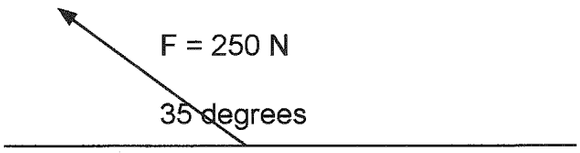
ICS 12

Ch 3 Worksheet

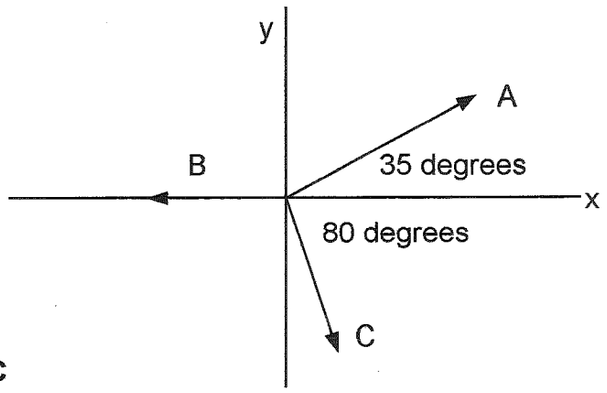
ANSWER ALL QUESTIONS ON FOOLSCAP, THEN STAPLE YOUR ANSWERS TO THIS QUESTION SHEET. REMEMBER TO SHOW ALL WORK (INCLUDING DIAGRAMS), AND BE CAREFUL WITH UNITS AND SIGNIFICANT DIGITS!!!

1. (a) What are the x and y components of the vector shown?



(b) Use analytical methods (ie, components) to find the resultant in the following case.

A: 100 N
B: 50 N
C: 70 N



Find: A + B - C

2. A girl slides down a ramp with uniform acceleration. She starts from rest and attains a speed of 3.5 m/s is 4.45 s. Find:
(a) Her acceleration
(b) The distance she moved in the first 4.45 s

3. Billy went for a ride in a hot air balloon at a fair. While the balloon was rising at a rate of 8.0 m/s and it was 150m above the ground, Billy accidentally dropped his camera.
(a) Find the maximum height that the camera reached.
(b) How long did it take for the camera to hit the ground?

4. The acceleration due to gravity on Mars is 4.0 m/s^2. If an astronaut on Mars were to toss a ball upwards with a speed of 10.0 m/s,
(a) How high would is go?
(b) What would be its velocity after 3.0 s?

5. How fast must a marble be rolled along an 80 cm high table so that when it rolls off the edge it will strike the floor at this same distance (80 cm) from the point directly below the table edge?

6. A water droplet is shot horizontally at 2.0 m/s from a hose. How far would it have dropped after traveling a horizontal distance of 1.00m?

7. A tennis ball was thrown off the roof of a 150m high building at an angle of 25 degrees above the horizontal, and with a speed of 30.0 m/s.
(a) How long before the ball hits the ground?
(b) How far from the building will the ball hit the ground?
(c) What will be the velocity of the ball when it hits the ground?

8. Robin Hood shoots an arrow downwards off the castle tower at an angle of 35 degrees to the horizontal. The speed of the arrow as it left the bow was 25 m/s. If the castle tower is 75.0 m high, and Prince John is 60.0 m from the base of the tower, will Prince John be hit by the arrow? Show all work!

9. A boat can travel at 10.0 m/s is still water. The rivers current is 4.0 m/s East and the river is 120 m wide.
(a) If the boat heads directly North, across the river, how long will it take to reach the opposite side of the river?
(b) How far is the boat pushed downstream by the time it reaches the opposite shore?
(c) If instead the boat is aimed upstream so that it goes directly across the river, what direction should the boat head?
(d) What is the resultant velocity for the situation in (c)?

10. An airplane can travel at 450 km/h in still air. A wind is blowing from the East with a speed of 80.0 km/h. What should the planes' heading be if it needs to go to a place that is in the direction 35.0 degrees east of south?

11. "Donna the Daredevil" is shot out of a canon at 45 degrees to the horizontal with an initial speed of 25.0 m/s. A net is located at a horizontal distance of 50.0 m from the cannon. At what height above the cannon should the net be placed in order to catch the Daring Donna?

1. (a) $F_x = -250N\cos 35° = -2.0\times10^2 N$ ½
$F_y = 250N\sin 35° = 1.4\times10^2 N$ ½ [2]

(b) $A_x = 100N\cos 35°$ $B_x = -50N$ $C_x = 70N\cos 80°$
$A_y = 100N\sin 35°$ $B_y = 0$ $C_y = -70N\sin 80°$

$A_x + B_x - C_x = 19.8N$ ✓
$A_y + B_y - C_y = 126N$ ✓

$R = \sqrt{R_x^2 + R_y^2} = 128N$

$\tan\theta = \frac{126}{19.8}$

$\theta = 81°$

R = 128N 81° above x axis [3]

2. $v_1 = 0.0m/s$
$v_2 = 3.5m/s$
$t = 4.45m/s$

(a) $a = \frac{v_2 - v_1}{t} = 0.79m/s^2$ [1]

(b) $\Delta d = \frac{1}{2}at^2 + v_1 t$
$\Delta d = 7.8m$ [1]

3. $v_1 = 8.0m/s$
$(\Delta d = -150m)$
$a = -9.8m/s^2$

(a) $v_2 = 0.0m/s$
$v_2^2 = 2a\Delta d + v_1^2$ ✓
$\Delta d = \frac{-v_1^2}{2a} = 3.26m$ [2]
height = $150m + \Delta d$ = 153m
(2 sf)

(b) $\Delta d = \frac{1}{2}at^2 + v_1 t$ ✓
$-150m = \frac{1}{2}(-9.8m/s^2)t^2 + 8.0m/s\, t$
$0 = -4.9t^2 + 8t + 150$ ✓ [2]

$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-8 \pm \sqrt{8^2 - 4(-4.9)(150)}}{2(-4.9)}$ ✓

$= \frac{-8 \pm 54.8}{-9.8} = 6.4s$

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$v_1 = 10.0\ m/s$
$a = -4.0\ m/s^2$

$v_2^2 = 2a\Delta d + v_1^2$

$\Delta d = \frac{-v_1^2}{2a} = 12.5\ m$

[2] $v_2 = 0$
$\Delta d = ?$

height = 13 m

(b) $v_2 = ?$
$t = 3.0\ s$

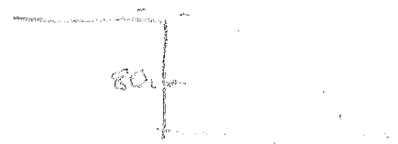
$a = \frac{v_2 - v_1}{t}$

$v_2 = at + v_1$
$= (4.0\ m/s^2)(3.0\ s) + 10.0\ m/s$

[2]

$v_2 = -2.0\ m/s$

5,



x
$\Delta d_x = 0.80\ m$
$v_x = v$
$t = ?$

y
$\Delta d_y = 0.80\ m$
$v_{1y} = 0.0\ m/s$
$a_y = 9.8\ m/s$
$t = ?$

[3]

$\Delta d_y = \frac{1}{2} a_y t^2 + v_{1y} t$

$t = \sqrt{\frac{2\Delta d_y}{a}} = \sqrt{\frac{2(0.80\ m)}{9.8\ m/s^2}} = 0.404\ s$

$v_x = \frac{0.80\ m}{0.404\ s} = \boxed{2.0\ m/s}$

6, →

[3]

x
$v_x = 2.0\ m/s$
$d_x = 1.00\ m$
$t = ?$

y
$v_{y1} = 0.0\ m/s$
$v_{y2} = ?$
$t = ?$
$\Delta d_y = ?$
$a_y = 9.8\ m/s^2$

$t = \frac{d_x}{v_x} = \frac{1.00\ m}{2.0\ m/s} = 0.50\ s$

$\Delta d_y = \frac{1}{2} a_y t^2 + v_{1y} t$
$= \frac{1}{2}(9.8\ m/s^2)(0.50\ s)^2$

$\Delta d_y = 1.2\ m$

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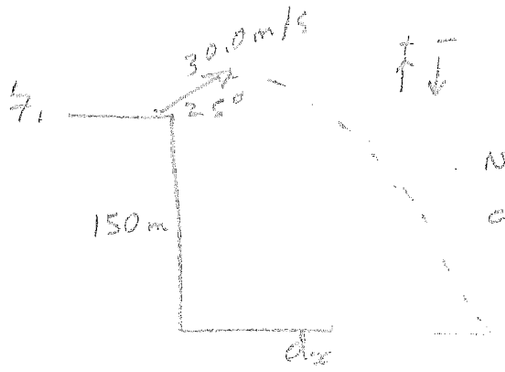


x: $v_{ix} = 30\,m/s \cos 25°$, $d_x = ?$, $t =$

y: $v_{iy} = 30.0\,m/s \sin 25°$, $a_y = -9.8\,m/s^2$, $\Delta d_y = -150\,m$, $t = ?$, $v_{fy} = ?$

(a) $\Delta d_y = \frac{1}{2} a_y t^2 + v_{iy} t$ ✓

$0 = \frac{1}{2}(-9.8) t^2 + (30 \sin 25°) t + 150\,m$

$0 = -4.9 t^2 + 12.7 t + 150$ ✓

[3] $t = \frac{-12.7 \pm \sqrt{12.7^2 - 4(-4.9)(150)}}{2(-4.9)} = \frac{-12.7 \pm 55.7}{-9.8}$

$\boxed{t = 7.0\,s}$ ✓ (6.9 s)

[1] (b) $d_x = v_x t = 1.9 \times 10^2\,m$ ✓

(c) $v_{fy} = a_y t + v_{iy}$

$= (-9.8\,m/s^2)(6.98\,s) + 30.0\,m/s \sin 25°$

$v_{fy} = -55.7\,m/s$

$v_x = 27.2\,m/s$ ✓

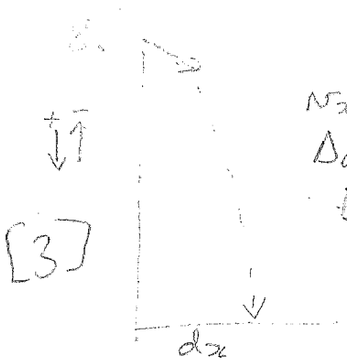
[3]

$v_f = \sqrt{v_{fy}^2 + v_x^2}$ ✓ $\tan\theta = \frac{55.7\,m/s}{27.2\,m/s}$

$= 62\,m/s$

$\theta = 64°$

$\therefore v_f = 62\,m/s$ [64° below horizontal]



x: $v_x = 25\,m/s \cos 35°$, $\Delta d_x = ?$, $t = ?$

y: $v_{iy} = 25\,m/s \sin 55°$, $a_y = 9.8\,m/s^2$, $\Delta d_y = 75.0\,m$, $t = ?$

[3] $\Delta d_y = \frac{1}{2} a_y t^2 + v_{iy} t$ ✓

$0 = \frac{1}{2}(9.8) t^2 + 25 \sin 35\, t - 75$ ✓

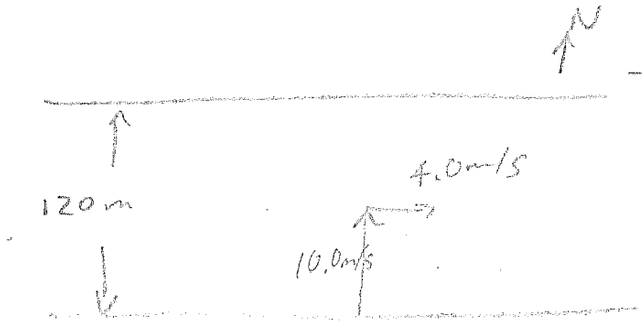
$t = \frac{-14.3 \pm \sqrt{205.6 - 4(4.9)(-75)}}{2(4.9)} = \frac{-14.3 \pm 40.9}{9.8}$ ✓

$t = 2.72\,s$ $\therefore d_x = v_x t = 56\,m$

No hit ✓

/10

9. (a)

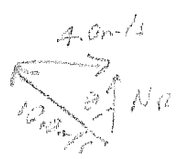


$$t = \frac{d_y}{N_y} = \frac{120\text{ m}}{10.0\text{ m/s}} = \boxed{12.0\text{ s}}$$ [2]

(b) $d_x = N_x t = (4.0\text{ m/s})(12.0\text{ s})$

$\boxed{d_x = 48\text{ m}}$ [2]

(c)



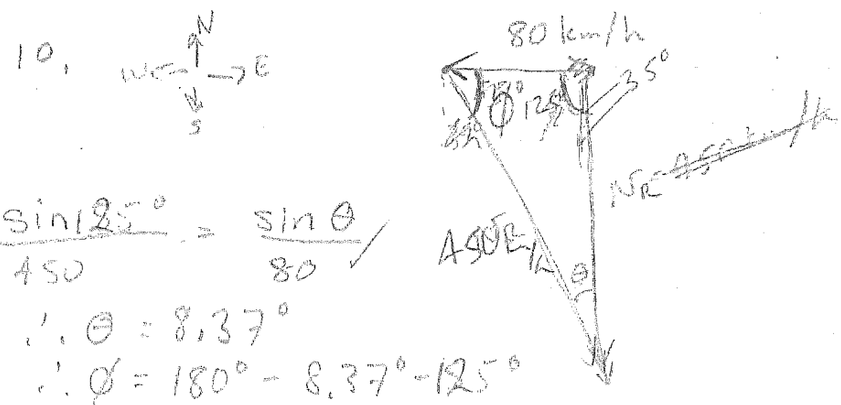
$\sin\theta = \frac{4.0}{10.0}$

$\therefore \boxed{\theta = 24^\circ \text{ W of N}}$ [2]

(d) $N_R = \sqrt{10.0\text{ m/s}^2 - 4.0\text{ m/s}^2}$

$N_R = 9.2\text{ m/s [N]}$ [2]

10.



$\frac{\sin 125^\circ}{450} = \frac{\sin\theta}{80}$ ✓

$\therefore \theta = 8.37^\circ$

$\therefore \phi = 180^\circ - 8.37^\circ - 125^\circ$

$= 46.6^\circ$

∴ Heading = 46.6° S of E or 43.4° E of S

[3]

11.

x	y
$N_{xo} = 25\cos 75^\circ$ m/s	$N_{oy} = 25\sin 15^\circ$
$d_x = 50.0$ m	$a_y = -9.8\text{ m/s}^2$
$t = ?$	$\Delta d_y = ?$
	$t =$

$t = \frac{d_x}{N_{xo}} = 2.83\text{ s}$ ✓

[3]

$\Delta d_y = \frac{1}{2} a_y t^2 + N_{oy} t$ ✓

$= \frac{1}{2}(-9.8)(2.83\text{ s})^2 + (25\sin 15^\circ)(2.83\text{ s})$

$\Delta d_y = 10.8\text{ m}$ ✓

∴ net should be 11 m above ground ✓

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