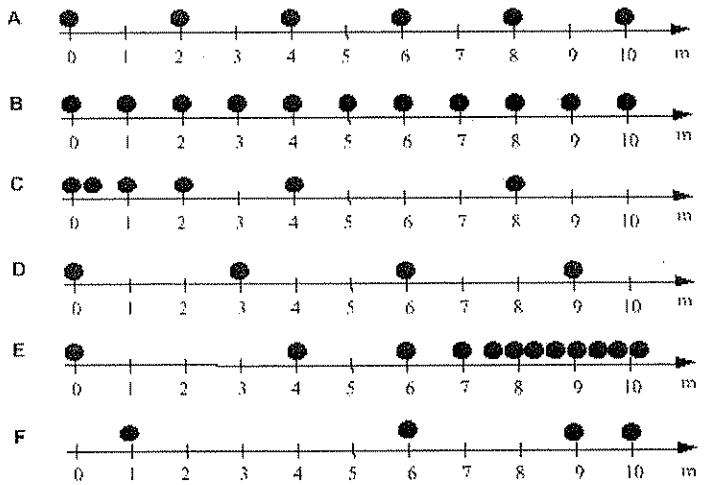
Due date: Fri Apr 29 12:00:00 am 2011 (EDT)

Flash snapshots were taken at time intervals of 1 second of a set of spheres moving from left to right. The diagrams below show the locations of each sphere when each photo was taken (these are called motion diagrams). The x-axis shown represents the position of the sphere (in units of meters) at these 1-second intervals. The positive direction is to the right.



Which of the following statements are true about the motion of the spheres depicted in these motion diagrams?

Choices: **True**, **False**.

A. The velocity in figure A is 2 m/s T
B. The acceleration in figure B is less than that in figure C T
C. The velocity in figure F is decreasing T
D. The velocity in figures B, C and F is constant F
E. The acceleration in figure F is negative T

Tries 0/99

A Model Rocket

Due on Friday, Apr 29 at 00:00 (EDT)

A model rocket is launched straight upward with an initial speed of 45.0 m/s. It accelerates with a constant upward acceleration of 1.88 m/s^2 until its engines stop at an altitude of 167 m. What is the maximum height reached by the rocket?

302 m

Tries 0/99

How long after lift off does the rocket reach its maximum height?

8.72 s

Tries 0/99

How long is the rocket in the air?

16.6 s

Tries 0/99

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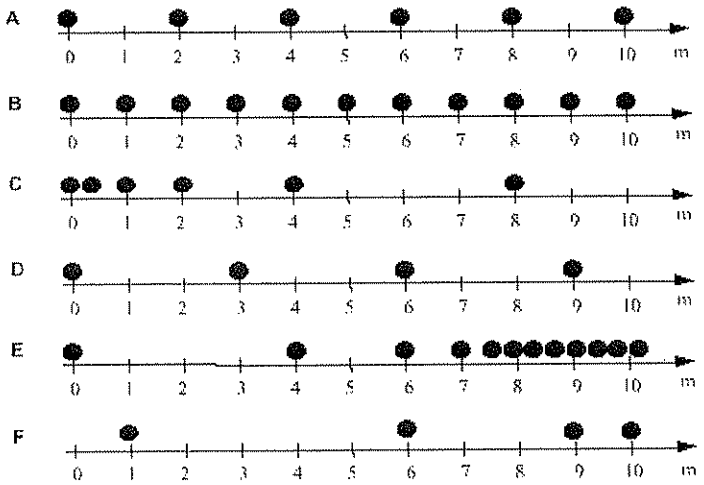


Which of the following statements are true about the motion of the spheres depicted in these motion diagrams?

Choices: **True**, **False**.

A. The velocity in figures A, D and F is constant F
B. The acceleration in figure F is positive F
C. The velocity in figure B is 1 m/s T
D. The velocity in figure E first decreases, then stays constant T
E. The acceleration in figures A and B is zero T

Tries 0/99

A Model Rocket

Due on Friday, Apr 29 at 00:00 (EDT)

A model rocket is launched straight upward with an initial speed of 54.7 *m/s*. It accelerates with a constant upward acceleration of 2.07 m/s^2 until its engines stop at an altitude of 164 *m*. What is the maximum height reached by the rocket?

351

Tries 0/99

How long after lift off does the rocket reach its maximum height?

9.03

Tries 0/99

How long is the rocket in the air?

17.5

Tries 0/99

G) kinematic, constant $a = -g$

known:	unknown
$v_0 = 54.7\ m/s$	t ?
$a_0 = 2.07\ m/s^2$	h_p ?
$h_1 = 164\ m$	

Estimate: $t_1 = 3\ s \approx 150\ m / 50\ m/s$

$t_{peak} > 60\ m/s / 9.8\ m/s^2 = 6\ s$

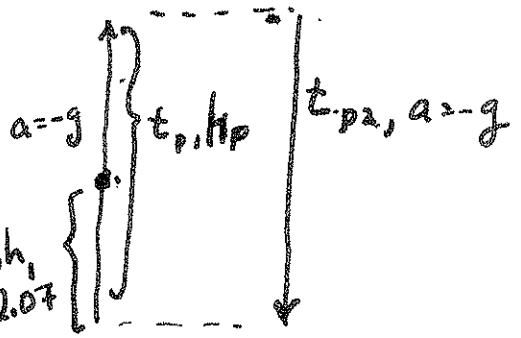
$h_{peak} = 164 + \frac{60+0}{2} \times 6 = 164 + \frac{180}{2}$

total height $= 250\ m$

total time $= 6 + 3 = 9\ s$ to peak

total up + down $\approx 2 \times 9 = 18\ s$

D) $y = y_0 + v_0 t + \frac{1}{2} a t^2$



A) up to t_1, h_1

$h_1 = v_0 t + \frac{1}{2} a t^2$

$0 = \frac{1}{2} a t_1^2 + v_0 t_1 - h_1$

$t_1 = \frac{-v_0 \pm \sqrt{v_0^2 + 2ah_1}}{a}$

$= \frac{v_0}{a}\left(\sqrt{1 + \frac{2ah_1}{v_0^2}} - 1\right)$

$t_1 = 2.85\ s$

$v_1 = v_0 + a t_1$

$t_p - t_1 = \frac{v_1}{g} = \frac{v_0 + a t_1}{g}$

$t_p = t_1 + \frac{v_0 + a t_1}{g}$

$h_p - h_1 = v_{ave}(t_p - t_1) = \frac{v_1}{2}(t_p - t_1)$

$$h_p - h_1 = \frac{v_1^2}{2g} = \frac{(v_0 + a t_1)^2}{2g}$$

$$h_p = h_1 + \frac{(v_0 + a t_1)^2}{2g} = 164\,m + \frac{(54.7\,m/s + 2.07\,m/s^2 \cdot 2.85\,s)^2}{2(9.8\,m/s^2)}$$

$$= 164\,m + 187\,m = 351\,m$$

a) correct units; estimate is consistent
- need to split trajectory into parts with equal, constant a.

b) What is t_p?

$$t_p = t_1 + \frac{v_0 + a t_1}{g} = 2.85\,s + \frac{54.7\,m/s + 2.07(2.85\,s)}{9.8\,m/s^2}$$

$$= 9.035$$ { correct units ✓ ; checks with estimate ✓

c) What is total time in air?

$$t_{total} = t_{up} + t_{down} = t_p + t_{down}$$

$$h_p = \frac{1}{2} g t_{down}^2$$

$$t_{down} = \sqrt{2 h_p / g}$$

$$t_{total} = 9.035 + \sqrt{2(351\,m)/9.8\,m/s^2}$$

$$= 17.5\,s$$

d) b & c check with estimates ✓
correct units