Q3- A ball is thrown into the air from ground level. After a time t = 1 s, the ball has traveled to a position x_1 = 28 m to the right of and y_1 = 11 m up from where it was thrown (at this time, the x and y components of the ball's velocity are still positive). The axes show the x and y directions to be considered positive

a) **What was the x component of the initial velocity of the ball?**
b) **What was the y component of the initial velocity of the ball?**
c) **What was the initial speed of the throw?**
d) **What was the initial angle of the throw relative to the horizontal?**
e) **What is the height of the ball at the top of its path?**

Answers:

a) What was the x component of the initial velocity of the ball?

As the x component of the velocity remains constant, it is given by

$V_{0x} * t = x_1$

Or $V_{0x} = x_1/t = 28/1 = 28$ m/s

$v_{0x} = 28$ m/s

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b) What was the y component of the initial velocity of the ball?

In vertical direction the ball is facing an downward acceleration of 9.8 m/s/s due to gravity hence the initial vertical velocity is given by

$[s = ut + (1/2)\, at^2]$

$Y_1 = v_{0y} * t + (1/2)(-9.8)t^2$

gives $11 = v_{0y} * 1 - 0.5 * 9.8 * 1$

or $v_{0y} = 11 + 4.9 = 15.9$ m/s

$v_{0y} = 15.9$ m/s

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c) What was the initial speed of the throw?

The initial speed is given by

$$V = \sqrt{v_{0x}^{\,2} + v_{0y}^{\,2}} = \sqrt{28^2 + 15.9^2} = 32.1995 \text{ m/s}$$

$v_0 = 32.1995$ m/s

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d) What was the initial angle of the throw relative to the horizontal? Please enter your answer in degrees.

The angle of projection is given by

Tan $\theta_0 = \frac{v_{0y}}{v_{0x}} = \frac{15.9}{28} = 0.5678$

Or $\theta_0 = 29.6^0$

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e) What is the height of the ball at the top of its path?

the maximum height is at the point when the vertical velocity is zero and this is given by the equation

$$v_y^2 = v_{0y}^2 + 2(-9.8)h$$

or $$0 = v_{0y}^2 + 2(-9.8)h_{\max}$$

or $$h_{\max} = \frac{v_{0y}^2}{19.6} = \frac{15.9^2}{19.6} = 12.898 \text{ m}$$

h_{max} = 12.9 m
