NAME: KEY

Linear Motion II Exam Review (CP)

1. A car traveling at 6 m/s is uniformly accelerated at a rate of 3 m/s² for 15 seconds.
   a. What is the car's final velocity?

$a = \frac{v_f - v_i}{t}$ $\quad 3 = \frac{v_f - 6}{15}$ $\quad 45 = v_f - 6$ $\quad \boxed{v_f = 51 \text{ m/s}}$

   b. How far does the car travel during this time?

$d = \frac{1}{2}at^2 + v_i t$ $\quad d = \frac{1}{2}(3)(15)^2 + (6)(15) = 337.5 + 90$ $\quad \boxed{d = 427.5 \text{ m}}$

   c. After the car reaches its final speed (part a.) it begins to slow down and comes to rest in 1 minute. What is the car's acceleration as it comes to rest?

$v_i = 51$
$v_f = 0$
$t = 1 \text{ min} = 60 \text{ s}.$

$a = \frac{v_f - v_i}{t} = \frac{0 - 51}{60}$ $\quad \boxed{a = -0.85 \text{ m/s}^2}$

2. What acceleration is necessary for a boat to increase speed from 13 m/s to 26 m/s over a distance of 1.25 km? Is this acceleration positive or negative? Explain.

$v_i = 13 \text{ m/s}$
$v_f = 26 \text{ m/s}$
$d = 1.25 \text{ km} = 1250 \text{ m}$

Find t first

$\bar{v} = \frac{v_i + v_f}{2} = \frac{13+26}{2} = 19.5$

$\bar{v} = \frac{d}{t}$ $\quad 19.5 = \frac{1250}{t}$ $\quad t = 64.1 \text{ s}$

$a = \frac{v_f - v_i}{t} = \frac{26-13}{64.1}$ $\quad \boxed{a = 0.20 \text{ m/s}^2}$

3. A car traveling at 8 m/s slows to a stop in 5 seconds. How far does the car travel over this time interval? What is the car's acceleration?

$v_i = 8 \text{ m/s}$
$v_f = 0 \text{ m/s}$
$t = 5 \text{ s}$

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

$a = \frac{0 - 8}{5}$ $\quad \boxed{a = -1.6 \text{ m/s}^2}$

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

$= \frac{1}{2}(-1.6)(5)^2 + (8)(5)$

$d = -20 + 40$ $\quad \boxed{d = 20 \text{ m}}$

↓ positive. speed up forwards

4. A pebble is dropped from the top of a 12 m high bridge. How fast is the pebble moving when it hits the ground? How long does it take the pebble to hit the ground?

Drop
$v_i = 0 \text{ m/s}$
$d = 12 \text{ m}$
$a = +10 \text{ m/s}^2$

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

$12 = \frac{1}{2}(10)t^2 + \cancel{(0)t}$

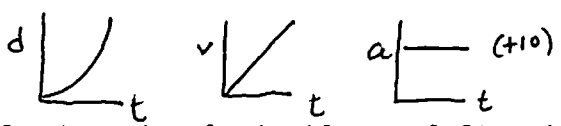
$2.4 = t^2$ $\quad \boxed{t = 1.55 \text{ s}}$

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

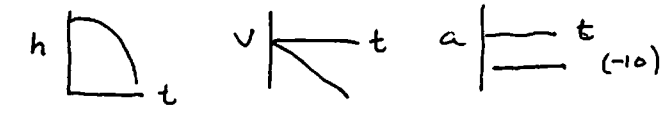
$10 = \frac{v_f - 0}{1.55}$ $\quad \boxed{v_f = 15.5 \text{ m/s}}$

5. Sketch the distance fallen (or height), velocity and acceleration graphs that correspond to the motion in question 4. (There are two ways you could do this - think of the ball drop lab.)

(A) As a drop (↓ is +)



(B) ↑ is +



6. Mary jumps into the air with a speed of 2.3 m/s. How high does she jump? How long is she in the air? up & down!

$v_i = 2.3 \text{ m/s}$
$a = -10 \text{ m/s}^2$
$v = 0 \text{ m/s}$ @ Max Height.

time to Max height:

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

$-10 = \frac{0 - 2.3}{t}$

$-10t = -2.3$

$t = .23 \text{ s}$

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

$= \frac{1}{2}(-10)(.23)^2 + (2.3)(.23)$

$= -0.26 + .53$

$\boxed{d = .26 \text{ m}}$

Total time = 2(.23)

$\boxed{T = .46 \text{ s}}$

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7. Sketch the height, velocity and acceleration graphs that correspond to the motion in question 6.

8. Is it possible to have a constant acceleration and also have a velocity of 0? Explain.

Yes! Happens @ max height → reversing direction.

9. Imagine you throw a ball straight up in the air and catch it at the same height from which it was thrown.
   a. Compare the time it takes the ball to go up to the time it takes the ball to come down.

      $t_{up} = t_{down}$

   b. Because the ball goes up and down, it will be at a particular height twice. Compare the speeds of the ball at those two different times.

      speeds same (but opposite velocities)

   c. Compare the velocities of the ball when it is at the same height.

      opposite (one + & one −)

   d. What is the speed of the ball at its maximum height?

      0 m/s

   e. What is the velocity of the ball at its maximum height?

      0 m/s

   f. What is the acceleration of the ball while going up?

      10 m/s^2 DOWN!!

   g. What is the acceleration of the ball while coming down?

      10 m/s^2 DOWN!!

   h. What is the acceleration of the ball at its maximum height?

      10 m/s^2 DOWN!!

   All the same! Gravity doesn't change!

   i. Was the velocity of the ball constant?

      NO

   j. Was the acceleration of the ball constant?

      Yes

10. A ball is launched straight up and is in the air for a total of 3 seconds. How high does it go and with what speed was it launched?

up & down
$a = -10\ m/s^2$
total time = 3 s
($\therefore t_{up} = 1.5$ s)
v = 0 m/s @ Max height
t = 1.5 s @ " "

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

$$-10 = \frac{0 - v_i}{1.5}$$

$$-15 = -v_i$$

$$v_i = 15\ m/s$$

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

$$d = \frac{1}{2}(-10)(1.5)^2 + (15)(1.5)$$

$$d = -11.25 + 22.5$$

$$d = 11.25\ m$$