CONCEPT: SOLVING SYMMETRICAL LAUNCH PROBLEMS

- If an object is launched *upwards*, v_{0y} is always **[POSITIVE | NEGATIVE]**
  - The maximum height or peak is *always* a point of interest, because $v_{(peak),y}$ = ___

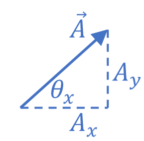
- If an object returns to the ________________ from which it was launched (___ = ___), its trajectory is **symmetrical.**
  - For symmetrical launches *ONLY*: ___ = ___ **&** ___ = ___ **&** ___ = ___ **&** ___ = ___

EXAMPLE**:** You kick a football at 20m/s angled 53° upward, and it later returns to the ground**.** Calculate **a)** the time the football takes to reach its max height**; b)** the total time of flight**; c)** the vertical component of the football's velocity when it returns to the ground**.**

PROJECTILE MOTION
1) Draw paths in X&Y and points of interest *(Points of Interest: initial, final, max height, etc.)*
2) Determine target variable
3) Determine interval and UAM equation
4) Solve

UAM EQUATIONS	
X	**Y**
$\Delta x = v_x t$	(1) $v_y = v_{0y} + a_y t$ (2) $v_y^2 = v_{0y}^2 + 2a_y\Delta y$ (3) $\Delta y = v_{0y}t + \frac{1}{2}a_y t^2$ *(4) $\Delta y = \frac{1}{2}(v_{0y} + v_f)t$

VECTOR EQs



$$A = \sqrt{A_x^2 + A_y^2}$$

$$\theta_x = \tan^{-1}\left(\frac{|A_y|}{|A_x|}\right)$$

$$A_x = A\cos(\theta_x)$$

$$A_y = A\sin(\theta_x)$$

PROBLEM: A flare gun launches signal flares with an initial speed of 110 m/s. How far does the flare travel if it is shot at ground level at an angle 65° above the horizontal?

A) 1890 m
B) 944 m
C) 507 m
D) 1040 m

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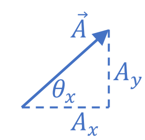

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PROBLEM: In a game of catch on a faraway planet, a ball is thrown with 10 m/s at 37° above the horizontal. It travels a horizontal distance of 32 m and lands on the ground. What is the magnitude of the gravitational acceleration on this planet?

A) 0.3 m/s²
B) 1.5 m/s²
C) 3 m/s²
D) 6 m/s²

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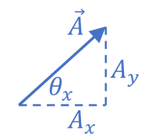

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