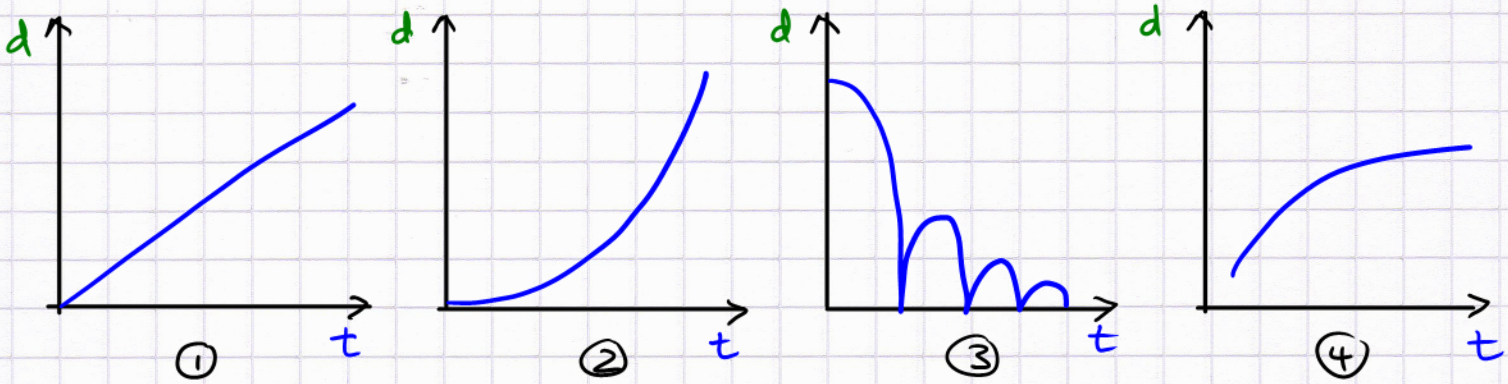
Tutorial 1 (Sept 23, 2010)

Giordano problems (not questions)

2.22

d = generic for position or displacement



Ⓐ person at the beginning of race, starting from rest

Ⓑ runner near the end of race after crossing finish line

Ⓒ ball dropped from window, bounces a few times

Ⓓ bowling ball rolls down lane, just after leaving hand

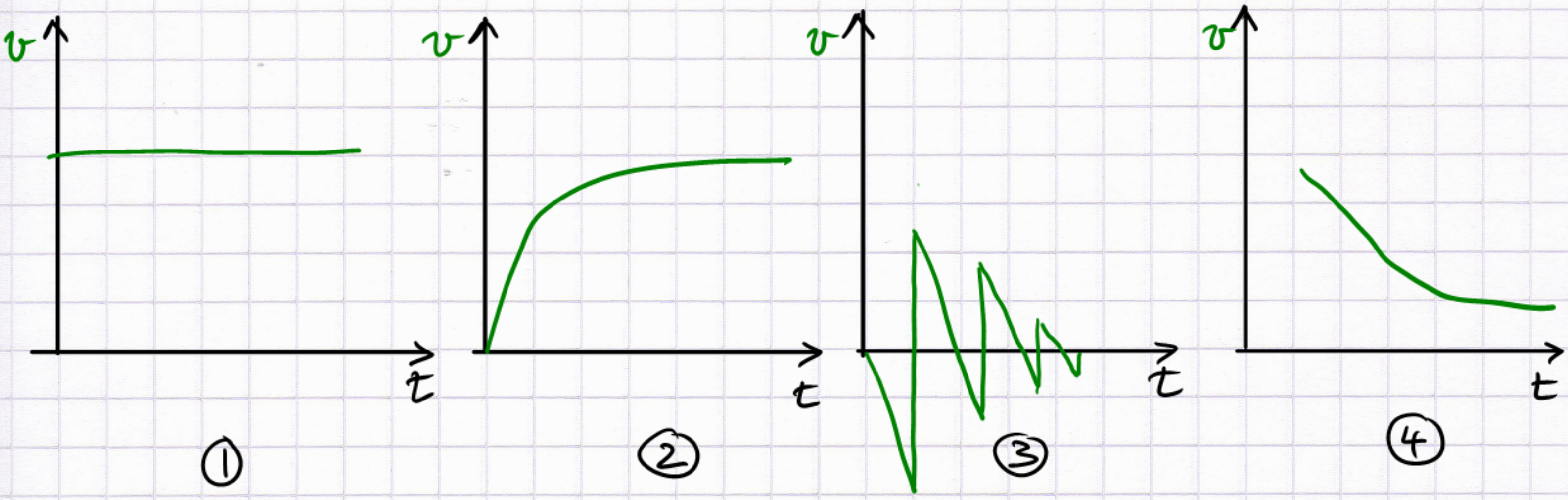
Ⓐ → ② ; starts from rest, zero velocity, accelerates (pos. curvature)

Ⓒ → ③ obvious: free-fall parabola + bounce d = vertical

Ⓓ → ① ball starts with constant velocity (no acc.)

Ⓑ → ④ slope levels off → decreasing velocity

2.23



(A) person at the beginning of race, starting from rest

(B) runner near the end of race after crossing finish line

(C) ball dropped from window, bounces a few times

(D) bowling ball rolls down lane, just after leaving hand

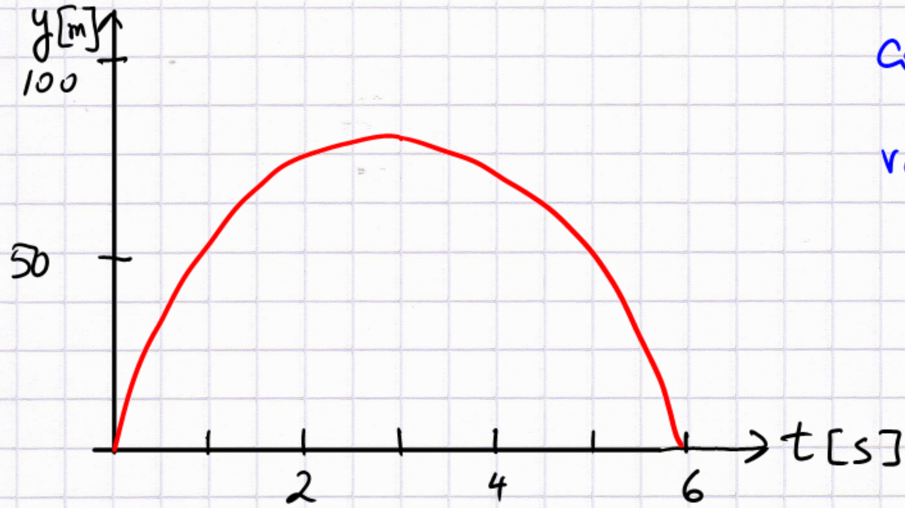
(A) → (2) velocity increases, then maximum (terminal velocity)

(B) → (4) velocity drops after finish line

(C) → (3) bounce = velocity reversal; neg. initial velocity followed by pos., etc.

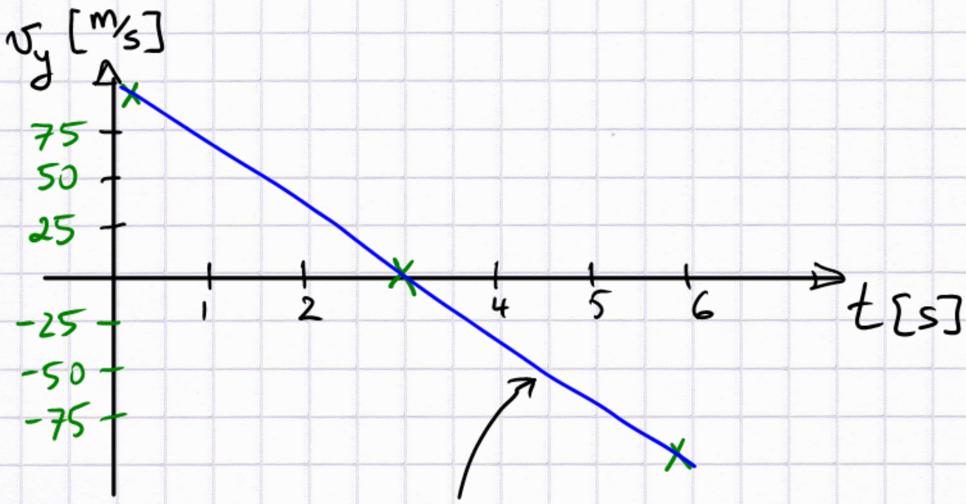
(D) → (1) constant-velocity slide

2.26



Construct a velocity-time graph

What is v_{max} ?



not unreasonable !

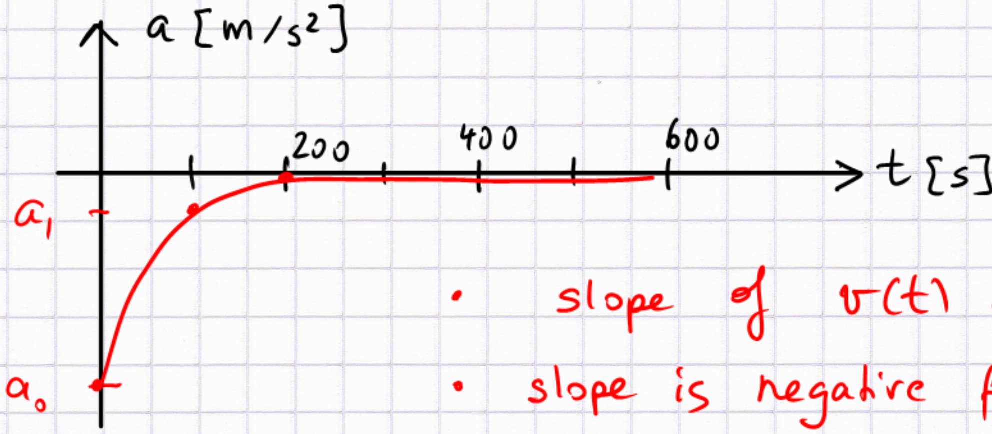
(correct if x(t) is a quadratic)

$v_{max} \approx 100$ m/s = max. velocity

-100 m/s = min. velocity

100 m/s = max. speed reached at t=0 and t=6 seconds

2.28 Given the velocity-time graph



- slope of $v(t)$ graph $= 0$ for $t > 200\,s$
- slope is negative for $t < 200\,s$
- slope is steeper (more negative) for early times

$$|a_0| \gtrsim \frac{10\ m/s}{50\,s} = 0.2\ \frac{m}{s^2}$$

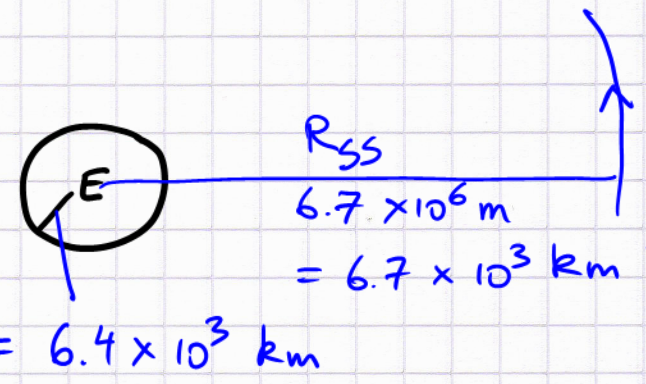
$$|a_1| \approx \frac{3.5\ m/s}{100\ s} = 0.035\ m/s^2$$

2.34 Space shuttle takes off + orbits E 18 times + lands at the same place $24^h\ 15^m$ later

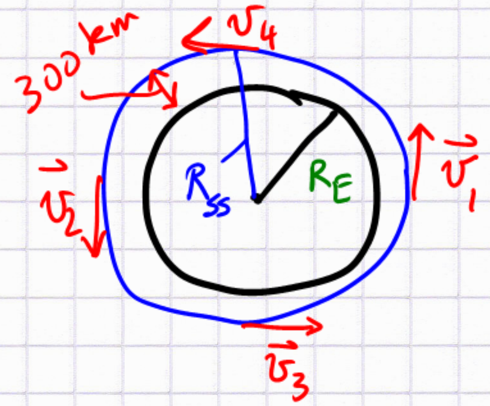
Assume a circular orbit $R = 6.7 \times 10^6$ m

(A) Average speed ? (B) Average velocity ?

(B)



∴



ignoring the change in trajectory not so crazy!

shuttle is 300 km above E

$\vec{v}_{avg} = 0$

Speed: $v = \frac{d}{T} = \frac{18 \times 2\pi R_{SS}}{T} = \frac{18 \times 6.28 \times 6.7 \times 10^6 \text{ m}}{(24 \cdot 3600 + 15 \cdot 60)\text{ s}}$

$= \frac{7.57 \cdot 10^8 \text{ m}}{8.73 \cdot 10^4 \text{ m}} = 8.7 \frac{\text{km}}{\text{s}}$ 2 significant digits

3 significant for intermediate step

How accurate was T ? $24 + \frac{15}{60} = 24.25$

didn't specify fraction of min. (2-3 digits)