEY

3. How much distance does it take a car to stop if the car is travelling at 120 km/hr and it can de accelerate at 6.1 m/s^2?

$\rightarrow 33.\overline{3}$ m/s.

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

$\frac{V_i^2}{2a} = d = \frac{(33.\overline{3})^2}{2(6.1)} = 91.1\text{m}$

* note $V_i \uparrow 2x$, $d \uparrow 4x$

OR $d \propto v^2$

4. If you start from rest, have a constant acceleration, and cover 155 m in 13 seconds, what is your top speed, your average speed, and your acceleration?

① Top speed.

$V_i = 0 \quad d = 155 \quad t = 13 \quad V_f = ?$

$d = \left(\frac{V_i + V_f}{2}\right) t$

$155 = \left(\frac{0 + V_f}{2}\right) 13$

$V_f = 23.85\text{m/s}$

② Avg speed

$V_{AVG} = \frac{d}{t} = \frac{155}{13} = 11.9\text{m/s}.$

③ Accel * multiple methods.

$V_f = V_i + at$

$23.85 = 0 + a(13)$

$a = 1.83\text{m/s}^2.$

5. How much runway does a plane need for take off if it can accelerate at 7 m/s^2, has a take off speed of 100 km/hr? $\rightarrow 27.\overline{7}$ m/s.

(Bonus, if the plane has mass of 1200 kg and we ignore friction, how much thrust does it require/)

$V_i = 0 \quad a = 7\text{m/s}^2 \quad V_f = 27.\overline{7}\text{ m/s} \quad d = ?$

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

$(27.\overline{7})^2 = 0 + 2(7)d$

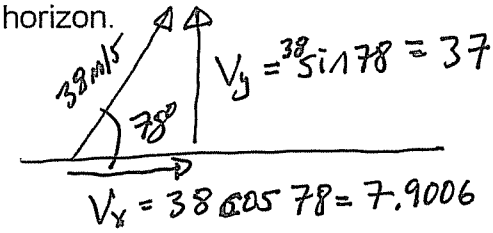
$d = 55.1\text{m}$

② $a = F/m =$

$F = ma = (1200)(7)$

$= 8400\text{ N}$

6. Find the range (horizontal distance) for a projectile that is launched at 38 m/s at 78 degrees above the horizon.



① Hang time $= t = \frac{2V_i}{a} = 7.5856$ sec.

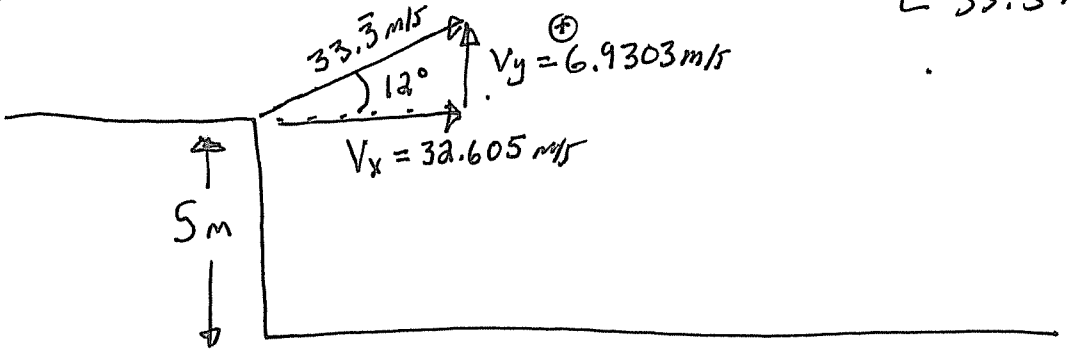
② Range $d_x = V_x \cdot t = (7.9006)(7.5856) = 59.9$ m.

7. Find the max height for the projectile in number 6. ↳ more than one possible solution.

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

$0^2 = (37.170)^2 + 2(-9.8)d \qquad d = 70.5$m.

8. Find the range for a car that launches off of a 5 m high cliff at 120 km/hr an angle 12 degrees above the horizon. ↳ 33.3 m/s.



① To avoid a quadratic, don't solve for t directly.

Find V_f

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

$= (6.9303)^2 + 2(-9.8)(5)$

$V_f = 12.084$ m/s (down)

② $t = ?$

$V_f = V_i + at$

$-12.084 = 6.9303 + (-9.8)t$

$t = 1.9403$ sec.

③ $d = V_x t$

$= (32.605)(1.9403) = 63.3$ m.