

AP Calculus AB - Rates of Change in Context and Straight-Line Motion - Test Answer Key

Common Core AP CALC AB 4.1, AP CALC AB 4.2, AP CALC AB 4.3 · maths-pdf.fr/en/

Use this answer key to score the rates of change test out of 20 points. Each solution shows the work and a scoring guide that says how the points are awarded. Give partial credit for a correct setup, a correct derivative or integral, and a correct final statement with units where they apply.

AP Calculus AB · Common Core State Standards: **AP CALC AB 4.1, AP CALC AB 4.2, AP CALC AB 4.3**

Question 1 - Interpreting derivatives [2 pts]

- a. At day 8 the plant is growing at 1.5 cm per day.
- b. At month 6 the share price is falling at \$2.30 per month.

Scoring: 1 point each for value, units, and direction in a full sentence.

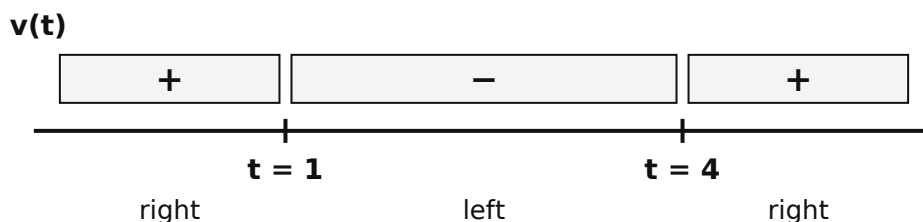
Question 2 - Position, velocity, acceleration [3 pts]

- a. $v = 3t^2 - 12$ and $a = 6t$.
- b. $3t^2 - 12 = 0$ gives $t = 2$ (since $t \geq 0$).
- c. $a(2) = 12 \text{ m/s}^2$.

Scoring: 1 point per part.

Question 3 - Direction from a sign chart [3 pts]

- a. At $t = 1$ and $t = 4$, where v changes sign.
- b. Left on $(1, 4)$, where $v < 0$.
- c. $v(2) = -2 < 0$ and $a(2) = -1 < 0$: same sign, so **speeding up**.



Sign chart for the velocity of a particle.

Scoring: 1 point per part.

Question 4 - Geometric rates [2 pts]

- $A' = 2\pi r = 16\pi \approx 50.3$ cm² per cm.
- $V' = 4\pi r^2$, so $V'(3) = 36\pi \approx 113.1$ cubic units per unit of radius.

Scoring: 1 point per part.

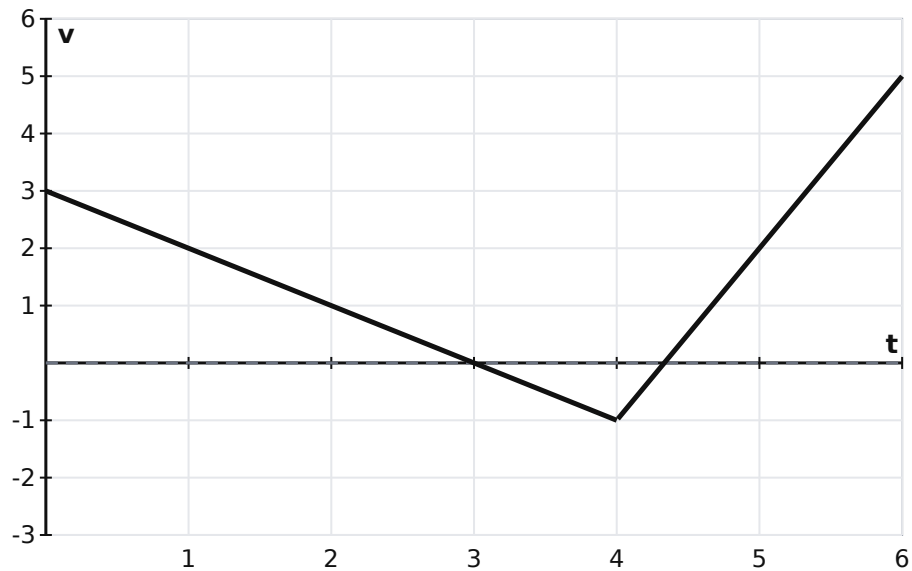
Question 5 - Velocity from a table [3 pts]

- $\frac{84-0}{6} = 14$ m/s.
- $\frac{84-12}{4} = 18$ m/s.
- The averages are 6, 14 and 22 m/s, increasing, so the sled is speeding up.

Scoring: 1 point per part.

Question 6 - Reading a velocity graph [3 pts]

- At $t = 3$ (where $3 - t = 0$) and $t = 4.33$ (where $3(t - 4) - 1 = 0$), about $t = \frac{13}{3}$.
- Slowing down when v and a have opposite signs: on $(0, 3)$ ($v > 0, a = -1 < 0$) and on $(4, \frac{13}{3})$ ($v < 0, a = 3 > 0$).
- The slope is 3 ft/s².



Velocity in feet per second.

Scoring: 1 point per part.

Question 7 - Exponential rate [2 pts]

$$N'(t) = 20e^{0.4t}, \text{ so } N'(3) = 20e^{1.2} \approx 66.4.$$

At day 3 the algae are increasing by about 66.4 thousand cells per day.

Scoring: 1 point for the derivative and value; 1 point for the interpretation with units.

Question 8 - Total distance [2 pts]

$v = 3(t-2)(t-4)$ changes sign at $t = 2$ and $t = 4$. Positions: $s(0) = 0$, $s(2) = 20$, $s(4) = 16$, $s(5) = 20$.

Distance: $20 + 4 + 4 = 28$ feet.

Scoring: 1 point for the turning points; 1 point for the total.

Total

20 points