Name: _____

Kinematics Review

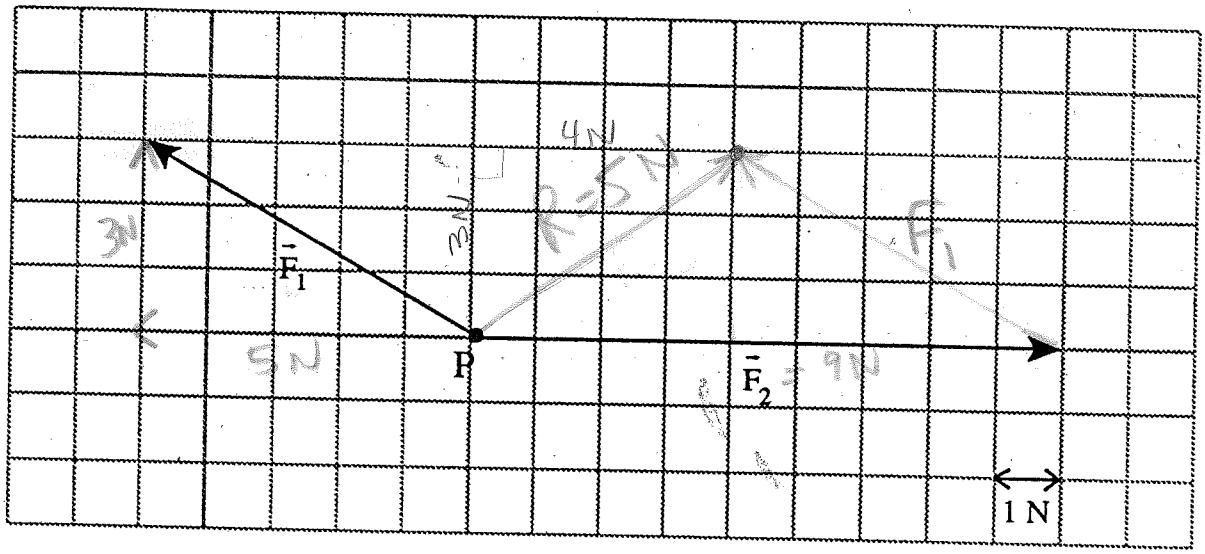
1. Which one of the following **best** describes the motion of a projectile close to the surface of the Earth? (assume no friction)

	VERTICAL ACCELERATION	HORIZONTAL SPEED
A.	constant	constant
B.	constant	changing
C.	changing	constant
D.	changing	changing

2. Which one of the following contains two vector quantities?

A. Mass, velocity
B. Time, momentum
C. Force, acceleration
D. Speed, displacement

3. The diagram below shows two force vectors $\vec{F}_1$ and $\vec{F}_2$ acting on an object at point P.

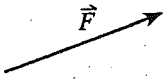


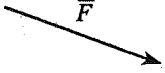
What is the magnitude of the resultant force?

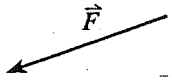
A. 3.0 N
B. 5.0 N
C. 7.0 N
D. 14.3 N

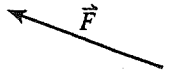
4. The diagram shows the vertical and horizontal components of a force, $\vec{F}_V$ and $\vec{F}_H$.

Which of the following is their resultant force $\vec{F}$?

A. 

B. 

C. 

D. 

5. A ball is kicked into the air from the surface of a playing field. If friction is negligible, the ball will follow a path that is

A. circular.
B. elliptical.
C. parabolic.
D. hyperbolic.

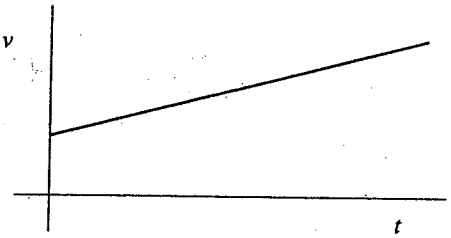
6. A rock is thrown from ground level at 18 m/s, 25° above horizontal. What are the vertical and horizontal components of its launch velocity?

	VERTICAL COMPONENT	HORIZONTAL COMPONENT
A.	16 m/s	7.6 m/s
B.	7.6 m/s	16 m/s
C.	20 m/s	9.3 m/s
D.	9.3 m/s	20 m/s

$V_v = 18 \sin 25 = 7.6$

$V_h = 18 \cos 25 = 16.3$

7. The graph shown below displays velocity v versus time t for a moving object.



The slope of this graph represents the object's

A. mass.
B. momentum.
C. acceleration.
D. displacement.

$\frac{\text{rise}}{\text{run}} = \frac{\Delta v}{\Delta t} = a$

8. A ball is thrown from level ground at 24 m/s, 30° above horizontal. How much time will it take to reach its maximum height?

A. 1.2s B. 2.1s C. 2.4s D. 7.3s

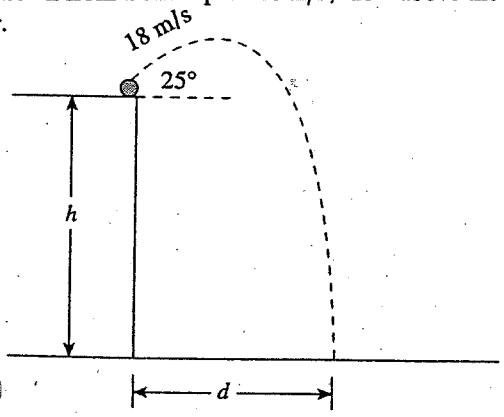
$V_{v_0} = 24 \sin 30°$, $t = ?$, $V_f = 0$, $a = -9.8 m/s^2$

9. A motorcycle accelerates uniformly from 12 m/s to 30 m/s while travelling 420 m. Its acceleration is

A. $0.043 m/s^2$ B. $0.050 m/s^2$ C. $0.10 m/s^2$ D. $0.90 m/s^2$

$V_f^2 = V_0^2 + 2ad$, $a = \frac{V_f^2 - V_0^2}{2d}$

10. A rock is thrown from a clifftop at 18 m/s, 25° above the horizontal. It lands on the beach 4.2 s later.



a) What is the height h of the cliff? **(4 marks)**

b) How far from the base of the cliff d did the rock land? **(3 marks)**

(range) use horizontal $V_h = 16.31 m/s$

$d = vt$
$= (16.31 m/s)(4.2 s)$
$= 69 m$

$V_{v_0} = 18 \sin 25 = 7.6 m/s$

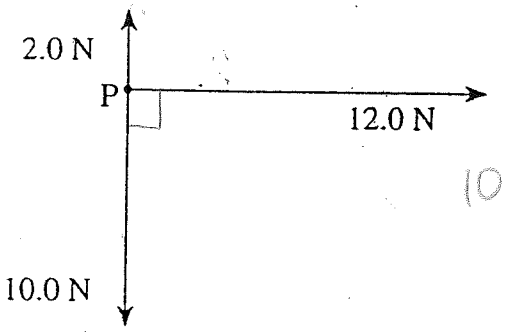
$V_h = 18 \cos 25 = 16.3 m/s$

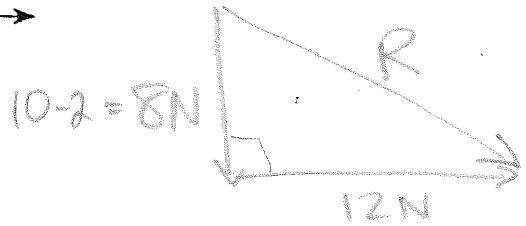
use vertical

a) $h = ?$, $t = 4.2$, $V_{v_0} = 7.61 m/s$, $a = -9.8 m/s^2$

$d = v_0 t + \frac{1}{2} a t^2$
$= (7.61 m/s)(4.2 s) + \frac{1}{2}(-9.8)(4.2)^2$
$= -54 m$

11. Three forces act at point P at the same time, as shown on the force vector diagram below.





What is the magnitude of the resultant force vector?

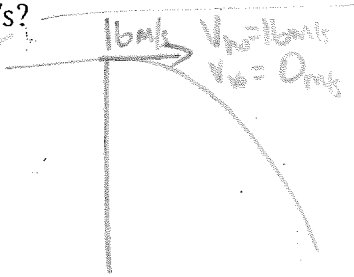
$8^2 + 12^2 = R^2$

$R = 14.4\,N$

(A.) 14.4 N
B. 17.0 N
C. 20.0 N
D. 24.0 N

12. A ball is rolled off a horizontal roof at 16 m/s. After leaving the roof, how long will the ball take to reach a speed of 18 m/s?

$V_h + V_y = \vec{V}$



$t = ?$
$a = -9.8\,m/s^2$
$V_{fy} = -8.246\,m/s$
$V_{oy} = 0\,m/s$

$t = \frac{V_f - V_o}{a} = 0.84\,s$

A. 0.20 s
(B.) 0.84 s
C. 1.8 s
D. 2.5 s

13. A projectile is fired with an initial velocity of 80 m/s at an angle of 37° above the horizontal. If air resistance is negligible, how much time elapses before the projectile reaches its maximum height?

$V_{yo} = 80\sin 37°$
$= 48.145\,m/s$

$t = ?$
$a = -9.8\,m/s$
$V_{yo} = 48.145\,m/s$
$V_{yf} = 0$

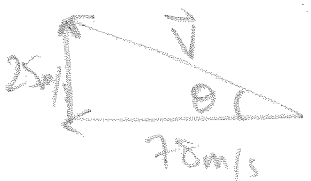
$V_f = V_o + at$ at $V_{yf} = 0$
$t = \frac{V_f - V_o}{a}$
$= 4.9\,s$

(A.) 4.9 s
B. 6.5 s
C. 8.2 s
D. 16 s

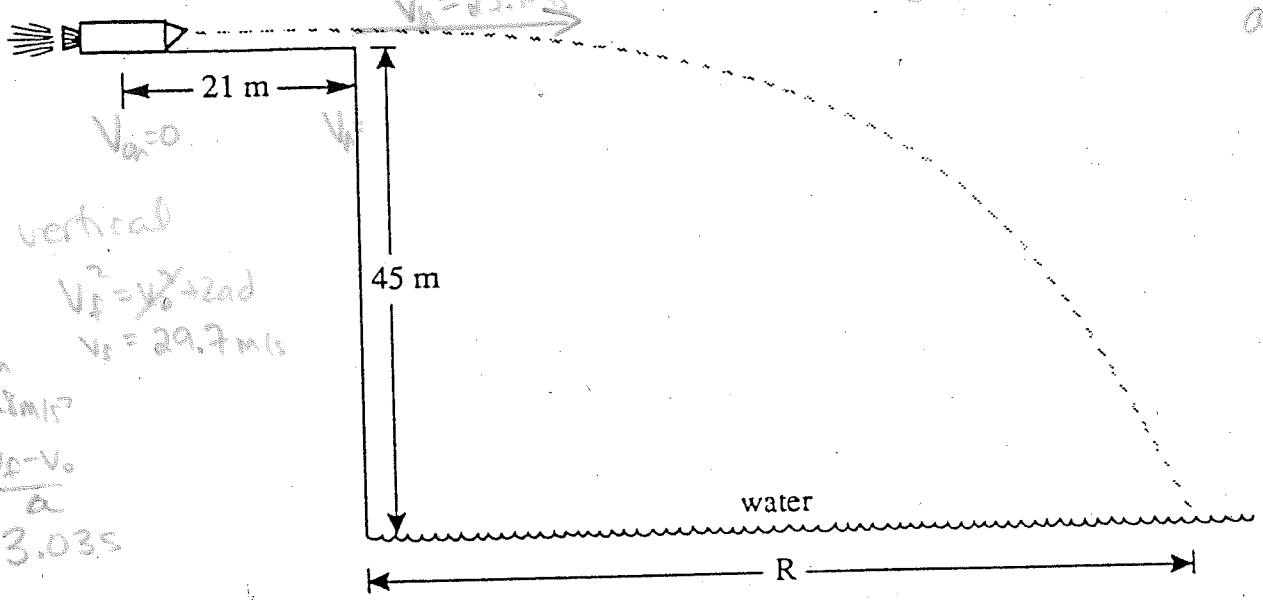
14. An airplane heads due west with an airspeed of 78 m/s. The wind is blowing due north at 25 m/s. What is the speed of the airplane relative to the ground?

pythag.

A. 53 m/s
B. 78 m/s
(C.) 82 m/s
D. 103 m/s



15. A rocket accelerates at 15 m/s^2 from rest for 21 m on a frictionless horizontal surface. The rocket stops firing at the cliff and falls freely from a height of 45 m.



If air resistance is not significant, what is the distance R when the rocket hits the water? (Range) **(7 marks)**

16. On a football field, Joe Speedy carries the ball for 8.0 m toward the **east**, then makes a right turn and proceeds 10.0 m directly **south**, then he is stopped by a tackle. What is Joe's resultant displacement? (*Your answer must include a neatly drawn vector diagram.*)

17. An aircraft has a velocity of 951 km/h, in a direction 30° **west of north**. What is the **west component** of the aircraft's velocity? (*Include a neatly drawn vector diagram.*)

18. Which one of the following is a **scalar** quantity?

A. force B. mass C. momentum D. velocity

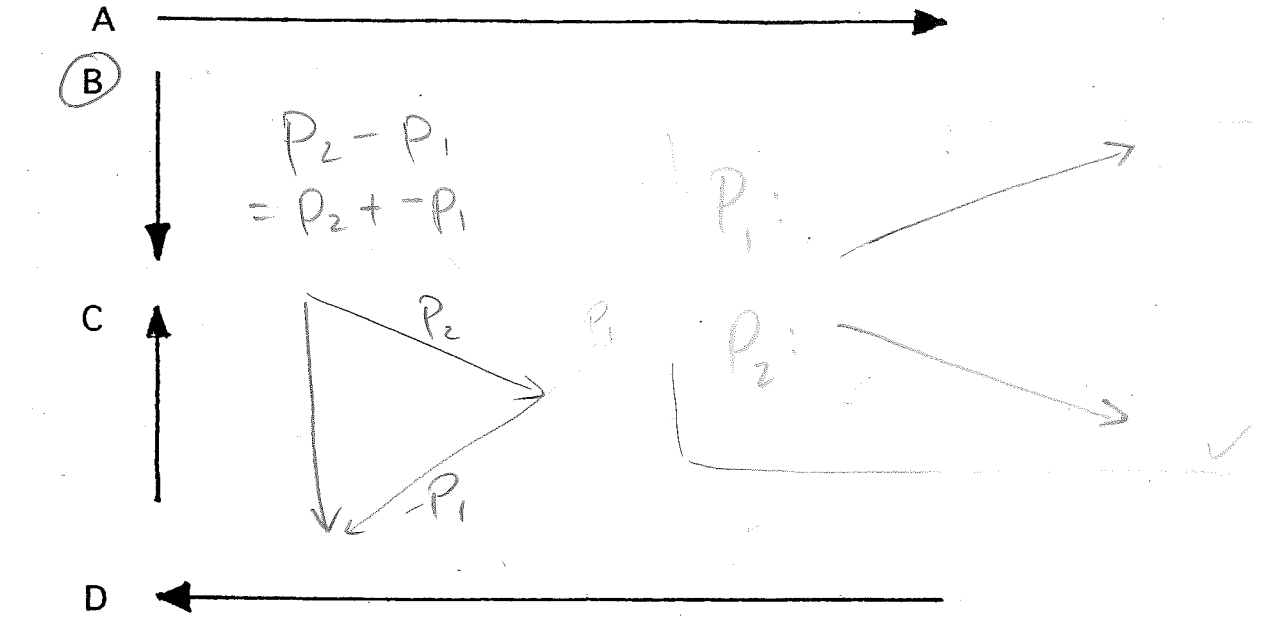
19. A golfer walks 120.0 m north, then 50.0 m east. What is the *magnitude* of the resultant displacement of the golfer?

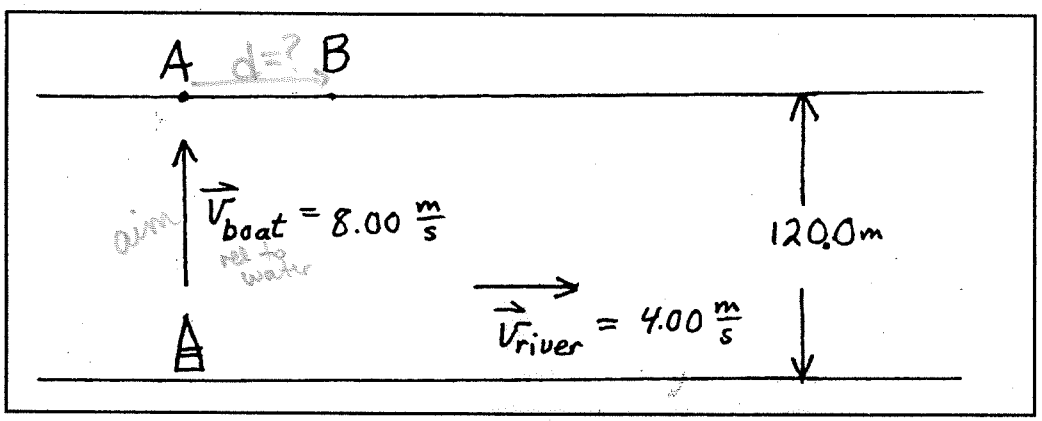
A. 70.0 m B. 130.0 m C. 170.0 m D. 109.0 m

20. Two aircraft approach each other 'head-on'. Plane A is moving with a velocity of 600.0 km/h relative to the ground. Plane B is moving with a velocity of 500.0 km/h relative to the ground. What is the velocity of plane A *relative to plane B?*

A. 500.0 km/h B. 600.0 km/h C. 100.0 km/h D. 1100.0 km/h

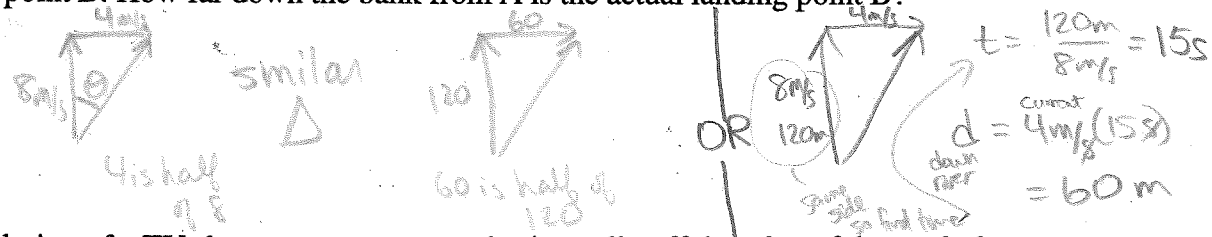
21. What is the vector *difference* between p_1 and p_2 ?



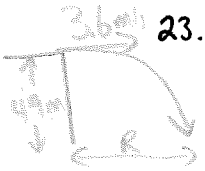


22. A motorboat starts from one side of the river, and aims directly across the river to point A. The velocity of the boat relative to the water is 8.00 m/s. The velocity of the river is 4.00 m/s, in a direction to the right on the diagram. The distance across the river is 120.0 m. The boat ends up landing at point B. How far down the bank from A is the actual landing point B?

A. 60.0 m
B. 120 m
C. 134 m
D. 268 m



23. During the filming of a TV show, a stuntman runs horizontally off the edge of the roof of a building 49 m high, with a horizontal velocity of 3.6 m/s.

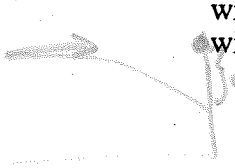


(a) For how many seconds will the falling stuntman be in the air?

(b) How far out from the edge of the building should the safety air bag be placed so he can fall without being hurt?

$V_{oy} = 0$
$t = ?$
$a = -9.8\,m/s^2$
$d = -49m$
$V_f = \sqrt{V_{oy}^2 + 2ad} = -30.99$
$t = \frac{V_f - V_o}{a} = 3.2s$
$R = V_x t = 3.6\,m/s(3.2s) = 11.4s$

24. A target is 5.2 m in front of you, and you aim a snowball at it, along a horizontal line, parallel with the ground. By what vertical distance will you miss the target, if you throw the snowball with a horizontal speed of 15 m/s?



t from horizontal
$t = \frac{d}{V_x} = \frac{5.2m}{15m/s} = 0.347s$

$d = ?$
$a = -9.8m/s^2$
$V_{yo} = 0$
$t = .347s$
$d = V_y t + \frac{1}{2}at^2$
$= \frac{1}{2}(-9.8)(0.347s)^2$
$= -0.59m$

25. Snoopy is flying his WWI rescue plane at an altitude of 566 m and with a horizontal velocity of 50.0 m/s. He sees his stranded comrades on the ground ahead of him, huddled around a fire hydrant. He wants to drop an emergency kit bag containing the essentials of survival (Puppy Chow, flea collars, and a physics book), so that it lands directly where they are sitting. Calculate at what horizontal distance from his comrades he must drop the package, so that it lands 'on target'. Assume no friction. (Also assume no fiction.)

26. A baseball fielder can throw a ball with a speed of 35.0 m/s. On a level field, he throws the ball at an angle of 40.0^0 with the horizontal.

(a) What is the vertical component of the ball's velocity?
(b) For how many seconds will the ball be in the air?
(c) To what altitude will the ball rise?
(d) What is the horizontal component of the ball's velocity?
(e) How far will the ball travel horizontally before it is caught at the same level?

27. A crow flying with a horizontal velocity of 12 m/s drops a walnut from its beak onto the Coquihalla Highway below the crow. If the road is 160 m below the crow, how far will the crow fly in a horizontal direction before the walnut hits the road below it?

28. A projectile is launched with a velocity of 13.2 m/s, at an angle of 37.0^0 above the horizontal. At the highest point in its trajectory, what will be its (a) vertical velocity? (b) horizontal velocity? (c) resultant velocity?

29. A BMX rider with a death wish wants to clear a creek 2.45 m wide, by leaving a 45.0^0 ramp on one side of the creek, and landing on another ramp at the same horizontal level, on the other side of the creek. What is the initial speed the rider will need to have to accomplish this?

30. **Experimental Techniques**

A skier is travelling down a slope, with uniform acceleration. Her displacement was measured at various times, and the following data was gathered:

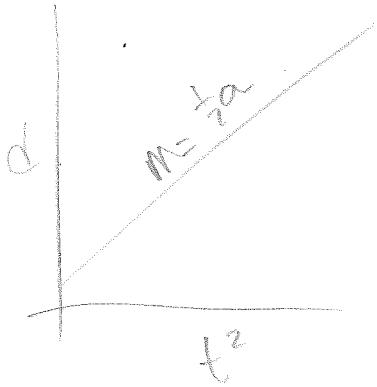
Displacement (m)	**0.18**	**0.72**	**1.62**	**2.88**	**4.50**
Time (s)	**0.30**	**0.60**	**0.90**	**1.20**	**1.50**
Velocity (m/s)	0.60	1.20	1.80	2.40	3.00

(a) Plot a properly labelled, **straight line graph** showing the nature of the relationship between displacement and time. The **independent variable** must be on the X-axis, and the **dependent variable** on the Y-axis.

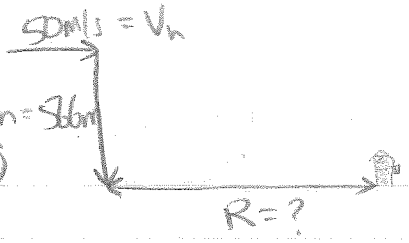
(b) Calculate the **slope** of your straight-line graph, and express it in proper measuring units.

(c) Write an equation that describes *your* graph specifically.

(d) Use your slope to calculate the **acceleration** of the skier. (Caution. *Think!*)



(25)



Vertical to get time

$t = ?$
$V_0 = 0$
$d = 566\,m$
$a = -9.8\,m/s^2$

$V_f^2 = V_0^2 + 2ad$

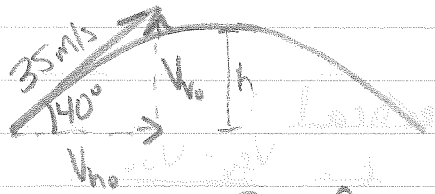
$V_f = \sqrt{2ad}$
$= -105.326\,m/s$

$t = \frac{V_f - V_0}{a} = 10.748\,s$

from horizontal get range:

$R = V_h t$
$= 50\,m/s \cdot 10.748$
$= \underline{537\,m}$ ✓

(26)



a) $V_{v_0} = 35 \sin 40° = 22.498\,m/s$
$= \underline{22.5\,m/s}$

b) t in air $= ?$ from vertical

$t = ?$
$V_{v_0} = 22.498\,m/s$
$V_{fv} = -22.498\,m/s$
$a = -9.8\,m/s^2$

$t = \frac{V_{fv} - V_{v_0}}{a} = \frac{-22.498 - 22.498}{-9.8} = 4.5914\,s$
$= \underline{4.59\,s}$

c) altitude reached $h = ?$

$V_{fv} = 0\,m/s$
$V_{0v} = 22.498\,m/s$
$a = -9.8\,m/s^2$

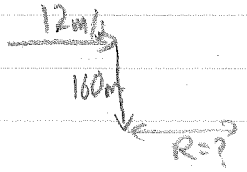
$V_f^2 = V_0^2 + 2ad$

$d = \frac{V_f^2 - V_0^2}{2a} = \frac{0^2 - (22.498)^2}{2(-9.8)} = \underline{25.8\,m}$ ✓

d) $V_h = 35 \cos 40° = 26.812\,m/s$ $= \underline{26.8\,m/s}$

e) $R = V_h t = (26.812)4.5914 = \underline{123\,m}$

(27)

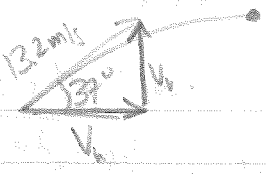


$t = ?$
$V_0 = 0$
$d = -160\,m$
$a = -9.8\,m/s^2$

$V_f^2 = V_0^2 + 2ad$
$V_f = \sqrt{2ad} = 56\,m/s$

$t = \frac{V_f - V_0}{a}$
$= 5.714\,s$

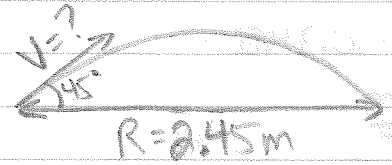
$R = V_h t = 12\,m/s \times 5.714\,s$
$= 68.568\,m$
$= \underline{69\,m}$ ✓

(28) 

$V_v = 13.2\,m/s \sin 37° = 7.944\,m/s$
$V_h = 13.2 \cos 37° = 10.542\,m/s$

at highest point:

a) $V_v = 0$
b) $V_h = 10.5\,m/s$
c) $V = V_h + V_v = 10.5\,m/s$ horizontal ✓

(29) 

$V_h = V\cos 45°$
$V_v = V\sin 45°$

horizontal:
$V_h = \frac{R}{t}$

$V\cos 45 = \frac{2.45m}{t}$

Vertical:
$t = \frac{V_{fv} - V_{ov}}{a}$

$t = \frac{-V\sin 45° - V\sin 45°}{-9.8\,m/s^2}$

$t = + \frac{2V\sin 45°}{+9.8\,m/s^2}$

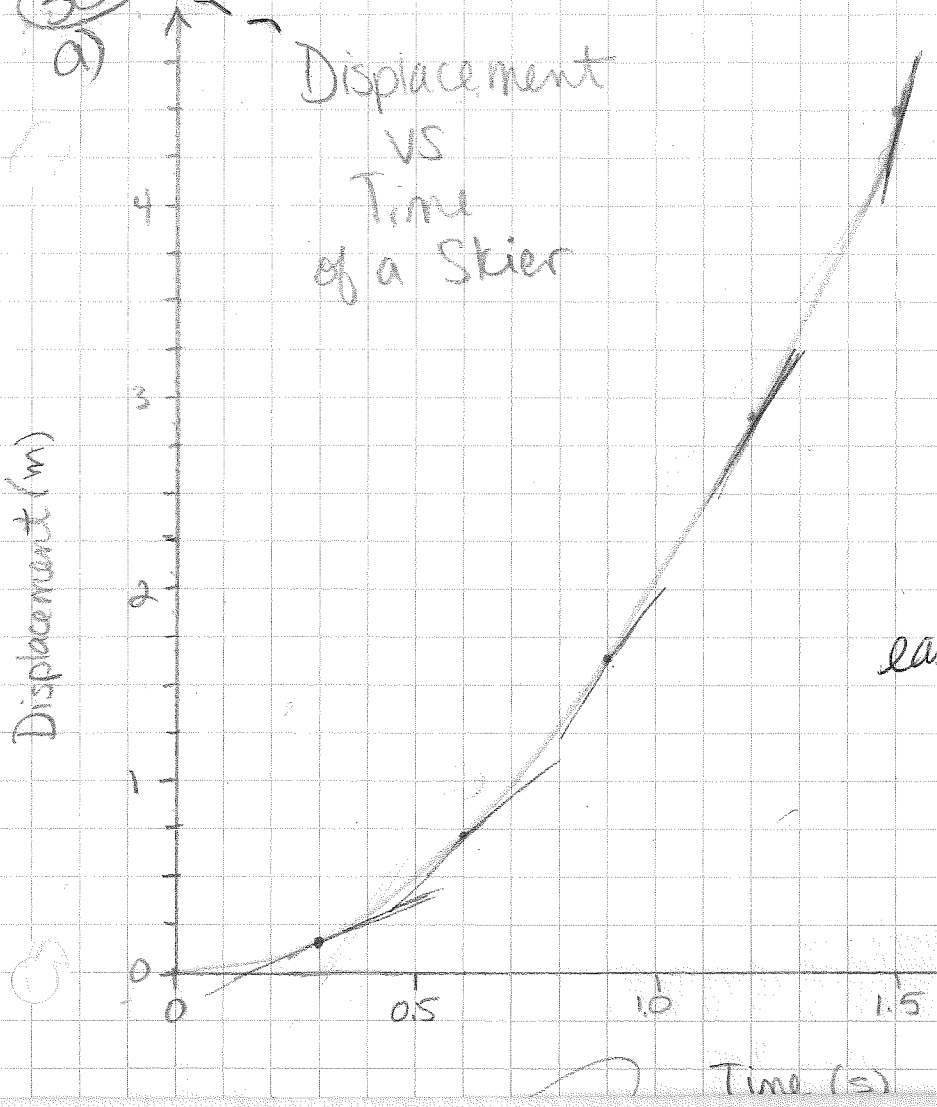
$V\cos 45 = \frac{2.45m}{2V\sin 45°} \times 9.8\,m/s^2$

$V^2 = \frac{2.45 \times 9.8}{2 \sin 45 \cos 45}$ ✓

$V = 4.90\,m/s$ 45° from horizontal

(30)

a)

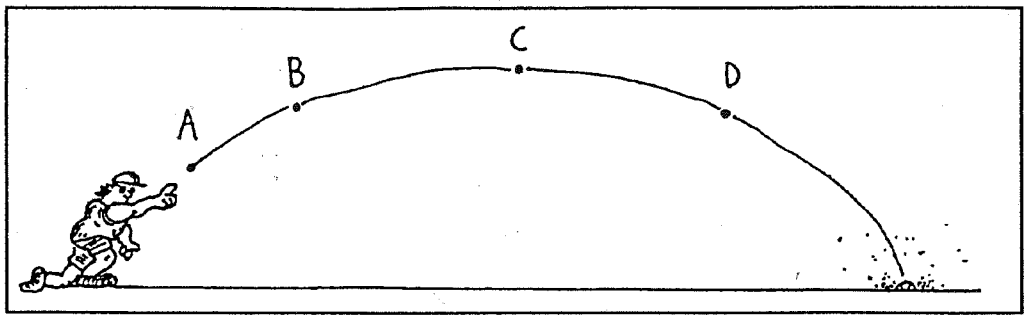


- need $v_{instant}$ vs t to get $m = a$
- $v_{instant}$ you get by taking slopes of tangents of this graph

(01)

easier need a d vs t^2 graph to get straight line w/ uniform accel situation

then $d = \cancel{v_0 t} + \underbrace{\frac{1}{2}a}_{m} t^2$



A ball is thrown into the air, and takes the path shown in the above figure. At **A**, the ball has just left the person's hand. The speed of the ball is v, its horizontal velocity is v_x, its vertical velocity is v_y, and its acceleration is a.

31. When the ball is at **C**, which statement is true?

A. $v = 0$
B. $v_x = 0$
C. $v_y = 0$
D. $a = 0$

32. Which statement describes the acceleration of the ball accurately?

A. $a = g$ only at **A.**
B. $a = 0$ only at **C.**
C. $a = g$ at **A, B, C,** or **D.**
D. $a = g$ everywhere except at **C.**

A golf ball is thrown horizontally off the top of a very high cliff, at a speed of 12 m/s, by a golfer who is angry because he missed a short putt on the previous hole.

33. After a time interval of 2.0 s has elapsed, what will the horizontal velocity of the golf ball be?

A. 12 m/s B. 0 m/s C. 20 m/s D. 32 m/s

34. After a time interval of 2.0 s has elapsed, what is the vertical velocity of the golf ball?

A. 12 m/s B. 0 m/s C. 20 m/s D. 32 m/s

35. After a time interval of 2.0 s has elapsed, how far has the ball travelled horizontally?

A. 24 m B. 40 m C. 64 m D. 12 m

A projectile is launched with a speed of 64 m/s, at an angle of 60^0 to the horizontal.

36. After 2.0 s, what is the vertical component of the projectile's velocity?

A. 64 m/s B. 55 m/s C. 36 m/s D. 32 m/s E. 12 m/s

37. After 2.0 s, what is the speed of the projectile?

A. 32 m/s B. 48 m/s C. 64 m/s D. 34 m/s E. 45 m/s