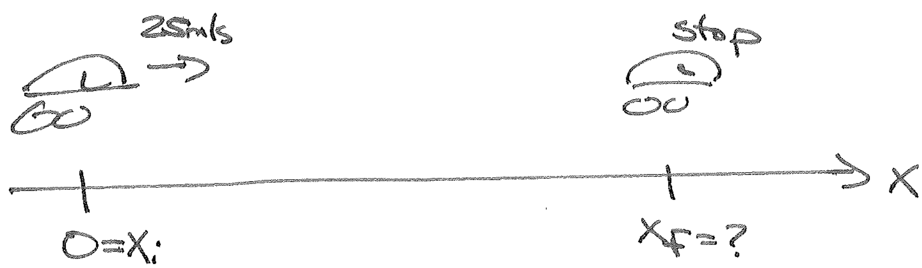
A Version

(1.) A car is traveling on a straight road with a speed of $25.0\,m/s$ when the driver hits the brakes causing a constant deceleration of $2.20\,m/s^2$. How far does the car go while stopping?

(a) $25.0\,m$	(b) $55.0\,m$	(c) $284\,m$	(d) $142\,m$ ✓	(e) $11.4\,m$



KNOWN: $(V_x)_i = 25\,m/s$

$(V_x)_f = 0$

$X_i = 0$

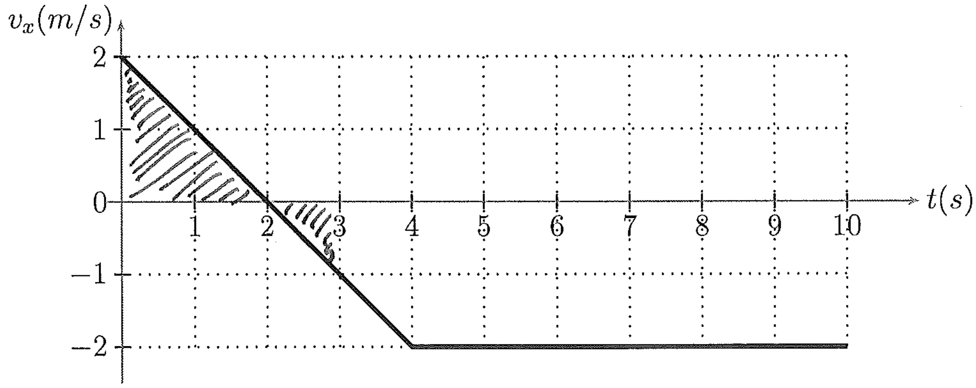
$a_x = -2.2\,m/s^2$

UNKNOWN: Δt, X_f

SINCE WE DON'T CARE ABOUT Δt: $(V_x)_f^2 = (V_x)_i^2 + 2a_x(X_f - X_i)$

$$\Rightarrow 0 = (25\,m/s)^2 + 2(-2.2\,m/s^2)(X_f - 0) \Rightarrow X_f = \frac{(25\,m/s)^2}{4.4\,m/s^2} = 142\,m$$

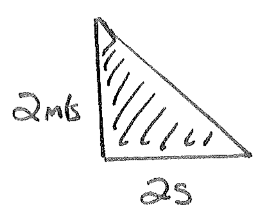
(2.) A train has the following velocity versus time graph. If the train starts at $x = 0$ at $t = 0$, what is the train's position after $3.0\,s$?



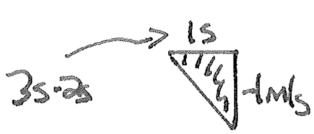
(a) $-1.5\,m$	(b) $1.5\,m$	(c) $0.5\,m$	(d) $-0.5\,m$	(e) $-1\,m$

ON V_x vs t graph ΔX = AREA FOR $t_i = 0$, $t_f = 3s$, $X_i = 0$ $X_f = ?$

$\Rightarrow \Delta X = X_f - 0 = X_f$



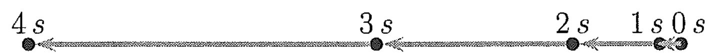
$\frac{1}{2}(2s)(2m/s) = 2m$



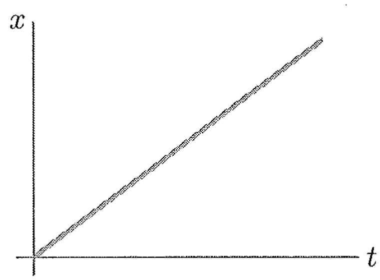
$\frac{1}{2}(1s)(-1m/s) = -.5m$

$\Rightarrow X_f = 2m - .5m = 1.5m$

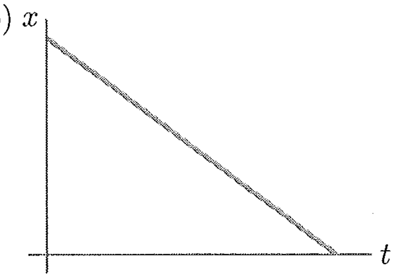
(3.) For the motion diagram shown, which of the following is the correct position-versus-time graph?



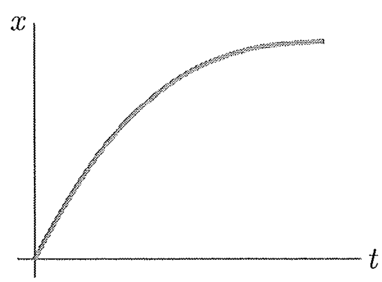
(a)



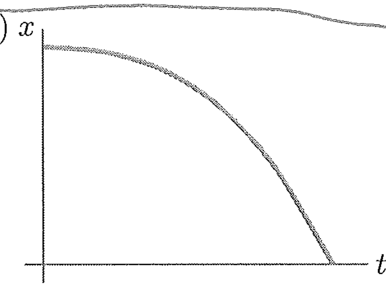
(b)



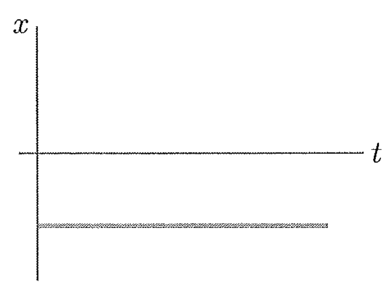
(c)



(d)



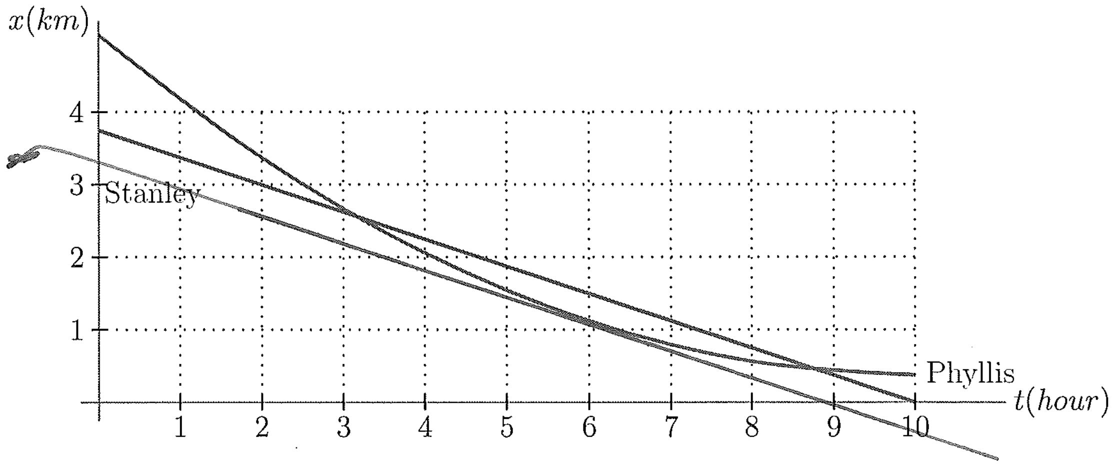
(e)



MOTION TO LEFT ⇒ DECREASING POSITION

INCREASING DISTANCE between dots ⇒ ACCELERATING ⇒ PARABOLA

(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?



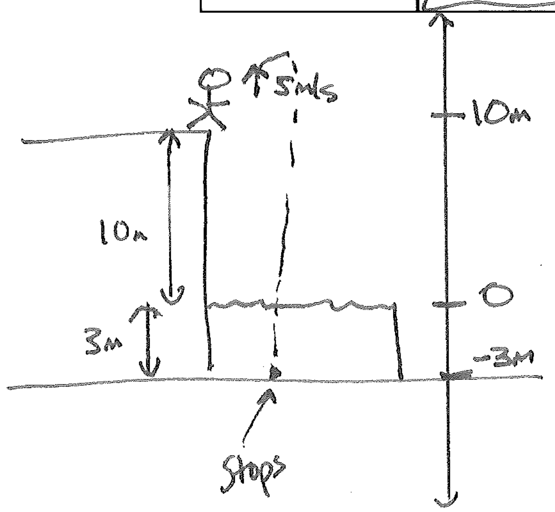
(a) 6 h	(b) 3 h	(c) 9 h	(d) Both 3 h and 9 h	(e) None are Correct

Slope gives V_x since this is x vs t.

at $t = 6h$ slope of phyllis's curve = slope of Stanley's line

(5.) An olympic diver is on a platform that is 10.0 m above a swimming pool that is 3.0 m deep. If she launches herself upwards with a speed of 5.0 m/s, what is the magnitude *AND DIRECTION* of the minimum acceleration needed to keep her from hitting the bottom of the pool? Use the standard convention that up is positive and ignore air resistance.

(a) $-37\,m/s^2$	(b) $37\,m/s^2$	(c) $-33\,m/s^2$	(d) $33\,m/s^2$	(e) $-9.8\,m/s^2$



FOR 1st MOTION:

KNOWN: $(V_y)_{i1} = 5\,m/s$, $y_i = 10\,m$, $y_f = 0$

$a_y = -9.8\,m/s^2$

UNKNOWN: $(V_y)_{f1}$, Δt_1

FOR 2ND MOTION: KNOWN: $y_i = 0$, $y_f = -3\,m$

$(V_y)_{f2} = 0$ (MIN. ACC. barely stops her)

UNKNOWN: $(V_y)_{i2}$, Δt_2, $a_2 = ?$

Also KNOW $(V_y)_{f1} = (V_y)_{i2}$

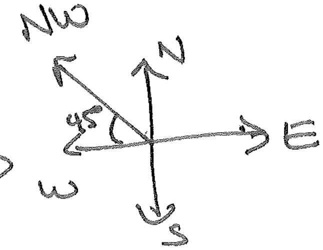
$$(V_y)_f^2 = (V_y)_i^2 + 2a_y(y_f - y_i) \xRightarrow{\text{1st motion}} (V_y)_{f1}^2 = (5\,m/s)^2 + 2(-9.8\,m/s^2)(0 - 10\,m) = 221\,m^2/s^2$$

$$\Rightarrow (V_y)_{f1} = \pm\sqrt{221\,m^2/s^2} = -14.866\,m/s \Leftarrow \text{choose Negative since going Downward}$$

$$(V_y)_f^2 = (V_{yi})^2 + 2a_y(y_f - y_i) \xRightarrow{\text{2ND Motion}} 0 = \left(\sqrt{221\,m^2/s^2}\right)^2 + 2a_2(-3\,m - 0) \Rightarrow 0 = 221\,m^2/s^2 - a_2(6\,m)$$

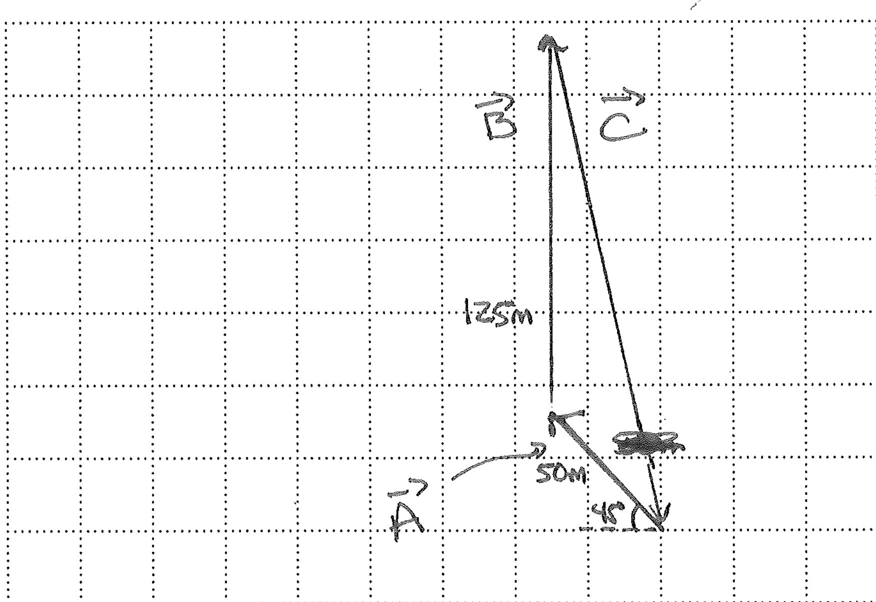
$$\Rightarrow a_2 = \frac{+221\,m^2/s^2}{6\,m} = +36.833\,m/s^2 = +37\,m/s^2 \Leftarrow$$

Correct Sign Since Negative Velocity AND Slowing Down $\Rightarrow$ Positive Acc.



(6.) A man leaves his house and walks $50\,m$ northwest. He then walks due north $125\,m$. Finally, he walks straight home. How far and at what standard angle did the man walk to get home? Please notice the included grid to help with your sketching.

(a) $164\,m$ at $-78°$	(b) $175\,m$ at $-78°$	(c) $164\,m$ at $102°$
(d) $175\,m$ at $102°$	(e) $164\,m$ at $-57°$	

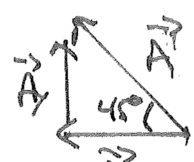


HERE $\vec{A}+\vec{B}+\vec{C}=0$

SINCE Returns Home

$\Rightarrow A_x + B_x + C_x = 0$

$A_y + B_y + C_y = 0$



$\vec{A}_x$ ⇝ to left

$\Rightarrow A_x = -50m\cos 45° = -35.4m$

$A_y = 50m\sin 45° = +35.4m$

Alternatively, use standard Angle

$\theta = 180° - 45° = 135°$, $A_x = 50m\cos 135° = -35.4m$, $A_y = 50m\sin 135° = 35.4m$

$B_x = 0$, $B_y = 125m$ $\Rightarrow$ $A_x + B_x + C_x = 0 \Rightarrow -35.4m + 0 + C_x = 0 \Rightarrow C_x = +35.4$

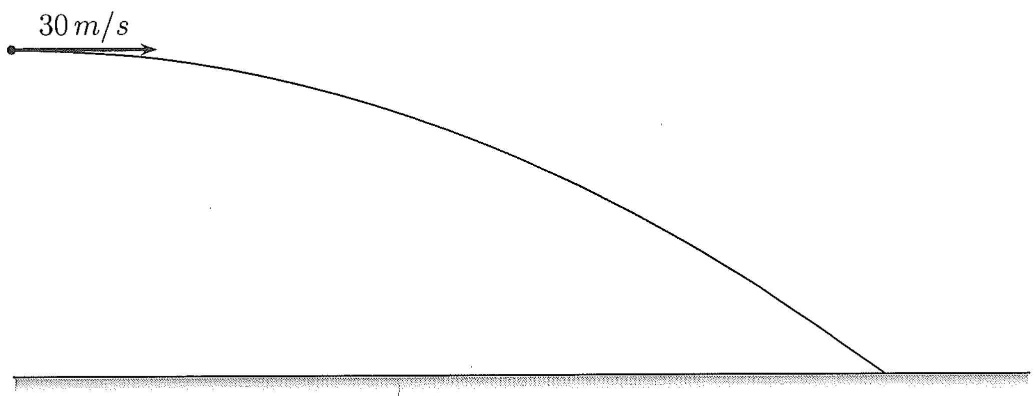
$A_y + B_y + C_y = 0 \Rightarrow 35.4m + 125m + C_y = 0 \Rightarrow C_y = -160.4m$ ← positive x Negative y ⇓ 4th QUAD.

$C = \sqrt{C_x^2 + C_y^2} = \sqrt{(35.4m)^2 + (160.4m)^2} = 164m$

4th QUAD ⇒ Calculator OK, $\theta = \tan^{-1}\left(\frac{C_y}{C_x}\right) = \tan^{-1}\left(\frac{-160.4}{35.4}\right) = -77.55° = -78°$

(7.) A projectile is launched horizontally at $30\,m/s$ and hits the ground $2.5\,s$ later. What direction is the projectile going when it hits the ground?

(a) $-9.8\,m/s^2$	(b) $-90°$	(c) $-22°$	(d) $-39°$	(e) $-77°$



Velocity gives DIRECTION OF MOTION!

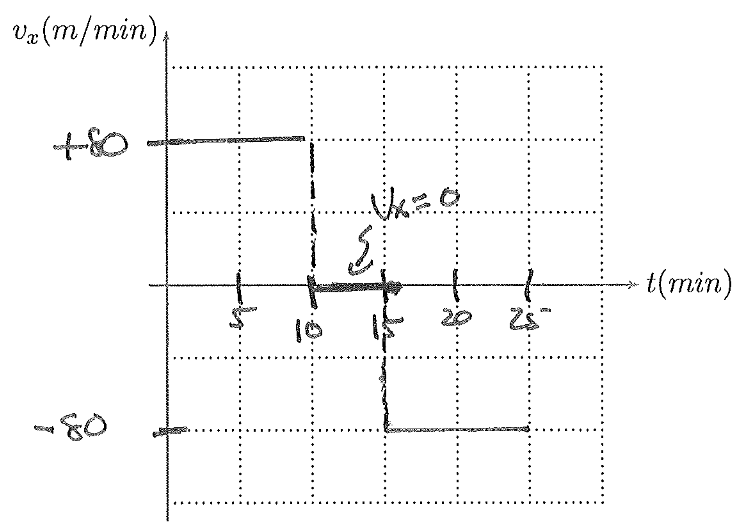
HORIZONTAL LAUNCH $\Rightarrow (V_x)_i = 30\,m/s,\ (V_y)_i = 0$

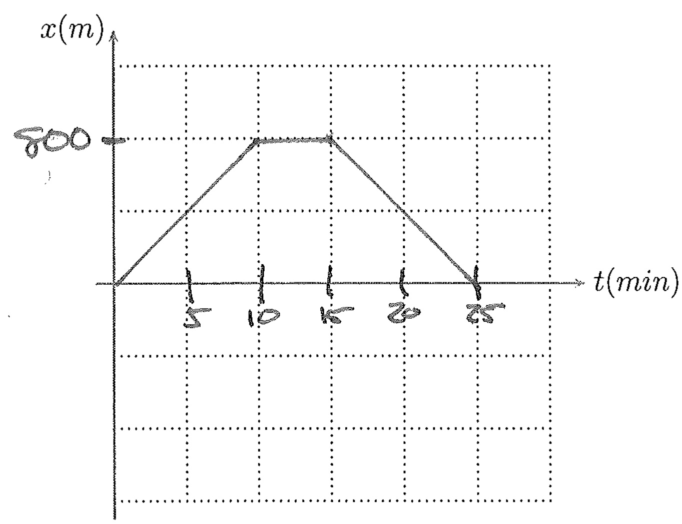
$(V_x)_F = (V_x)_i = 30\,m/s,\quad (V_y)_F = (V_y)_i - g\Delta t = 0 - (9.8\,m/s^2)(2.5\,s) = -24.5$

$$\theta = \tan^{-1}\left(\frac{(V_y)_F}{(V_x)_F}\right) = \tan^{-1}\left(\frac{-24.5}{30}\right) = -39.24° = -39°$$

(8.) One chilly morning a student leaves her house for school. She takes 10 min, walking at 80 m/min, to reach the bus stop. She waits 5 min for the bus. She gets cold and bored, so she decides to skip class and go home. She walks home in another 10 min.

In the region below, sketch the student's velocity-versus-time graph and her position-versus-time graph. Assume that all motion is along a straight street. For full points, your graphs must have the correct numerical values for position, velocity, and time. Please show all calculations in the region below the graphs. They must also have the correct shape. Please label whether you are attempting to draw a straight line, horizontal line, or parabola.





SHE WALKS with Constant 80m/min ⇒ HORIZONTAL line. SHE WAITS FOR 5MIN ⇒ $V_x = 0$.

Graph gives total time though ⇒ $V_x = 0$ for $t = 10$ min to $t = 15$ min.

SHE WALKS in opposite direction, it takes same elapsed time to go BACK same distance ⇒ $V_x = -80$ m/min FOR $t = 15$ min to $t = 25$ MIN

Constant $V_x = 80$ m/min ⇒ $V_x = \frac{\Delta x}{\Delta t}$ ⇒

$\Delta x = V_x \Delta t = (80\,m/min)(10\,min) = 800\,m$.

UNIFORM MOTION ⇒ STRAIGHT LINE for x vs. t.

$V_x = 0 \Rightarrow \Delta x = 0 \Rightarrow$ X stays at 800m for $t = 10$ min to 15 min.

WALKS home ⇒ $X = 0$ ~~After~~ at $t = 25$.

UNIFORM Motion ⇒ ANOTHER STRAIGHT line