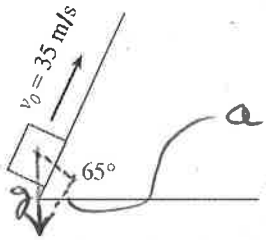
KEY

1. An object is fired up a frictionless ramp as shown in the diagram.
If the initial velocity is 35 m/s, how long does the object take to return to the starting point?

A. 3.6 s
B. 3.9 s
C. 7.9 s
D. 17 s



$a = g \sin 65^\circ$
$= 9.8 \sin 65^\circ$
$= 8.88$

$v_0 = 35$, $v = -35$, $a = -8.88$, $d = 0$, $t = ?$

$t = \frac{v - v_0}{a}$
$= \frac{-35 - 35}{-8.88}$
$= 7.9$ s

2. In landing, a jet plane decelerates uniformly and comes to a stop in 38 s, covering a distance of 1 500 m along the runway. What was the jet's landing speed when it first touched the runway?

A. 2.1 m/s
B. 39 m/s
C. 79 m/s
D. 170 m/s

$\bar{v} = \frac{1500 \text{ m}}{38 \text{ s}} = \frac{v + v_0}{2}$

$\therefore v_0 = \frac{2(1500)}{38} = 79 \frac{\text{m}}{\text{s}}$

3. A 35 kg object released from rest near the surface of a planet falls 7.3 m in 1.5 s. What is the acceleration due to gravity on this planet?

A. 4.9 m/s^2
B. 6.5 m/s^2
C. 9.7 m/s^2
D. 170 m/s^2

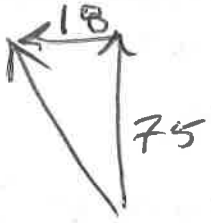
$v_0 = 0$, $t = 1.5$, $d = 7.3$, $a = ?$

$d = v_0 t + \frac{1}{2} a t^2$

$a = \frac{2d}{t^2} = \frac{2(7.3)}{1.5^2} = 6.5 \frac{\text{m}}{\text{s}^2}$

4. An airplane heads due north with an airspeed of 75 m/s. The wind is blowing due west at 18 m/s. What is the airplane's speed relative to the ground?

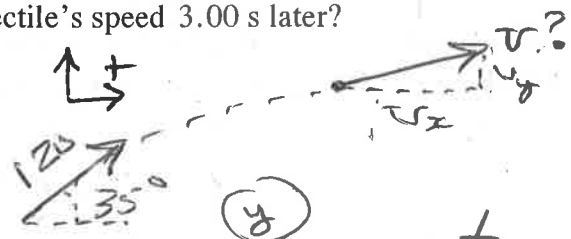
A. 57 m/s
B. 73 m/s
C. 77 m/s
D. 93 m/s



$\sqrt{75^2 + 18^2} = 77 \frac{\text{m}}{\text{s}}$

5. A projectile is launched at 35.0° above the horizontal with an initial velocity of 120 m/s.
What is the projectile's speed 3.00 s later?

A. 68.8 m/s
B. 98.3 m/s
C. 106 m/s
D. 120 m/s

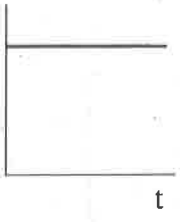


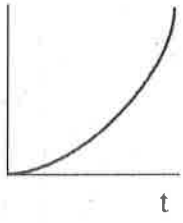
	x	y
v_0	$120 \cos 35$	$120 \sin 35^\circ$
v	"	?
a	0	-9.80
d		
t	3	3

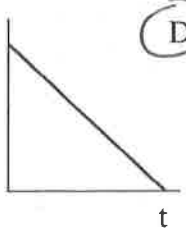
(y)
$v_y = v_0 + at$
$= 120 \sin 35^\circ + (-9.80)3$
$v_y = 39.429$

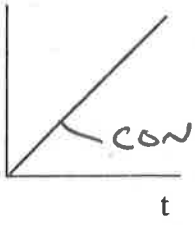
$v = \sqrt{v_x^2 + v_y^2} = 106 \frac{\text{m}}{\text{s}}$

6. Which of the following graphs best illustrates the horizontal displacement of a projectile as a function of time? Ignore friction.

A. 

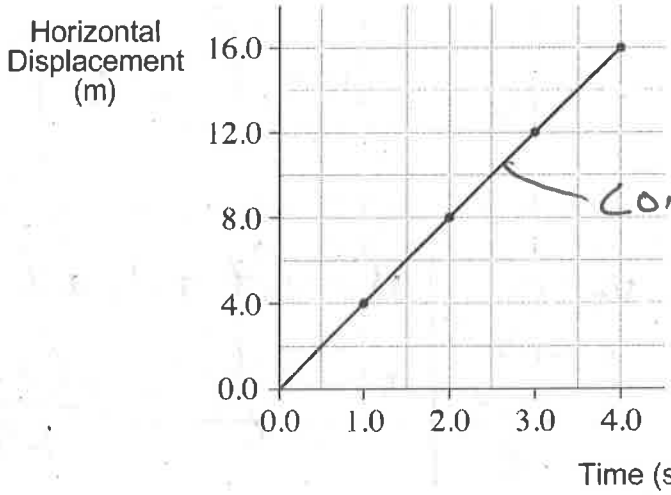
B. 

C. 

(D.) 

7. A projectile is fired into the air at some angle above the horizontal. The horizontal displacement of the projectile is measured against time in flight and the collected data is shown as a horizontal displacement versus time graph.
Based on this graph, the horizontal velocity of the projectile during this time interval is

(A.) constant.
B. increasing.
C. decreasing.
D. equal to zero.



8. A projectile is fired with an initial velocity of 65 m/s at an angle of 23° above the horizontal. If air resistance is negligible, how much time elapses before the projectile reaches its maximum height?

A. 2.6 s
B. 2.8 s
C. 6.1 s
D. 6.6 s

(y) $v_0 = 65\sin 23°$
$a = -9.8$
$v = 0$
$t = ?$

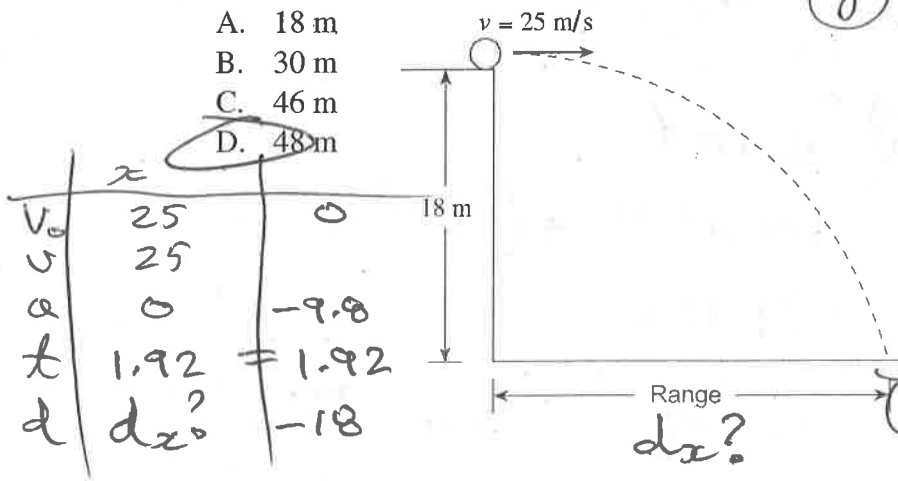
$v = v_0 + at$

$t = \frac{v - v_0}{a}$

$= \frac{-65\sin 23°}{-9.8} = 2.59$ s

9. What is the range of the projectile launched horizontally at 25 m/s from the 18 m-high cliff edge as shown in the diagram below?

A. 18 m
B. 30 m
C. 46 m
(D.) 48 m



	x	y
v_0	25	0
v	25	
a	0	−9.8
t	1.92	= 1.92
d	d_x?	−18

(y) $d = \frac{1}{2}at^2$

$t = \sqrt{\frac{2d}{a}}$

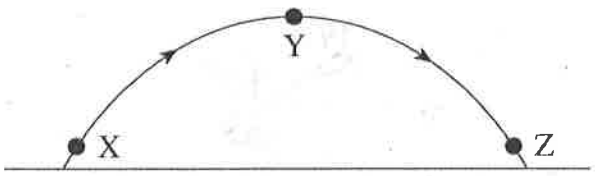
$= \sqrt{\frac{2(-18)}{-9.8}}$

$t = 1.92$ s

(x) $d_x = v_x t = 25(1.92)$

$= 47.9$ m

10. Consider three points in the path of a certain projectile as shown in the diagram below.



What is the acceleration of the projectile at each of these points?

	ACCELERATION (m/s^2)		
	At X	At Y	At Z
A.	+9.8	0	−9.8
B.	+9.8	0	+9.8
C.	−9.8	0	−9.8
D.	−9.8	−9.8	−9.8

11. A projectile is launched over level ground with an initial velocity of 65 m/s at 30° above the horizontal. What is the projectile's time of flight?

A. 3.6 s
B. 6.6 s
C. 11 s
D. 13 s

(y) $v_0 = 65\sin 30^\circ$
$v = -65\sin 30^\circ$
$a = -9.8$
$d = 0$

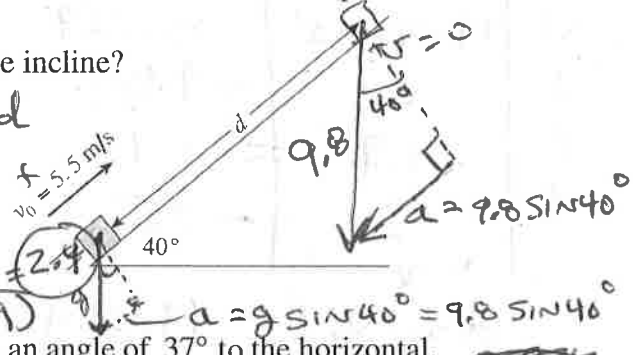
$t = \frac{v - v_0}{a}$
$= \frac{-65\sin 30^\circ - 65\sin 30^\circ}{-9.8} = \frac{-65}{-9.8}$

12. A block is launched up the frictionless incline in the diagram below with an initial speed of 5.5 m/s.
What is the maximum displacement, *d*, of the block up the incline?

A. 0.44 m
B. 0.87 m
C. 1.5 m
D. 2.4 m

$a = -6.299$
$v_0 = 5.5$
$v = 0$
$d = ?$

$v^2 = v_0^2 + 2ad$
$d = \frac{v^2 - v_0^2}{2a}$
$d = \frac{-5.5^2}{2(-6.299)} = 2.4$



13. A projectile is launched at 30 m/s over level ground at an angle of 37° to the horizontal. What maximum height does this projectile reach?

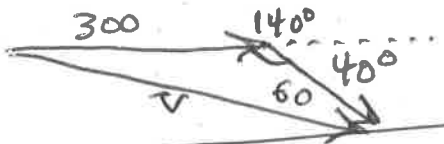
A. 3.1 m
B. 17 m
C. 29 m
D. 46 m

(y)
$v_0 = 30\sin 37^\circ$
$v = 0$
$a = -9.8$
$d = ?$

$v^2 = v_0^2 + 2ad$
$d = \frac{v^2 - v_0^2}{2a}$
$= \frac{(30\sin 37^\circ)^2}{2(-9.8)} = 16.6$ m
$= 17$ m

14. A few minutes after takeoff a jet is heading due east with an air speed of 300 km/h. If the wind is blowing at 60 km/h, towards 40° S of E, what is the jet's ground speed?

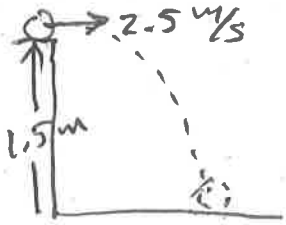
A. 260 km/h
B. 340 km/h
C. 350 km/h
D. 360 km/h



$v = \sqrt{300^2 + 60^2 - 2(300)(60)\cos 140°} = 348.1 \frac{m}{s}$

15. A green ball rolls off of the end of a table at 2.5 m/s. The table top is 1.5 m above the floor. How much time passes before the ball hits the floor?

A. 0.35 s
B. 0.55 s
C. 0.60 s
D. 1.2 s



$v_0 = 0$, $a = 9.8$, $d = 1.5$, $t = ?$

$d = \frac{1}{2}at^2$

$t = \sqrt{\frac{2d}{a}} = \sqrt{\frac{2(1.5)}{9.8}}$

$t = 0.553\ s$

16. An aircraft heads due south with a speed relative to the air of 44 m/s. Its resultant speed over the ground is 47 m/s. The wind blows from the west.

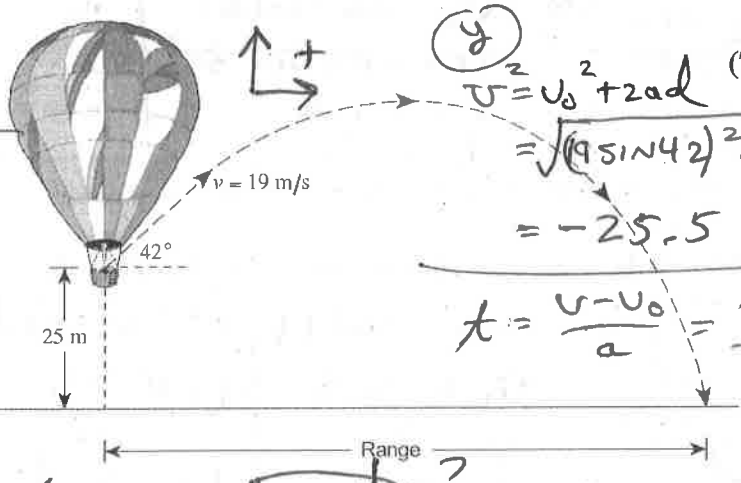
a) What is the speed of the wind? $\sqrt{47^2 - 44^2} = 16.5 \frac{m}{s}$ **(4 marks)**

b) What is the direction of the aircraft's path over the ground? **(3 marks)**

$\cos\theta = \frac{44}{47}$ $\therefore \theta = 20.58°$ $\therefore$ [21° E OF S]

17. A 0.50 kg ball is thrown at 42° above the horizontal at 19 m/s from a stationary hot air balloon 25 m above the ground.

What is the range? **(7 marks)**



	x	y
v_0	$19\cos 42°$	$19\sin 42°$
v	$19\cos 42°$	-25.527
a	0	-9.80
t	3.9	3.9
d	?	-25

(y) $v^2 = v_0^2 + 2ad$

$= \sqrt{(19\sin 42)^2 + 2(9.8)(25)}$

$= -25.5$

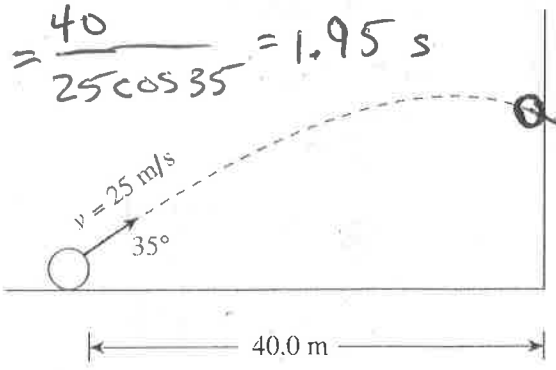
$t = \frac{v - v_0}{a} = \frac{-25.5 - 19\sin 42}{-9.8}$

$= 3.9\ s$

$d_x = v_x t = 19\cos 42°(3.902) = 55\ m$ d_x?

18. A projectile is launched towards a wall as shown in the diagram below.
With what velocity (magnitude and direction) does the projectile hit the wall? **(7 marks)**

$t = \frac{d}{v} = \frac{40}{25\cos 35} = 1.95\ s$



$v_x = 25\cos 35° = 20.4788$

$v_y = 25\sin 35° - 9.8(1.95)$

$= -4.80$

$21 \frac{m}{s}$

$\sin\theta = \frac{4.80}{21.033}$

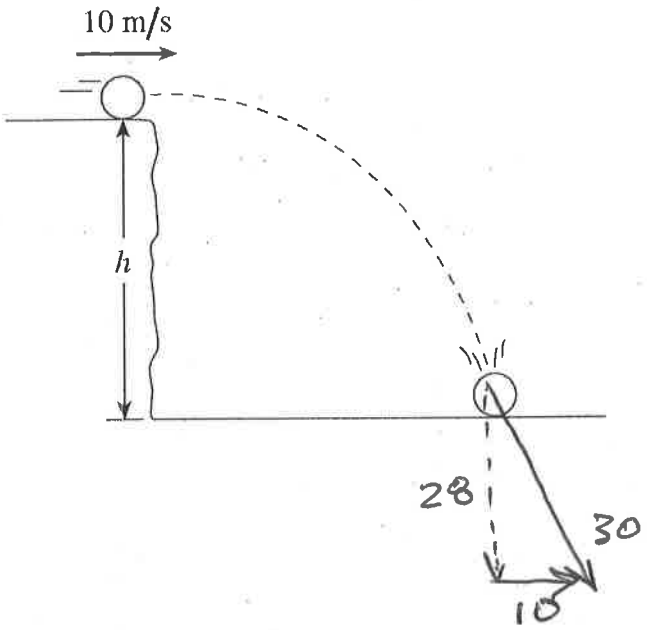
$\theta = 13°$

$21 \frac{m}{s}$ [13° BELOW H

19. A blue ball rolls off the cliff shown below at 10 m/s and hits the ground with a speed of 30 m/s.

a) What is the vertical component of the ball's impact velocity? **(4 marks)**

b) How high (h) is the cliff? **(3 marks)**



(y)

$v_0 = 0$

$v = 28.284$

$a = +9.8$

$d = ?$

$v^2 = v_0^2 + 2ad$

$d = \frac{v^2 - v_0^2}{2a}$

$= \frac{28^2 - 0^2}{2(9.8)}$

$= \frac{800}{19.6}$

$= 40.816$

$d = 41 \text{ m}$