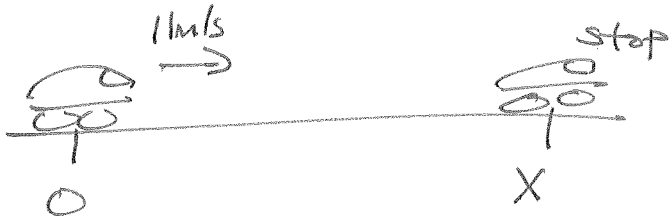
(1.) A car is traveling on a straight road with a speed of $11.0\,m/s$ when the driver hits the brakes causing a constant deceleration of $5.9\,m/s^2$. How far does the car go while stopping?

$\boxed{\text{(a) } 10.3\,m}$	(b) $15.0\,m$	(c) $20.5\,m$	(d) $59.2\,m$	(e) $120\,m$



KNOWN: $X_0 = 0$, $V_{0x} = 11\,m/s$

$a_x = -5.9\,m/s^2$, $V_x = 0$

UNKNOWN: X, t

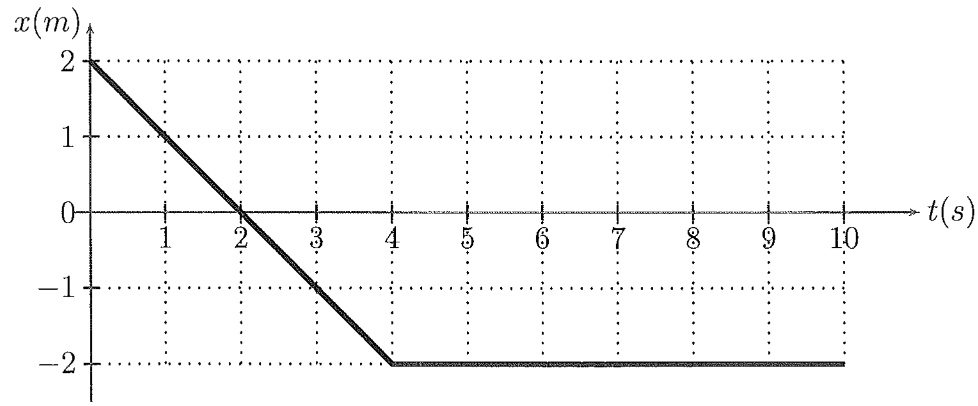
SINCE t UNKNOWN: $V^2 = V_{0x}^2 + 2a_x(X - X_0)$

$\Rightarrow 0 = (11\,m/s)^2 + 2(-5.9\,m/s^2)(X - 0)$

$\Rightarrow X = \dfrac{-(11\,m/s)^2}{2(-5.9\,m/s^2)} = 10.254\,m = 10.3\,m$

Average Velocity

(2.) A car has the following position-versus-time graph. What is the car's ~~displacement~~ Average Velocity for the time interval from 0 s to 8.0 s?



(a) $-1\,m/s$	(b) $-0.50\,m/s$	(c) $-0.44\,m/s$	(d) $-0.25\,m/s$	(e) $0\,m/s$

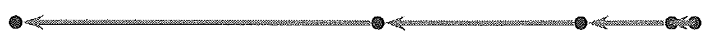
$$V_{AV} = \frac{\Delta X}{\Delta t}$$

For $t_1 = 0$, $X_1 = 2m$ ← FROM GRAPH

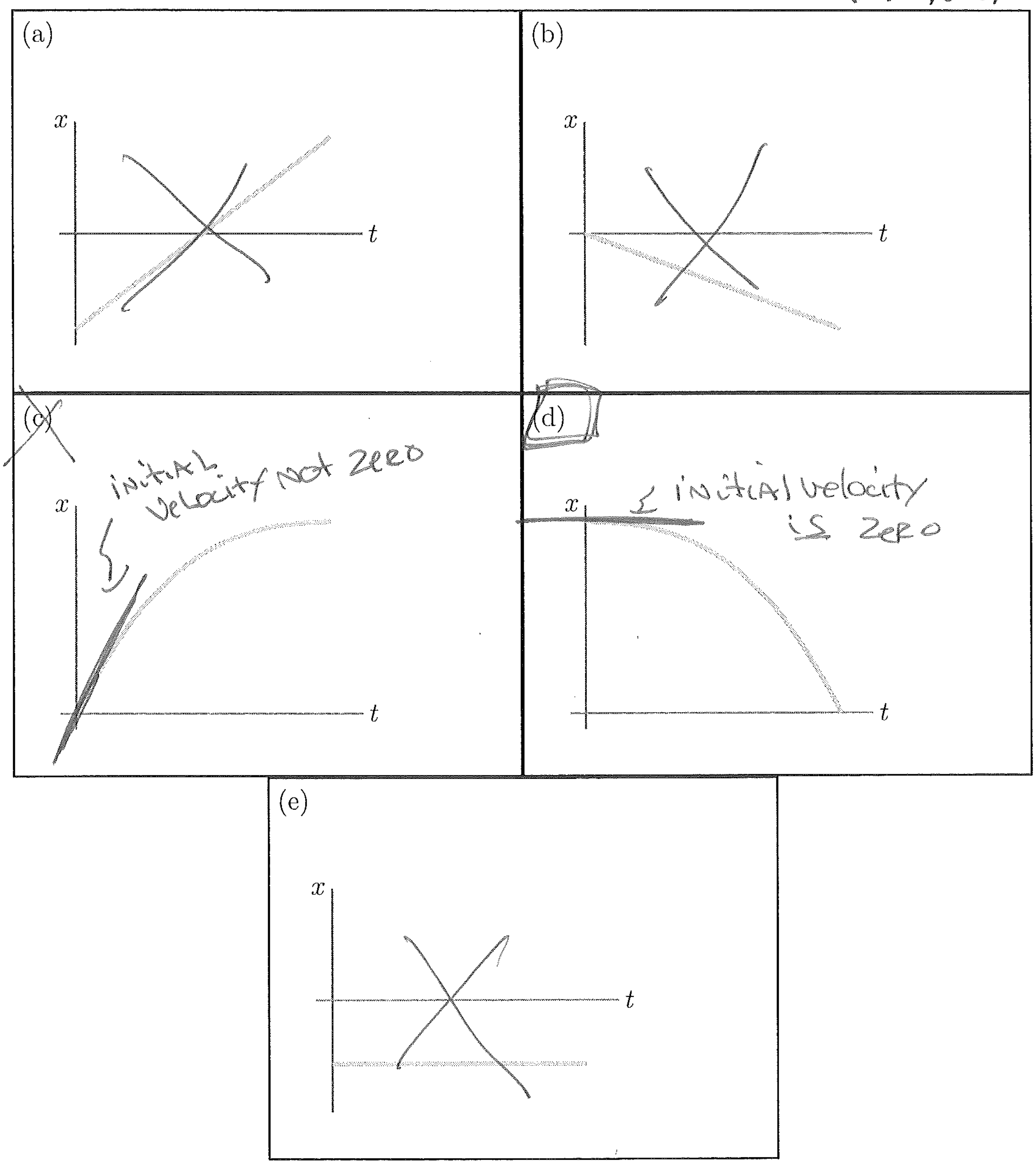
$t_2 = 8s$, $X_2 = -2m$ ←

$$\therefore\ V_{AV} = \frac{-2m - 2m}{8s - 0} = \frac{-4m}{8s} = -0.5\,m/s$$

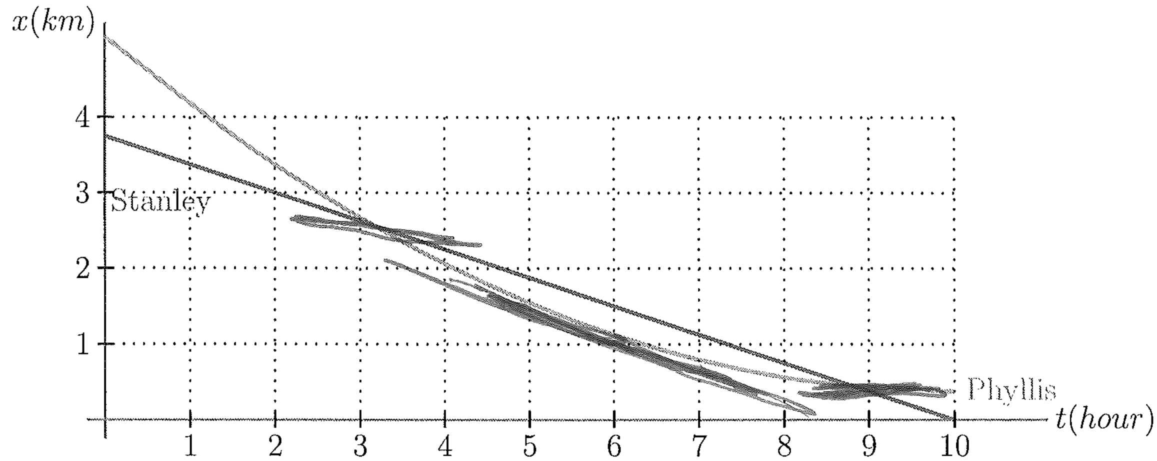
(3.) A man starts from rest and walks to the left as shown in the following motion diagram. Which of the graphs below correctly shows his position versus time?



Accelerating ⇒ Curved plot so not (a), (b), or (e)



(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?

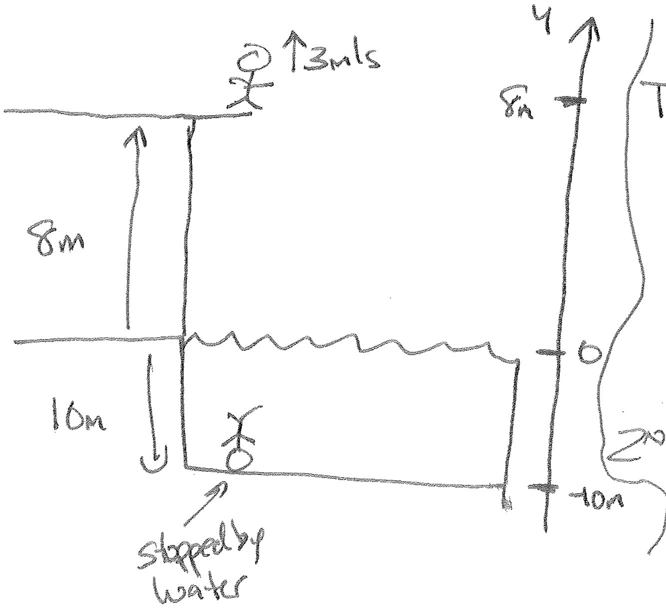


(a) 3 h	(b) 6 h	(c) 9 h	(d) Both 3 h and 9 h	(e) At 3 h, 6 h and 9 h

Only at t=6h Does the slope of Phyllis's Curve match the slope of Stanley's Line

(5.) An olympic diver is on a platform that is $8.0\,m$ above the waterfa ~~a~~ swimming pool that is $10.0\,m$ 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) $13\,m/s^2$	(b) $-13\,m/s^2$	(c) $19\,m/s^2$	(d) $-8.3\,m/s^2$	(e) $8.3\,m/s^2$



Two Motions:

1st Motion Known: $V_{01} = 3m/s$, $Y_{01} = 8m$

$Y_1 = 0$, $a_{y1} = -9.8m/s^2$ ← No Air Resistance

1st Motion Unknown: V_1, t_1

2nd Motion Known: $y_{02} = 0$, $y_2 = -10M$

Minimum Acc $\Rightarrow V_2 = 0$

2nd Motion Unknown: V_{02}, a_2, t_2

Also know that $V_{02} = V_1$ since first motion leads directly into 2nd

Before we can find a_2, we need V_1

$V_y^2 = V_{0y}^2 + 2a_y(y-y_0) \Rightarrow V_1^2 = (3m/s)^2 + 2(-9.8m/s^2)(0-8m) = (3m/s)^2 + 156.8m^2/s^2$

$\Rightarrow V_1 = \pm\sqrt{165.8m^2/s^2} = \mp 12.876m/s$ so $V_{02} = -12.876m/s$

Both are possible

just being careful down is negative

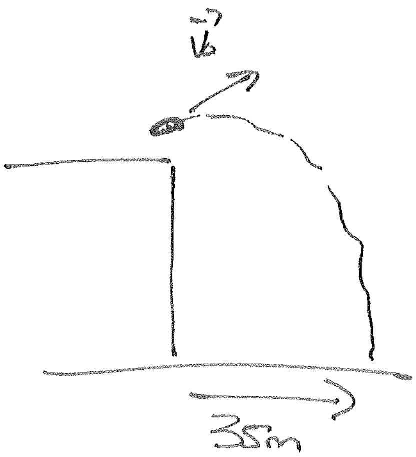
Using $V_y^2 = V_{0y}^2 + 2a_y(y-y_0)$ with 2nd Motion $\Rightarrow 0 = (-\sqrt{165.8m^2/s^2})^2 + 2a_2(-10m-0)$

$\Rightarrow 0 = 165.8m^2/s^2 - a_2(20m) \Rightarrow a_2 = \frac{+165.8m^2/s^2}{20m} = +8.29m/s^2 = +8.3m/s^2$

Makes sense, to slow down Acc. must be opposite to velocity

(6.) A projectile is launched from the top of a cliff with a speed of $45\,m/s$. If its range is $35\,m$ and it hits the ground after $2.5\,s$, at what angle was it launched?

(a) 80.9°	(b) 71.9°	(c) 15.8°	(d) 4.88°	(e) Cannot be determined without knowing the cliff's height



KNOWN: $V_0 = 45 m/s$, $X_0 = 0$, $X = 35m$, $Y = 0$

$t = 2.5s$

UNKNOWN: $V_{0x}, V_{0y}, \alpha, Y_0$

$$X = X_0 + V_{0x}t \Rightarrow 35m = 0 + V_{0x}(2.5s) \Rightarrow V_{0x} = \frac{35m}{2.5s} = 14 m/s$$

$$V_{0x} = V_0 \cos\alpha \Rightarrow \cos\alpha = \frac{V_{0x}}{V_0} = \frac{14 m/s}{45 m/s} = 0.3111$$

$$\alpha = \cos^{-1}(0.3111) = 71.87°$$

(7.) A projectile is launched horizontally at $22.0\,m/s$ some distance above the ground. It hits the ground $1.50\,s$ later. With what speed did the projectile hit the ground?

(a) $0\,m/s$	(b) $14.7\,m/s$	(c) $22\,m/s$	$\boxed{\text{(d) } 26.5\,m/s}$	(e) $36.7\,m/s$

HORIZONTAL LAUNCH $\Rightarrow$

$V_{ox} = 22 m/s$

$V_{oy} = 0$

$t = 1.5 s$

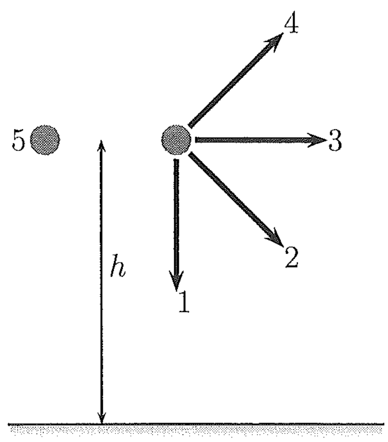
Speed $\Rightarrow V = \sqrt{V_x^2 + V_y^2}$

$V_x = V_{ox} = 22 m/s$

$V_y = V_{oy} - gt = 0 - 9.8 m/s^2 (1.5 s) = -14.7 m/s$

$V = \sqrt{(22 m/s)^2 + (14.7 m/s)^2} = 26.5 m/s$

(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 shortest to longest, 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.



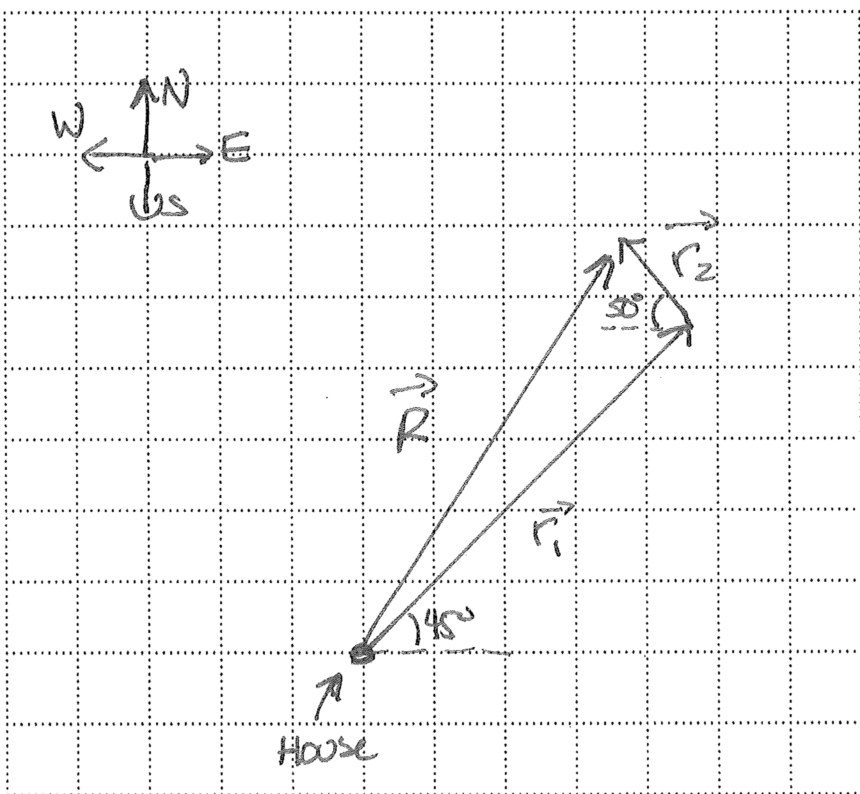
(a)	1, 2, 3, 4, 5
(b)	1, 2, 5, 3, 4
(c)	$\boxed{1,\ 2,\ 5,\ 3,\ 4}$
(d)	4, 3, 2, 5, 1
(e)	4, 3, 2, 5, 1

Time of Flight is determined by how long it takes projectile to go the Floor, i.e., $y = 0$. So the more distance in y, the longer the time of Flight. ~~$y = y_0 + V_{0y}t - \frac{1}{2}gt^2$ ⇒ V_{0y} determines time of Flight, V_{0y} is $V_0 \sin\theta$~~ 1 and 2 are thrown downwards ⇒ shorter times, ~~3 and 5 have~~ 1 is thrown straight down, so only y-velocity ⇒ reaches first. 3 and 5 both initially have no y-motion, so take an equal time which is longer than 2.

4 has upwards initial motion, so takes longest.

(9.) A man leaves his house and walks 60 m at 45° north of east. He then walks 15 m at 50° north of west.

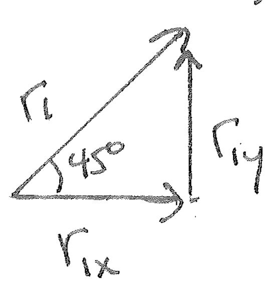
(a) On the grid below, sketch the man's displacement vectors at the proper locations for finding their vector sum graphically, as well as, the vector sum. Label the vectors as $\vec{r}_1$ and $\vec{r}_2$ (for the first and second motions respectively). Label the vector sum as $\vec{\mathbf{R}}$. *(5pts.)*



(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.)*

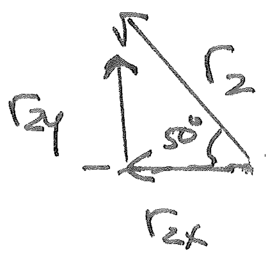
$\vec{R}$ points from house to final position, so we want $-\vec{R}$

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



$r_{1x} = r_1 \cos 45° = 60m \cos 45° = 42.43m$

$r_{1y} = r_1 \sin 45° = 60m \sin 45° = 42.43m$



r_{2x} to left $\Rightarrow r_{2x} = -r_2 \cos 50° = -15m \cos 50°$
$= -9.64m$

r_{2y} up $\Rightarrow r_{2y} = +r_2 \sin 50° = +15m \sin 50°$
$= 11.49m$

$R_x = 42.43m - 9.64m = 32.79m$

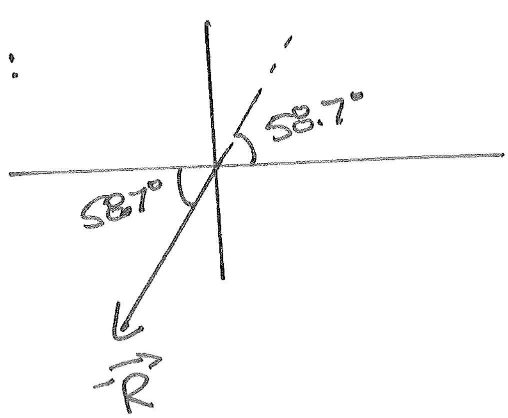
$R_y = 42.43m + 11.49m = 53.92m$

$R = \sqrt{R_x^2 + R_y^2} = \sqrt{(32.79m)^2 + (53.92m)^2} = 63.1m$

$\vec{R}$ has positive R_x AND R_y $\Rightarrow$ 1st QUAD $\Rightarrow$ Calculator OK

$\theta = \tan^{-1}\left(\frac{R_y}{R_x}\right) = \tan^{-1}\left(\frac{53.92}{32.79}\right) = 58.7°$

To get Home :



EITHER This picture,
OR standard Angle of
$180° + 58.7° = 238.7°$