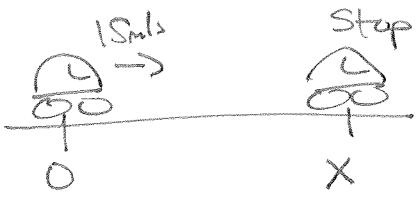
(1.) A car is traveling on a straight road with a speed of $15.0\,m/s$ when the driver hits the brakes causing a constant deceleration of $1.90\,m/s^2$. How far does the car go while stopping?

(a) $10.3\,m$	(b) $42.1\,m$	(c) $59.2\,m$	(d) $120\,m$	(e) $240\,m$



KNOWN: $V_{0x} = 15\,m/s$, $X_0 = 0$

$a_x = -1.9\,m/s^2$, $V_x = 0$

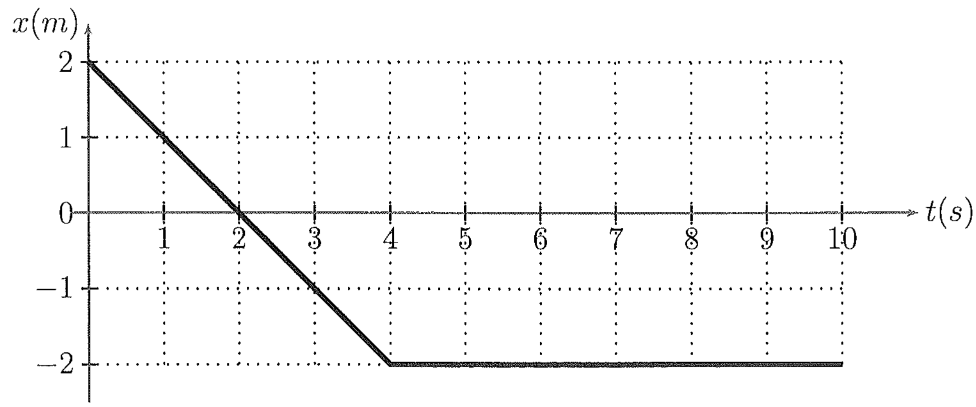
Slowing DOWN

UNKNOWN: X, t

Use $V_x^2 = V_{0x}^2 + 2a_x(X - X_0)$ to Avoid Finding t

$\Rightarrow 0 = (15\,m/s)^2 + 2(-1.9\,m/s^2)(X - 0) \Rightarrow X = -\dfrac{(15\,m/s)^2}{2(-1.9\,m/s^2)} = +59.21\,m$

(2.) A car has the following position-versus-time graph. What is the car's *average* velocity for the time interval from $0\,s$ to $7.0\,s$?



(a) $-1\,m/s$	(b) $-0.57\,m/s$	(c) $-0.29\,m/s$	(d) $-0.22\,m/s$	(e) $0\,m/s$

$$V_{AV} = \frac{\Delta x}{\Delta t}$$

For $t_1 = 0$ $x_1 = 2m$ ← From Graph

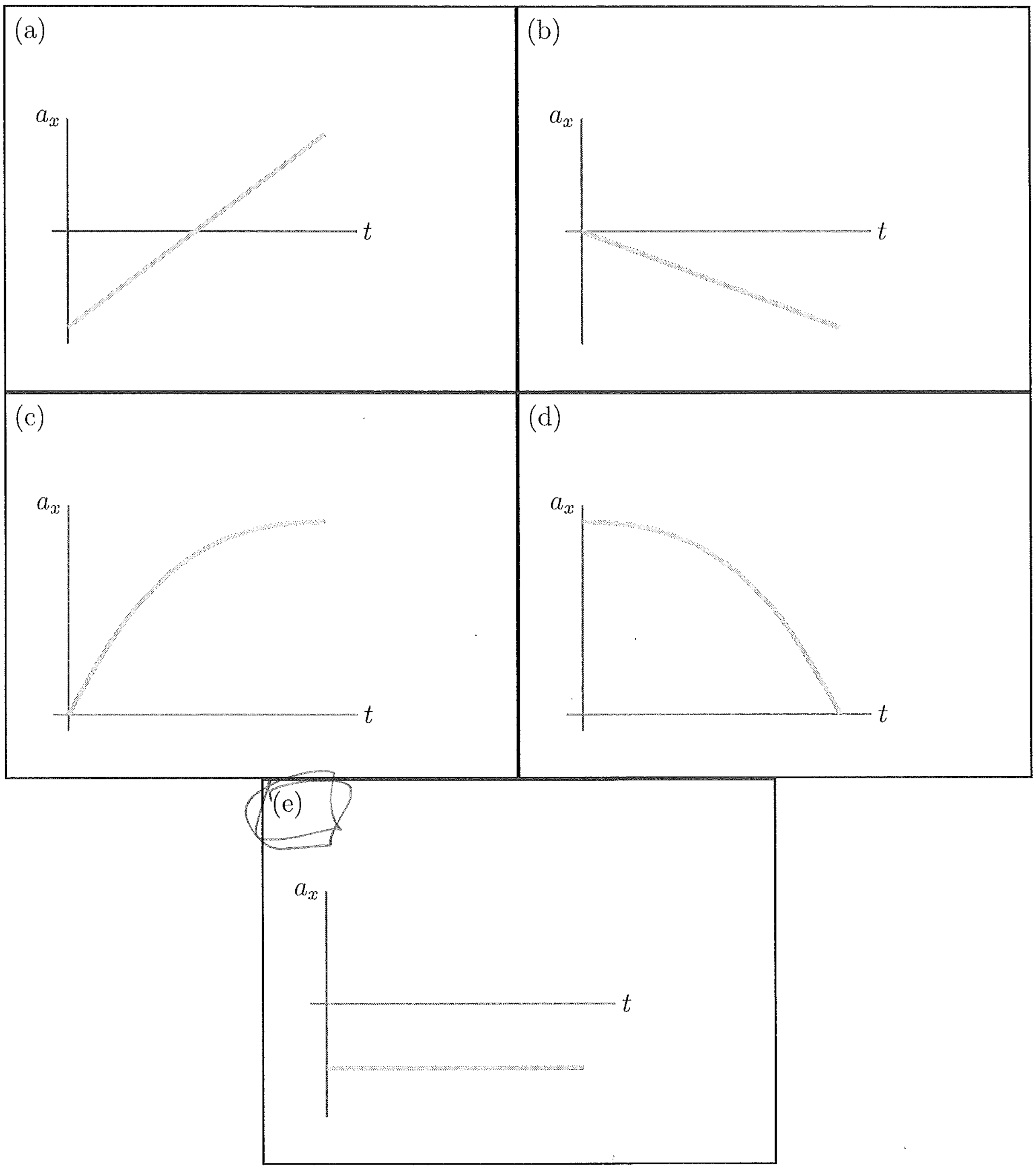
$t_2 = 7s$, $x_2 = -2m$

$$\text{So } V_{AV} = \frac{-2m - 2m}{7s - 0} = \frac{-4m}{7s} = -0.57 m/s$$

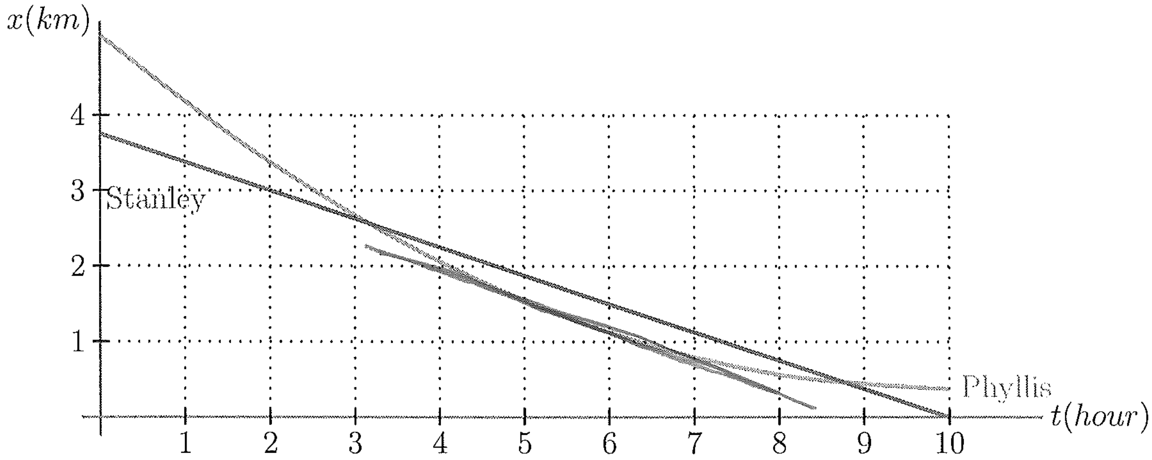
steadily increasing speed

(3.) A man starts from rest and walks to the left as shown in the following motion diagram. Which of the graphs below correctly shows his acceleration versus time?

Constant Acceleration
⇒ Horizontal graph



(4.) The position-versus-time graphs for two people, Phyllis and Stanley, are shown below. At what time or times do they have the same velocity?

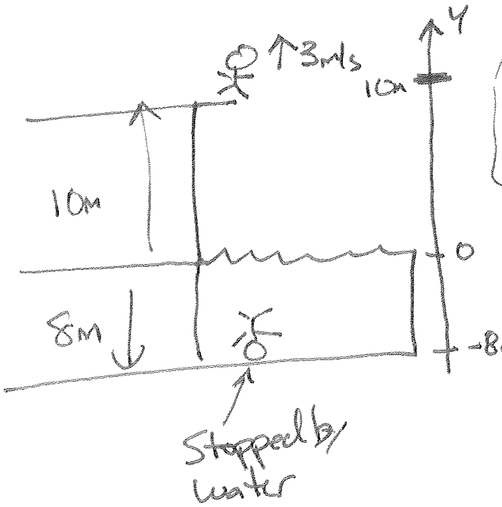


(a) $3\,h$	(b) $6\,h$	(c) $9\,h$	(d) Both $3\,h$ and $9\,h$	(e) At $3\,h$, $6\,h$ and $9\,h$

Only at 6h does the slope of Phyllis's Curve EQUAL the slope of Stanley's Line

(5.) An olympic diver is on a platform that is 10.0 m above a swimming pool that is 8.0 m deep. If she launches herself upwards with a speed of 3.0 m/s, what is the magnitude *AND DIRECTION* of the minimum acceleration needed in the water to keep her from hitting the bottom of the pool? Use the standard convention that up is positive and ignore air resistance. Assume the diver goes in a completely straight line.

(a) $-19\,m/s^2$	(b) $19\,m/s^2$	(c) $13\,m/s^2$	(d) $-13\,m/s^2$	(e) $8.3\,m/s^2$



2 Motions

1st KNOWN: $V_0 = 3\,m/s$, $y_{0_1} = 10\,m$, $y_1 = 0$

$a_1 = -9.8\,m/s^2$ ← No Air Resistance

1st UNKNOWN: V_1, t_1

2ND KNOWN: $y_{02} = 0$, $y_2 = -8\,m$, $V_2 = 0$

2ND UNKNOWN: V_{02}, a_2, t_2

Since 1st Motion LEADS to 2ND $\Rightarrow V_{02} = V_1$ So Find V_1 First. No interest In time $\Rightarrow V_1^2 = V_{01}^2 + 2a_1(y_1 - y_{01}) \Rightarrow V_1^2 = (3\,m/s)^2 + 2(-9.8\,m/s^2)(0 - 10\,m) = 9\,m^2/s^2 + 196\,m^2/s^2$

$\Rightarrow V_1 = \pm\sqrt{205\,m^2/s^2}$ but we pick $-\sqrt{205\,m^2/s^2}$ since we know she's going Down.

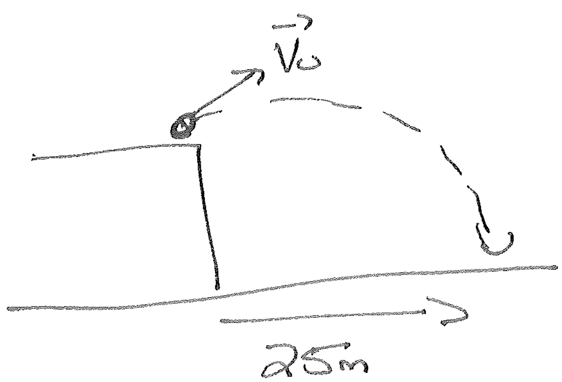
With $V_{02} = -\sqrt{205\,m^2/s^2} = -14.3\,m/s$ we can find a_2 using same basic eqn but it becomes $V_2^2 = V_{02}^2 + 2a_2(y_2 - y_{02}) \Rightarrow 0 = (-\sqrt{205\,m^2/s^2})^2 + 2a_2(-8\,m - 0)$

$$\Rightarrow 0 = 205\,m^2/s^2 - 16\,m\,a_2 \Rightarrow a_2 = \frac{+205\,m^2/s^2}{+16\,m} = +12.8125\,m/s^2$$
$$= +13\,m/s^2$$

Makes sense, acceleration must be opposite to velocity to slow her down.

(6.) A projectile is launched from the top of a cliff with a speed of $35\,m/s$. If its range is $25\,m$ and it hits the ground after $4.5\,s$, at what angle was it launched?

(a) 80.9°	(b) 71.9°	(c) 39.1°	(d) 5.77°	(e) Cannot be determined without knowing the cliff's height



KNOWN: $X_0 = 0$, $X = 25m$, $V_0 = 35m/s$

$t = 4.5s$, $y = 0$

UNKNOWN: y_0, V_{0x}, V_{0y}, V_x, V_y, α

$X = X_0 + V_{0x}t$ CAN find V_{0x}, then $V_{0x} = V_0 \cos\alpha$ will give α

$\therefore$ $25m = 0 + V_{0x}(4.5s) \Rightarrow V_{0x} = \frac{25m}{4.5s} = 5.556m/s$

$V_{0x} = V_0\cos\alpha \Rightarrow \cos\alpha = \frac{V_{0x}}{V_0} = \frac{5.556m/s}{35m/s} = 0.15873$

$\therefore$ $\alpha = \cos^{-1}(0.15873) = 80.8668° = 80.9°$

(7.) A projectile is launched horizontally at $25.0\,m/s$ some distance above the ground. It hits the ground $2.10\,s$ later. With what speed does the projectile hit the ground?

(a) $0\,m/s$	(b) $20.6\,m/s$	(c) $25\,m/s$	(d) $32.4\,m/s$	(e) $45.6\,m/s$

Horizontal launch $\Rightarrow$ $V_{ox} = 25\,m/s$

$V_{oy} = 0$

$t = 2.1\,s$

Speed $\Rightarrow$ $V = \sqrt{V_x^2 + V_y^2}$

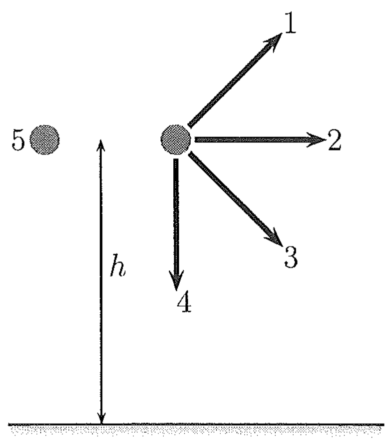
$V_x = V_{ox} = 25\,m/s$

$V_y = V_{oy} - gt = 0 - 9.8\,m/s^2 (2.1\,s)$

$= -20.58\,m/s$

$V = \sqrt{(25\,m/s)^2 + (20.58\,m/s)^2} = 32.4\,m/s$

(8.) Four balls are simultaneously launched with the same speed, from the same height, h, above the ground, but with the different directions shown. At the same instant, ball 5 is released from rest at the same height. Which of the following is the correct ranking, from longest to shortest, for the amount of time it takes each of these balls to hit the ground. Any pairs that hit the ground simultaneously have been circled.



(a) 1, 2, 3, 4, 5
(b) 1, 2, 5, 3, 4
(c) 1, 2, 5, 3, 4
(d) 4, 3, 2, 5, 1
(e) 4, 3, 2, 5, 1

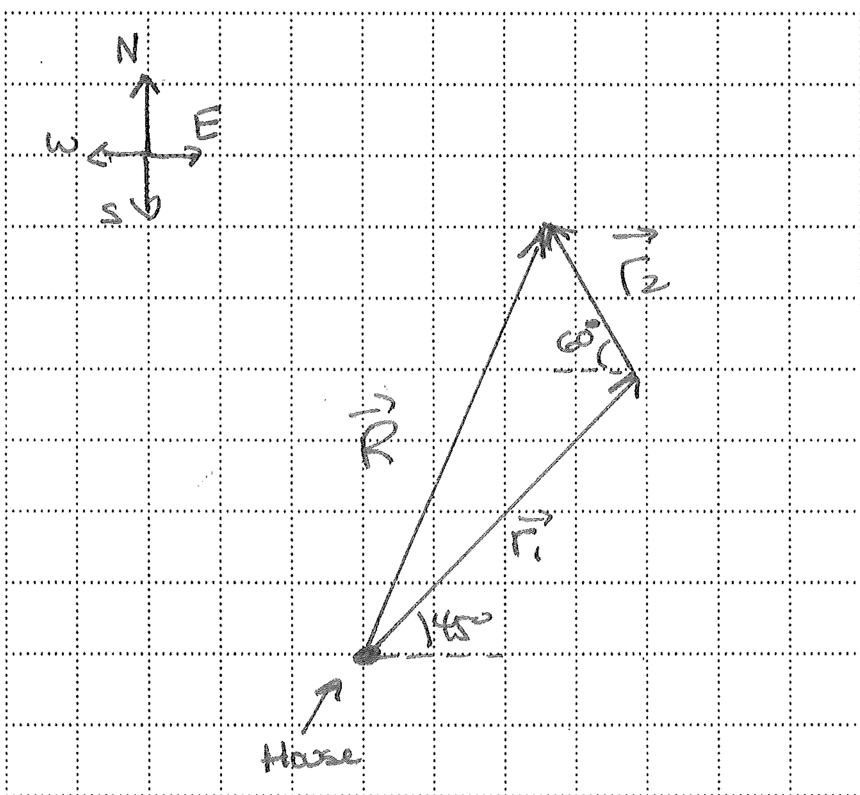
TIME OF FLIGHT = time to Hit GROUND = time until $y = 0$,
So VERTICAL Motion DETERMINES. 1 is going to take the Most time Because its the only one that will go up Before Coming BACK DOWN, Next are 2 AND 5. They BOTH HAVE NO INITIAL VELocity IN THE y-DIRECTION, so their times ARE EQUAL ~~AND~~ But SHORTER THAN ~~2~~ 1's.

4 is the QUICKEST Since its INITIAL velocity IS All IN THE y-DIRECTION

LEAVING 3 to be SOMEwhere Between 4 AND 2.

(9.) A man leaves his house and walks 50.0 m at 45° north of east. He then walks 25 m at 60° north of west.

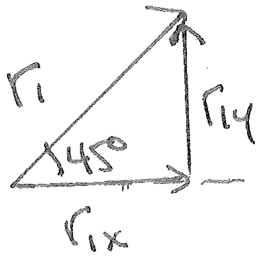
(a) On the grid below, sketch the man's displacement vectors at the proper locations for finding their vector sum graphically, as well as, the vector sum. Label the vectors as $\vec{\mathbf{r}}_1$ and $\vec{\mathbf{r}}_2$ (for the first and second motions respectively). Label the vector sum as $\vec{\mathbf{R}}$. *(5pts.)*



(b) From his final position after the second motion, how far and in what direction must the man walk *in order to get home*? *(5pts.)*

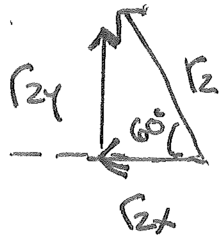
Notice $\vec{R}$ points FROM House to FINAL Position, $\boxed{\text{SO we want } -\vec{R}}$

$R_x = r_{1x} + r_{2x}$, $R_y = r_{1y} + r_{2y}$



$r_{1x} = r_1 \cos 45° = 50m \cos 45° = 35.355m$

$r_{1y} = r_1 \sin 45° = 50m \sin 45° = 35.355m$



r_{2x} to left $\Rightarrow$ $r_{2x} = -r_2 \cos 60° = 25m \cos 60°$

$= -12.5m$

r_{2y} up $\Rightarrow$ $r_{2y} = +r_2 \sin 60° = +25m \sin 60°$

$= +21.65m$

$R_x = 35.355m - 12.5m = 22.855m$

$R_y = 35.355m + 21.65m = 57.005m$

} Both positive so $\vec{R}$ in 1st Quad $\Rightarrow$ Calc. OK

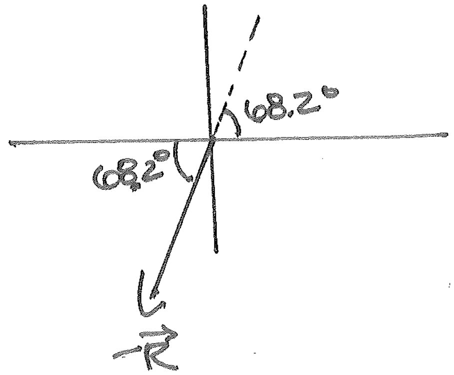
$R = \sqrt{R_x^2 + R_y^2} \Rightarrow$

$R = \sqrt{(22.855m)^2 + (57.005m)^2} = 61.4m$

$\theta = \tan^{-1}\left(\frac{R_y}{R_x}\right) = \tan^{-1}\left(\frac{57.005}{22.855}\right) = 68.2°$

So $-\vec{R}$ is Flipped by 180°

To get Home:



Either This Picture or standard Angle of $180° + 68.2° = 248.2°$