PHYSICS 12

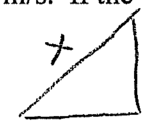
NAME: Key

Kinematics II

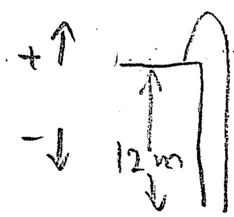
1) A car traveled up a hill at constant speed of 10.0 m/s and then returned down the hill at 20.0 m/s. If the time to turn around is ignored, what was the average speed for the trip?

$V_{ave} = \frac{d_t}{t_t}$; assume hill is x long so: $d_t = 2x$, $t_{up} = \frac{d}{v} = \frac{x}{10}$, $t_{down} = \frac{d}{v} = \frac{x}{20}$ so $t_t = \frac{x}{10} + \frac{x}{20} = \frac{2x}{20} + \frac{x}{20} = \frac{3x}{20}$

$V_{ave} = \frac{2x}{3x/20} = 2x \cdot \frac{20}{3x} = \frac{40}{3} = 13.3\ m/s$



2) A ball is thrown vertically up at 3.0 m/s off the edge of a 12 m cliff. How long will it take for the ball to hit the ground at the bottom of the cliff?



$V_0 = 3.0\ m/s$
$d = -12\ m$
$a = -9.8\ m/s$
$t = ?$

$d = V_0 t + \frac{1}{2}at^2$
$-12 = 3t - 4.9t^2$
$4.9t^2 - 3t - 12 = 0$

Use quadratic form.
$t = \frac{3 \pm \sqrt{3^2 - 4(4.9)(-12)}}{2(4.9)}$ = 244
$t = \frac{3 \pm 15.6}{9.8} = 1.9s, -1.28s$

3) A race car driver must average 200 km/h for four laps to qualify for a race. Because of engine trouble, the car averages only 170 km/h over the first two laps. What average speed must be maintained for the last two laps? each lap = L distance

$V_{ave} = \frac{d_t}{t_t} = 200 = \frac{4L}{t}$; $t_1 = \frac{2L}{170}$, $t_2 = \frac{2L}{x}$

$t_1 + t_2 = \frac{2L}{170} + \frac{2L}{x}$

4) A stone is thrown vertically upward with a speed of 10.0 m/s from the edge of a cliff 65 m high. a) How much later does it reach the bottom of the cliff? b) What is its speed just before hitting? c) What total distance did it travel?

$V_0 = 10\ m/s$
$d = -65\ m$
$a = -9.8\ m/s^2$

b) $V_f^2 = V_0^2 + 2ad$
$V_f^2 = 10^2 + 2(-9.8)(-65)$
$V_f^2 = 1374$
$V_f = 37.1\ m/s$ down

a) $V_f = V_0 + at$
$-37.1 = 10 + (-9.8)t$
$t = 4.8s$

c) d to top
$V_f^2 = V_0^2 + 2ad$
$0 = 10^2 + 2(9.8)d$
$(d = 5.1\ m \times 2) + 65$
$d = 75.2\ m$

5) A late passenger, sprinting at 8 m/s, is 30 m away from the rear end of a train when it starts out of the station with uniform acceleration of 1 m/s^2. Can the passenger catch the train if the platform is long enough? passenger must run 30m more than the train travels

$d_p = d_t + 30m$ →
$d_p = V_0 t$; $d_t = V_0 t + \frac{1}{2}at^2$
$= 8t$; $= \frac{1}{2}(1)t^2$
$= .5t^2$

$8t = .5t^2 + 30$
$(0 = .5t^2 - 8t + 30) \times 2$
$t^2 - 16t + 60 = 0$
$(t-6)(t-10)$

$t = 6, 10s$
(why 2 solutions?)

6) A rock is dropped down a deep well and the sound of it striking the water is heard 3.0 s later. If the speed of sound is 340 m/s, how deep is the well?

$v_0 = 0$

$t_{rock} + t_{sound} = 3.0\,s$

$d_{rock} = d_{sound}$

$v_0 t + \frac{1}{2} a t_r^2 = v t_s$

$\frac{1}{2}(9.8) t_r^2 = 340\, t_s$

$4.9 t_r^2 = 340(3.0 - t_r)$

$= 1020 - 340 t_r$

$4.9 t_r^2 + 340 t_r - 1020 = 0$

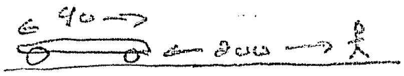
quad. form. $t_r =$

$t_r = 2.88\,s$

$d = \frac{1}{2}(9.8)(2.88)^2$

$= 40.6\,m$

7) A 90 m long train begins accelerating from rest. The front of the train passes a railway worker, who is standing 200 m from where the front of the train started, at a speed of 25 m/s. What will be the speed of the last car as it passes the worker?



$v_0 = 0$ $\quad a = ?$

$v_f = 25\,m/s$

$d = 200\,m$

$v_f^2 = v_0^2 + 2ad$

$25^2 = 0^2 + 2(a)(200)$

$a = 1.56\,m/s^2$

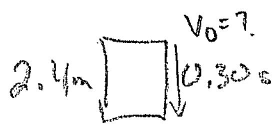
$v_f^2 = v_0^2 + 2ad$

$= 0 + 2(1.56)(290\,m)$

$= 906$

$v_f = 30.1\,m/s^2$

8) A falling stone takes 0.30 s to travel past a window 2.4 m tall. From what height above the top of the window did the stone fall?



$a = 9.8\,m/s$

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

$2.4\,m = v_0(.3) + \frac{1}{2}(9.8)(.3)^2$

$v_0 = 6.53\,m/s$

from top of building $v_0 = 0\,m/s$, $v_f = 6.53\,m/s$ at window

$v_f^2 = v_0^2 + 2ad$

$(6.53)^2 = 0^2 + 2(9.8)d$

$d = 2.17\,m$

9) An arrow is fired at an apple 25.0 m away. If the sound of the arrow piercing the apple is heard 3.4 s later, how fast did the arrow travel? Assume the speed of sound is 330 m/s.

$t_{arrow} + t_{sound} = 3.4\,s$

$t_{sound} = \frac{d}{v} = \frac{25}{330} = .076\,s$

$t_{arrow} = 3.4\,s - .076\,s$

$= 3.324$

$v = \frac{d}{t} = \frac{25\,m}{3.324} = 7.5\,m/s$

Answers: 1) 13.3 m/s, 2) 1.9s, 3) 243 km/h, 4) 4.8 s, -37 m/s, 75.2 m, 5) yes, t=6 s or 10 s
6) 41 m, 7) 30.1 m/s, 8) 2.17 m, 9) 7.5 m/s