Physics 11 **Kinematics Problem Examples #1**

1. How far does a car travel if it accelerates from rest for 5.0 seconds with an acceleration of 8.0 m/s^2?

$d = ?$
$v_i = 0$
$t = 5.0\,s$
$a = 8.0\ m/s^2$

$d = v_i t + \frac{1}{2} a t^2$
$= (0)(5.0\,s) + \frac{1}{2}(8.0\ m/s^2)(5.0\,s)^2$
$= 0 + \frac{1}{2}(80)(25)$
$= 100\ m$

2. An object is dropped from a cliff. How far has it dropped after 10 seconds?

$d = ?$
$t = 10\,s$
$a = 9.8\ m/s^2$
$v_i = 0$

$d = v_i t + \frac{1}{2} a t^2$
$= 0 + \frac{1}{2}(9.8\ m/s^2)(10\,s)^2$
$= 490\ m$

3. A car accelerates at a constant rate of 3.0 m/s^2 from an initial velocity of 20 m/s for 10 seconds.

a) How far does it travel?

$d = ?$
$a = 3.0\ m/s^2$
$v_i = 20\ m/s$
$t = 10\,s$

$d = v_i t + \frac{1}{2} a t^2$
$= (20\ m/s)(10\,s) + \frac{1}{2}(3.0\ m/s^2)(10\,s)^2$
$= 200\ m + 150\ m$
$= 350\ m$

b) How fast will it be going after 15 s?

$v_f = ?$
$v_i = 20\ m/s$
$t = 15\,s$
$a = 3.0\ m/s^2$

$a = \frac{v_f - v_i}{t}$ → solve for v_f
$\therefore at = v_f - v_i$
$v_f = v_i + at$

$v_f = v_i + at$
$= 20\ m/s + (3.0\ m/s^2)(15\,s)$
$= 65\ m/s$

4. A car accelerates from rest at a rate of 2.0 m/s^2. How fast will it be going at the end of a 400 m stretch?

$v_f = ?$
$v_i = 0$
$a = 2.0\ m/s^2$
$d = 400\ m$

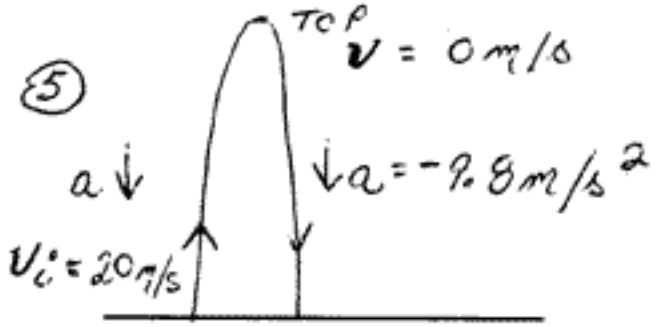
$d = \frac{v_f^2 - v_i^2}{2a}$
$\therefore 2ad = v_f^2 - v_i^2$
$2ad + v_i^2 = v_f^2$

$\therefore v_f = \sqrt{(v_i^2 + 2ad)}$
$= \sqrt{0^2 + 2(2.0)(400)}$
$= \sqrt{1600}$
$= 40\ m/s$

5. A ball is thrown straight up with an initial velocity of 20.0 m/s.
a) How high does the ball rise?
b) How long does it take the ball to get to the top?
c) How long does the ball remain in the air?
d) What is the velocity of the ball after 1.0 seconds?
e) At what time does the ball have a velocity of -10.0 m/s?
f) What is the ball's position when it is -10.0 m/s?

FROM KINEMATICS PROBLEM EXAMPLES #1

⑤



a) $d = ?$
$v_i = 20\ m/s$
$a = -9.8\ m/s^2$
$v_f = 0\ m/s$ (AT TOP)

$$d = \frac{(v_f^2 - v_i^2)}{2a}$$

$$= \frac{0^2 - 20^2}{2(-9.8)}$$

$$= \frac{-400}{-19.6} = \underline{\underline{20\ m}}$$

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b) $t = ?$ (TO TOP)
$v_i = 20\ m/s$
$a = -9.8\ m/s^2$
$v_f = 0\ m/s$

$$a = \frac{v_f - v_i}{t}$$

$$\therefore t = \frac{v_f - v_i}{a}$$

$$= \frac{0 - 20}{-9.8} = 2.04\ s = \underline{\underline{2.0\ s}}$$

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c) TIME TO THE TOP = TIME TO BOTTOM
SO TOTAL TIME IN AIR IS $2(2.04\ s) = \underline{\underline{4.1\ s}}$

<u>OR</u> FIND t TO DROP 20.4m. & DOUBLE TIME

$t = ?$ (TO BOTTOM)
$a = +9.8\ m/s^2$
$v_i = 0\ m/s$ (AT TOP)
$d = 20.4\ m.$

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

$$\therefore 2d = at^2$$

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

$$= \sqrt{\frac{2(20.4)}{9.8}} = 2.04\ s$$

⑤ d) $v_f = ?$

$t = 1.0\,s$

$a = -9.8\,m/s^2$

$v_i = 20\,m/s$

$a = \frac{v_f - v_i}{t}$

$\therefore at = v_f - v_i$

$v_f = v_i + at$

$= (20\,m/s) + (-9.8\,m/s)(1.0s)$

$= 10.2\,m/s = \underline{\underline{10\,m/s}}$

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e) $t = ?$

$v_f = -10\,m/s$

$a = -9.8\,m/s^2$

$v_i = 20\,m/s$

$a = \frac{v_f - v_i}{t}$

$\therefore t = \frac{v_f - v_i}{a}$

$= \frac{-10 - 20}{-9.8}$

$= \frac{-30}{-9.8} = \underline{\underline{3.1\,s}}$

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f) $d = ?$

$v_f = -10\,m/s$

$a = -9.8\,m/s^2$

$v_i = 20\,m/s$

$t = 3.06\,s$ (FROM e)

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

$= (20)(3.06) + \frac{1}{2}(-9.8)(3.06)^2$

$= 61.2\,m + -45.88$

$= 15.3\,m = \underline{\underline{15\,m}}$