1. In section "c" (15–25s) the spider's acceleration is
   a) constant and positive
   b) constant and negative
   c) positive, increasing with time.
   d) negative, decreasing (becoming more negative) with time.
   e) zero

2. Over this interval the spider's velocity is:
   a) constant and positive.
   b) constant and negative
   c) positive, decreasing with time.
   d) continuously increasing from negative to positive.
   e) continuously decreasing from positive to negative.

3. In section "b" (5–15s) the spider's velocity is about
   a) 6 m/s
   b) 0.6 m/s
   c) 0.06 m/s
   d) -0.6
   e) -0.06 m/s

$\Delta x \sim -0.6\,m$

$\Delta t = 10s$

$\langle v \rangle = \frac{\Delta x}{\Delta t} = \frac{-0.6\,m}{10s} = -0.06\,m\,s^{-1}$

4. There are about a 500 billion stars in the Milky Way galaxy. The mass of the sun is about $2 \times 10^{30}\,kg$. Estimate the mass of the Milky Way.
   a) $10^{18}\,kg$
   b) $10^{41}\,kg$
   c) $10^{42}\,kg$.
   d) $10^{44}\,kg$.
   e) $10^{50}\,kg$.

$500 \times 10^9 \cdot 2 \times 10^{30}\,kg = 10^{42}\,kg$

5. A ball drop experiment measures $t = 1.5s$ for a drop of 1.88m. You conclude that g is
   a) $0.60\ m\,s^{-2}$
   b) $1.67\ m\,s^{-2}$
   c) $9.798\ m\,s^{-2}$
   d) $9.800\ m\,s^{-2}$
   e) $10\ m\,s^{-2}$

Do you know where you might be?

$x = x_0 + v_{0x} t + \frac{1}{2} g t^2$

$1.88\,m = \frac{1}{2} g (1.5s)^2$

$= 1.67\,m\,s^{-2}$

(THIS IS g ON THE MOON)

6. The world record for the 100m dash is just under 10s. How long would it take to run a mile (1610m) with the same average acceleration?
   a) 40s
   b) 56s
   c) 160s
   d) 4 minutes
   e) 400s

$x = x_0 + v_{0x} t + \frac{1}{2} a t^2$

$100\,m = \frac{1}{2} a t^2$

$a = 2\,m\,s^{-2}$

$1610\,m = \frac{1}{2} a t^2$

$t = \sqrt{1610\,s^2} \sim 40s$

Name KEY ID # A

7. Standing at the top of the Campanile in Pisa ($h = 55m$) Galileo throws a 1kg weight upward with a velocity of 10 m/s; at the same time his assistant throws a 2kg weight downward with the same velocity.

a) What is the time difference between the impact of the first and second weights?

(7)

1kg: $t=0$: $y_0 = 55m$, $v_{0y} = +10ms^{-1}$; $t=t_1$: $y=0$, $v_y = ?$

2kg: $t=0$: $y_0 = 55m$, $v_{0y} = -10ms^{-1}$; $t=t_2$: $y=0$, $v_y = ?$

$a = g = -9.8ms^{-2}$

$y = y_0 + v_{0y}t + \frac{1}{2}gt^2$

$0 = 55m + 10ms^{-1} - 4.9ms^{-2}t^2$ QUADRATIC $t_1 = 4.52s$

$0 = 55m - 10ms^{-1}t - 4.9ms^{-2}t^2$ QUADRATIC $t_2 = 2.48s$

$t_{1kg} - t_{2kg} =$ 2.04s

b) What are their velocities just before they strike the ground?

$v = v_0 - 9.8ms^{-2}t$

$= 10ms^{-1} - 9.8ms^{-2} \cdot 4.52s = -10ms^{-1} - 9.8ms^{-2} \cdot 2.48s$

(3)

$v_0 = 12\ ms^{-1}$

$t_1 = 4.79s$ $t_2 = 2.34s$

$t_1 - t_2 = 2.45s$

$v_f = -35ms^{-1}$

— O —

$v_0 = 15\ ms^{-1}$

$t_1 = 5.21s$ $t_2 = 2.15s$

$t_1 - t_2 = 3.06s$

$v_f = -36s$

$v(1kg) =$ $-34\ ms^{-1}$

$v(2kg) =$ $-34\ ms^{-1}$

−1pt if not "minus" or "down"