Section 2. Problem Solving
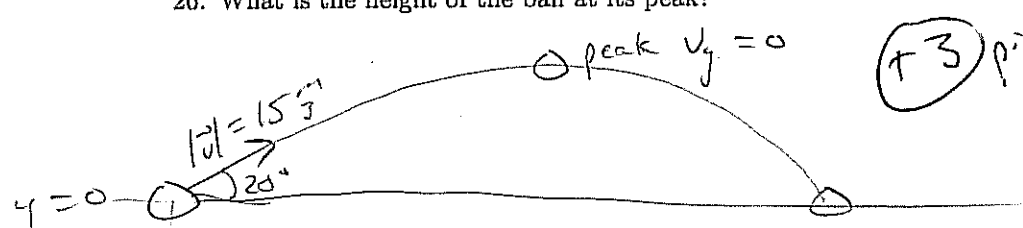
A soccer ball is kicked at an angle of 20° and an initial speed of 15 m/s. Answer the following questions about the motion of the ball.

26. What is the height of the ball at its peak?

(+3) picture   (+15)

$V_x = 15 \cos(20)$
$= 14.1 \frac{m}{s}$ (+3)

$V_{y_0} = 5.13 \frac{m}{s}$

at peak: $V_y = 0$
$y_0 = 0$ (+2)

$V_y^2 = V_{0y}^2 - 2g(y - y_0)$ (+4) eq.

$0 = (5.13)^2 - 2(9.8)(y - 0)$

$(5.13)^2 = 2(9.8)(y)$

$y = \frac{(5.13)^2}{2(9.8)} = \boxed{1.34 \, m}$ (+3) answer unit

27. How far horizontally does the ball travel between where it is kicked and where it hits the ground?

(+15)

(+3) picture

$X = X_0 + V_x t$

$X = 0 + 14.1 (1.05 s)$

$\boxed{X = 14.8 \, m}$

need t!

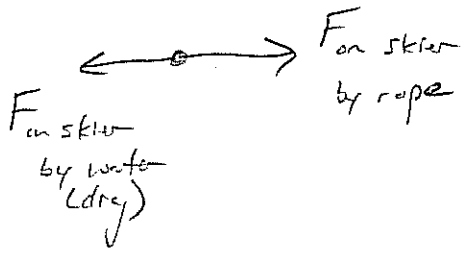$y_0 = 0$
$y = 0$
$V_{0y} = 5.13 \frac{m}{s}$ (+3)
$t = ?$

$y - y_0 = V_{0y} t - \frac{1}{2} g t^2$ (+2) Eq.

$0 = 5.13 t - \frac{1}{2}(9.8)t^2$

$4.9 t^2 = 5.13 t$

$t = \frac{5.13}{4.9} = 1.05 s$ (+2) time

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28. A 70-kg waterskier is being pulled by a ski rope. A horizontal resistive force by the water (i.e. drag) opposes the motion of the waterskier. When the rope pulls to the right with a force of 300 N, the skier speeds up from 9.00 m/s to 18 m/s in 20 s. What is the resistive force (i.e. drag) on the skier by the water?

$t = 0$
$V_{ox} = 9.0 \frac{m}{s}$

$t = 20 \ s$
$V_x = 18 \frac{m}{s}$

(+3) picture with knu
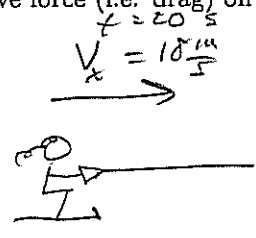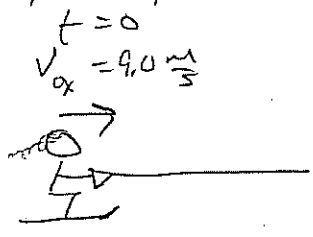
$F_{on \ skier \ by \ rope}$

$F_{on \ skier \ by \ water \ (drag)}$

(+3) force diagram

Newt. 2nd law: $\Sigma \vec{F} = m\vec{a}$ (+2) Newt. 2nd law

$F_{on \ skier \ by \ rope} - F_{on \ skier \ by \ water} = ma_x$ (+2) with forces

need a_x ; use $V_x = V_{ox} + a_x t$ (+5) accel.

$$a_x = \frac{V_x - V_{ox}}{t} = \frac{18 - 9}{20} = \frac{9 \frac{m}{s}}{20 \ s} = 0.45 \frac{m}{s^2}$$

$F_{on \ skier \ by \ water} = F_{on \ skier \ by \ rope} - ma_x$ (+3) solve for $F_{on \ skier \ by \ water}$

$$= 300 \ N - (70 \ kg)(0.45 \frac{m}{s^2})$$

$$= 300 \ N - 31.5 \ N$$

$$= 268.5 \ N$$

$$\approx \boxed{269 \ N}$$ (+2) ans + units

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