Topic 2B Part II: Skill 15 – Objects launched vertically upward

75. Complete the following states for objects launched upward.

A. The distance up is equal to distance down

B. The velocity at the top (high point) is 0

C. The acceleration for the entire path is $9.8 m/s^2 \approx 10 m/s^2$ downward including the high point

D. Time up equals time down. (ie time at the top equals 1/2 of total flight time)

E. The landing velocity is equal but opposite of the launch velocity

F. The total displacement is 0 when the object returns to launch height.

G. If an object is launched upward with positive velocity, its velocity at the high point will be 0. So to solve this problem you can set $v_f = 0$ for the upward ½ of the flight. Or you can set the $v_i = 0$ for the second half of the flight where v_f is equal in magnitude to launch velocity.

H. Remember the v_i stands for initial velocity for the time frame you are exploring. Launch velocity equals v_i, and landing velocity equals v_f only if you are examining the total time of flight

76. An object is launched with a velocity of 39.2m/s (≈40m/s) and returns to the same height from which it was launched.

a. What is the change in velocity experienced by the object?

$\Delta V = V_f - V_i = -39.2 m/s - 39.2 m/s = -78.4 m/s$

$-40 m/s - 40 m/s = -80 m/s$

b. What is the total time of flight for the object? (Show the equation used to solve]

$t = \frac{\Delta V}{a} = \frac{-80 m/s}{-10 m/s^2} = 8 s$ $\quad \frac{-78.4 m/s}{-9.81 m/s^2} = 7.99 s$

c. What is the total vertical displacement of the object after the total time of flight?

0

d. What is the maximum height reached by the object? [At what point in the flight does this occur? What else is known about the kinematic variables at the point of maximum displacement?]

find distance by looking at fall from top

$V_i = 0$

$d = ?$

$a = 9.8 m/s^2$

$t = 4 s$

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

$d = \frac{1}{2}(9.81 m/s^2)(4 s)^2 = 78.4 m$

77. A rocket is launched vertically with a velocity of 25m/s and returns to level ground. (Show your equation)

a. What is the maximum height reached by the rocket?

falls from $V_i = 0$ to $V_f = 25\ m/s$

$\bar{V} = 12.5\ m/s$

$t = \frac{\Delta V}{a} = 2.54\ s$

$d = vt = 31.855\ m$

with $a = 9.81\ m/s^2$ $d = 31.25\ m$

b. What is the total time of flight for the rocket?

$t = \frac{\Delta V}{a} = \frac{-25\ m/s - 25\ m/s}{9.81\ m/s^2} = 5.1\ s$

78. Tigger the tiger bounces so that he is in the air for 1.5 seconds. (You may use a "Head Problem" grid but show your work for supporting steps).

a. What is the maximum height reached by Tigger?

$d = \frac{1}{2}at^2$ $d = \frac{1}{2}(9.81\ m/s^2)(.75\ s)^2 = 2.76\ m$

b. What is Tigger's initial launch velocity?

$V_f = 0 + (9.81\ m/s^2)(.75\ s) = 7.34\ m/s$

c. What is the magnitude of the acceleration acting on Tigger at the high point of his bounce?

$-9.81\ m/s^2$ or magnitude $9.81\ m/s^2$

79. The vertical launch velocity of tennis ball is 30m/s.

a. What is the maximum height reached by the tennis ball?

fall back

$V_f^2 = V_i^2 + 2ad$

$(30\ m/s)^2 = 2(9.81\ m/s^2)\,d$ $d = 45.9\ m$

b. What is the total time of flight?

6s

c. What is the final velocity of the tennis ball?

$-30\ m/s$

80. A projectile is fired straight up at a speed of 100. m/s. When the projectile returns to its starting position, its speed is

a. less than 100. m/s.
b. more than 100. m/s.
c. 100. m/s.
d. It depends on how long it takes to return.

81. A projectile is launched straight upwards at 75 m/s. Three seconds later, its velocity is

a. 60 m/s
b. 45 m/s
c. 30 m/s
d. Zero

$V_f = V_i + at$

$V_f = 75^m/_s + (-10^m/_{s^2})(3s)$

$V_f = 45^m/_s$

82. When a rock thrown straight upward gets to the exact top of its path, the magnitude of its

a. velocity is zero and its acceleration is zero.
b. velocity is zero and its acceleration is about 10. m/s^2.
c. ~~velocity is about 10.~~ m/s and its acceleration is zero.
d. velocity is about 10. m/s and its acceleration is about 10. m/s^2.

83. Farsley Hensworth hits a pop-foul directly upward in a baseball game. 5 seconds later, the catcher fumbles the ball. (assume equal height between bat and catcher) How high was the ball hit into the air?

How far does something fall in 2.5s?

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

$d = \frac{1}{2}(9.81^m/_{s^2})(2.5s^2)$

$d = 30.65m$

84. A baseball thrown directly upward with an initial velocity of 30 m/s will rise to what height? What is the time to the top of the trajectory? What is its velocity when it strikes the ground again?

How far does something fall if it reaches a speed of $30^m/_s$?

$V_i = 0$

$V_f = 30^m/_s$

$a = 9.8^m/_{s^2}$

$d = ?$

$V_f^2 = V_i^2 + 2ad$

$(30^m/_s)^2 = 2(9.8^m/_{s^2})d$

$d = 46m$

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Skill 14 - Dropped Objects

85. A ball is thrown vertically upward with an initial velocity of 29.4 meters per second. What is the maximum height reached by the ball? [Neglect friction.]

≃ 3s

A) 14.7 m
B) 29.4 m
C) 44.1 m
D) 88.1 m

86. A softball is thrown straight up, reaching a maximum height of 20 meters. Neglecting air resistance, what is the ball's approximate vertical speed when it hits the ground?

A) 10 m/sec
B) 20 m/sec
C) 15 m/sec
D) 40 m/sec

87. After a model rocket reached its maximum height, it then took 5.0 seconds to return to the launch site. What is the approximate maximum height reached by the rocket? [Neglect air resistance.]

A) 49 m
B) 98 m
C) 120 m
D) 250 m

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

$d = \frac{1}{2}(10\,m/s^2)(5s)^2$

88. A ball is thrown straight up with a speed of 12 meters per second near the surface of Earth. What is the maximum height reached by the ball? [Neglect air friction.]

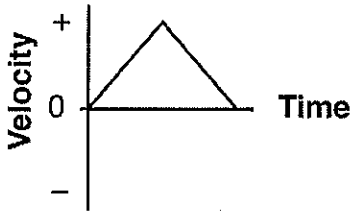
A) 15 m
B) 7.3 m
C) 1.2 m
D) 0.37 m

$v_i = 0$ (high pt)
$v_f = 12\,m/s$ (launch = landing)
$d = ?$
$a = 9.8\,m/s^2$

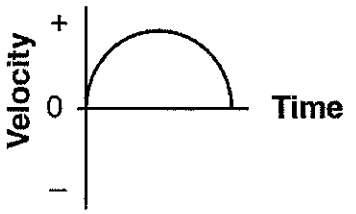
$v_f^2 = v_i^2 + 2ad$
$(12\,m/s)^2 = 0 + 2(9.8\,m/s^2)(d)$
$144\,m^2/s^2 = 19.6\,m/s^2\,d$

89. A student throws a baseball vertically upward and then catches it. If vertically upward is considered to be the positive direction, which graph best represents the relationship between velocity and time for the baseball? [Neglect friction.]

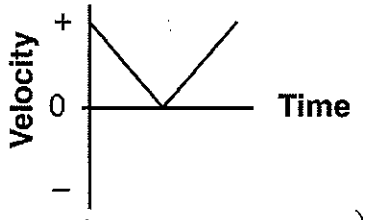
A)



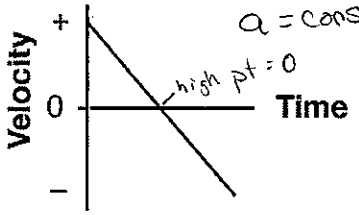
B)



C)



D)

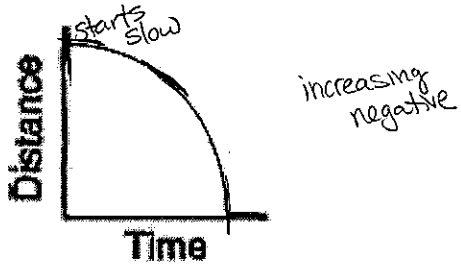


a = constant negative

high pt = 0

Topic 2B- Free Fall

90. The graph below represents the motion of an object's position with respect to time.



Which of the following motions could be represented by the above kinematics graph?

A) The object is speeding up away from a reference point on the ground.
B) The object is slowing down moving away from a reference point on the ground.
C) The object is speeding up moving toward a reference point on the ground.
D) The object is slowing down moving toward a reference point on the ground.

91. A projectile is defined as an object that

A) is experiencing only the force of gravity
B) is experiencing any net force
C) is in equilibrium
D) is slowing down

92. If an object is launched upward at 30m/s and lands at the same height from which it was launched, the change in velocity over the total flight is approximately

A) + 60 m/s
B) 0 m/s
C) - 60 m/s
D) - 30 m/s

$\Delta V = V_f - V_i$
$\Delta V = -30\,m/s - 30\,m/s = -60\,m/s$

93. If a stomp rocket is launched vertically upward with a velocity of 15 m/s, approximately, how much time is required for it return to level ground?

A) 3 seconds
B) 1.5 seconds
C) 0 seconds
D) 30 seconds

$V_f = V_i + at$
$-15\,m/s = 15\,m/s + (-10\,m/s^2)t$

94. A kangaroo jumps to a height of 1.25m to knock down a pesky drone. What is the kangaroo's air time (total time of flight)?

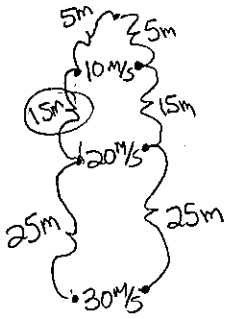
A) 0.5 second
B) 0.13 seconds
C) 1 seconds
D) 0.26 seconds

$t_{1/2} = \sqrt{\frac{2d}{a}} = \sqrt{\frac{2(1.25m)}{10\,m/s^2}} = \sqrt{\frac{2.5\,m}{10\,m/s^2}}$
$= \sqrt{.25\,s^2}$
$t_{1/2} = .5s$

Topic 2B- Free Fall

95. An object is launched upward and travels a distance of 25m between 0 and 1 seconds of flight. Between 1 and 2 seconds it will travel. (approximate using magnitude of 10 m/s/s for g) [Hint think about relationship between v_i, v_f, v_{avg})

A) more than 25 m
B) approximately 15 m
C) approximately 20m
D) approximately 25m



96. As an object launched vertically travels upward, acceleration

A) increases B) decreases
C) remains constant

97. For an object launched upward, the distance traveled each second

A) remains constant
B) initially increases (on the way up) and then decreases (on the way down)
C) initially decreases (on the way up) and then increases (on the way down)
D) decreases over the entire time of flight.

98. An astronaut jumps for joy on the moon and has a hang time (total time of flight) of 1.24 seconds. The gravitational field strength (acceleration due to gravity) is 1.6 m/s^2. What is the max height of the jump?

A) 3.0×10^{-1} m B) 2.5 m
C) 1.0 m D) 5×10^{-1}m

$d = \frac{1}{2}at^2$
$d = \frac{1}{2}(1.6 m/s^2)(.62s)^2$
$d = (.8 m/s^2)(.3844 s^2) = .31m$

max height $= \frac{1}{2}at$
$t = 1.24s$
$\frac{1}{2} = .62s$

99. In order to determine the gravity on a planet a space probe launches a dart vertically upwards with a velocity of 10m/s and measures exactly 6 seconds until it returns to the same location. Calculate the acceleration due to gravity (gravitational field strength) on this planet.

A) 1.67 m/s^2 B) 60 m/s^2
C) 9.8 m/s^2 D) 3.3 m/s^2

$V_i = 10 m/s$
$V_f = -10 m/s$
$a = ?$
$t = 6s$

$V_f = V_i + at$
$-10 m/s = 10 m/s + a(6s)$
$a = 3.3 m/s$

100. Sketch the shape of the position vs time graph for an object that is launched vertically with a velocity of 30 m/s and returns to level ground. [Hint: Think about the "dot diagram"]