

AP Calculus AB · Derivatives in Context: Motion and Related Rates · Worksheet

Common Core AP Calculus AB Unit 4 · mathovore.fr

Name: _____ Date: ____/____/____ Score: _____

This ap calculus contextual applications worksheet gives 25 problems on derivatives in context: motion and related rates, ordered from easy to hard, with a separate answer key.

These 25 problems practice derivatives in context for AP Calculus AB Unit 4: interpreting rates, motion along a line, local linearization, L'Hôpital's Rule and related rates. They go from short interpretations to multi-step problems.

The last seven problems are word problems with pictures. Include units in every answer.

AP Calculus ABCommon Core: AP Calculus AB Unit 4

AP Calculus Contextual Applications Worksheet: problems 1-5

Problem 1: Interpret a rate with units

Maya's hot cocoa has temperature $T(t)$ in $^{\circ}\text{F}$, t minutes after it is poured. She finds $T'(5) = -3.2$. Interpret this value with units.

Problem 2: Velocity and acceleration functions

A cart moves along a track with position $s(t) = t^2 - 6t + 5$ feet at time t seconds. Find $v(t)$ and $a(t)$.

Problem 3: When is the cart at rest?

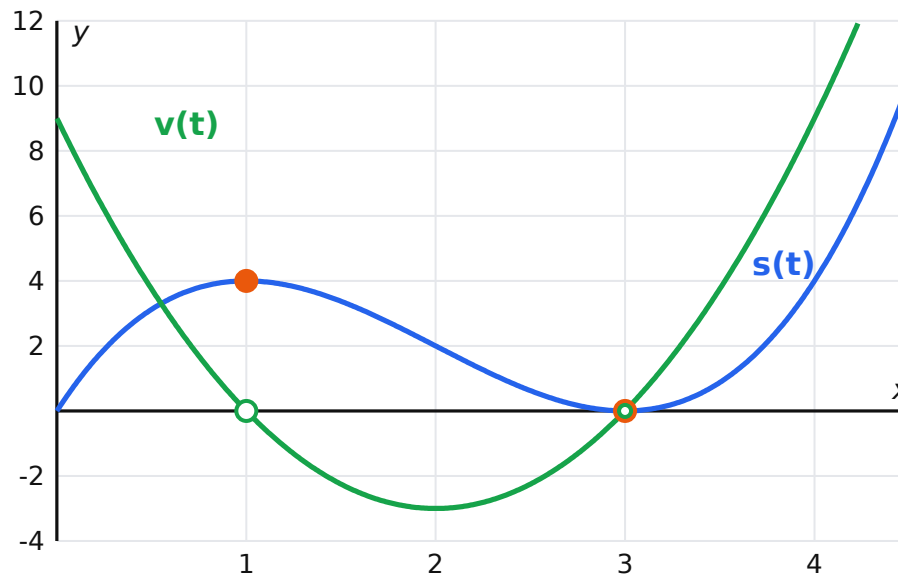
For the cart in the previous problem, find the velocity at $t = 4$ and the time when it is momentarily at rest. Then find its position then.

Problem 4: Where the particle turns around

A particle moves on a line with $s(t) = t^3 - 6t^2 + 9t$ for $0 \leq t \leq 5$. Find the times when it is at rest and its positions then.

Problem 5: Direction of motion

For the particle in the previous problem, the graphs of $s(t)$ (blue) and $v(t)$ (green) are shown. On which intervals does the particle move right, and on which does it move left?



Velocity (green) is the slope of position (blue). Where $v = 0$ the position graph turns around.

AP Calculus Contextual Applications Worksheet: problems 6-10

Problem 6: Speeding up or slowing down

For $s(t) = t^3 - 6t^2 + 9t$ with $0 < t < 5$, find $a(t)$ and the intervals on which the speed is increasing.

Problem 7: Total distance traveled

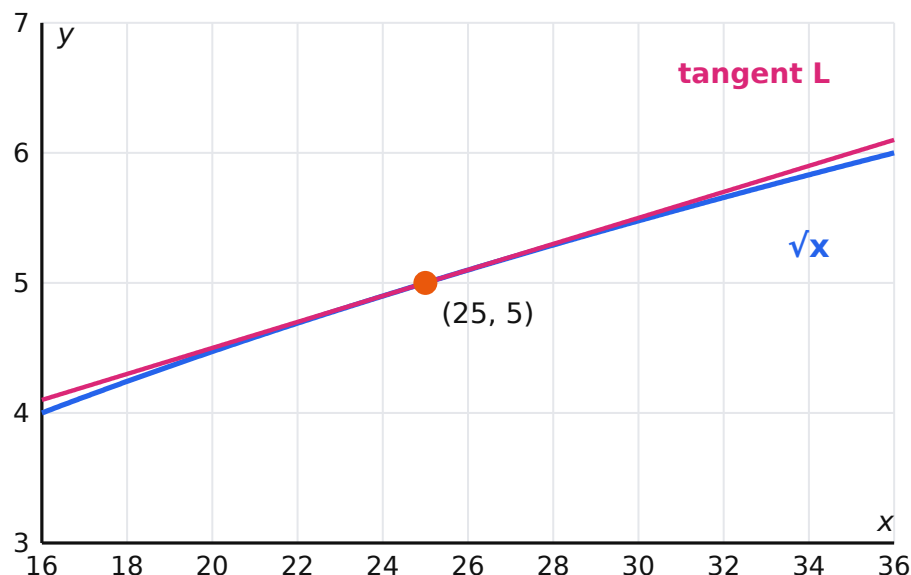
For $s(t) = t^3 - 9t^2 + 24t$ (feet, seconds) find the total distance traveled from $t = 0$ to $t = 6$.

Problem 8: Linearization of a cube

Write the local linearization of $f(x) = x^3$ at $x = 2$ and use it to approximate $f(2.1)$.

Problem 9: Estimate a square root

Approximate $\sqrt{50}$ using the tangent line to $f(x) = \sqrt{x}$ at $x = 49$. Is the estimate too large or too small? The graph near $x = 25$ shows the same shape.



The tangent line at $x = 25$ stays above the concave-down curve, so linearization overestimates.

Problem 10: Estimate a logarithm

Use the tangent line to $f(x) = \ln x$ at $x = 1$ to approximate $\ln(1.05)$.

AP Calculus Contextual Applications Worksheet: problems 11-15

Problem 11: Estimate a cube root

Approximate $\sqrt[3]{8.3}$ with a local linearization of $f(x) = x^{1/3}$ at $x = 8$.

Problem 12: L'Hôpital with sine

Evaluate $\lim_{x \rightarrow 0} \frac{\sin(3x)}{x}$.

Problem 13: L'Hôpital with a quartic

Find the value of $\lim_{x \rightarrow 1} \frac{x^4 - 1}{x^3 - 1}$ by differentiating the numerator and the denominator.

Problem 14: Apply L'Hôpital twice

Evaluate $\lim_{x \rightarrow 0} \frac{e^{2x} - 1 - 2x}{x^2}$.

Problem 15: Logarithm over a root

Determine whether $\lim_{x \rightarrow \infty} \frac{\ln x}{\sqrt{x}}$ exists and find its value.

AP Calculus Contextual Applications Worksheet: problems 16-20

Problem 16: Polynomial over exponential

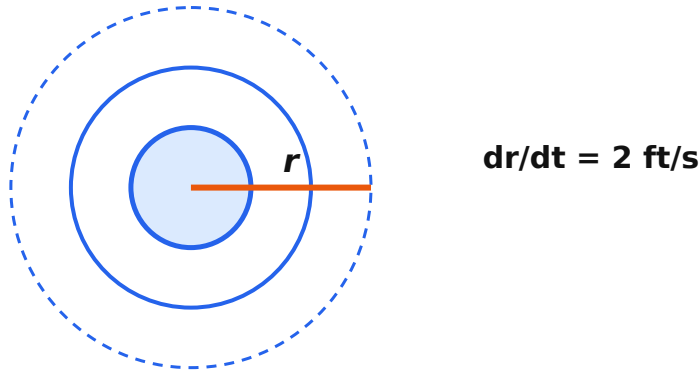
Evaluate $\lim_{x \rightarrow \infty} \frac{x^3}{e^{2x}}$.

Problem 17: Cosine and a square

Evaluate $\lim_{x \rightarrow 0} \frac{1 - \cos 3x}{x^2}$ and name the form that allows L'Hôpital's Rule.

Problem 18: Expanding ripple

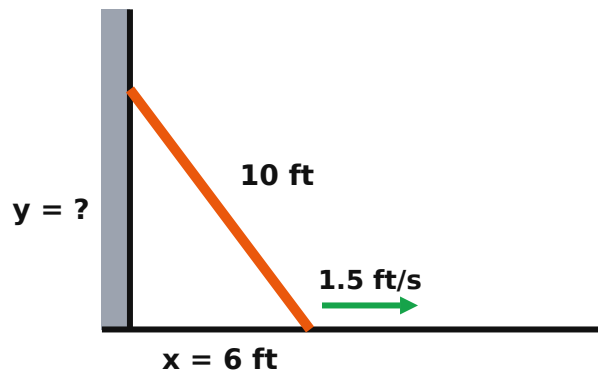
A pebble creates a circular ripple whose radius grows at 2 ft/s. How fast is the enclosed area increasing when the radius is 10 ft?



The ripple radius r increases at 2 ft/s.

Problem 19: Sliding ladder

A 10-foot ladder leans on a wall. Its base is 6 ft from the wall and slides away at 1.5 ft/s. How fast is the top sliding down the wall?



A 10-foot ladder with its base 6 ft from the wall.

Problem 20: Inflating a ball

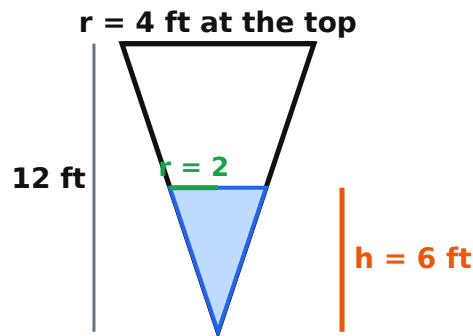
Air is pumped into a spherical ball at 30 in³/s. How fast is the radius increasing when the radius is 3 inches? (Use $V = \frac{4}{3}\pi r^3$.)

AP Calculus Contextual Applications Worksheet: problems 21-25

Problem 21: Filling a conical tank

Water is poured at 5 ft³/min into a tank shaped like a cone with its vertex down. The cone is 12 ft tall with a top radius of 4 ft. How fast is the water level rising when the water is 6 ft deep?

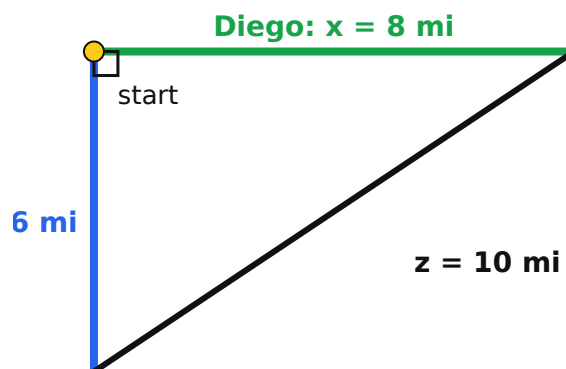
(Use $V = \frac{1}{3}\pi r^2 h$.)



Similar triangles give $r = h/3$, so at $h = 6$ ft the surface radius is 2 ft.

Problem 22: Two walkers

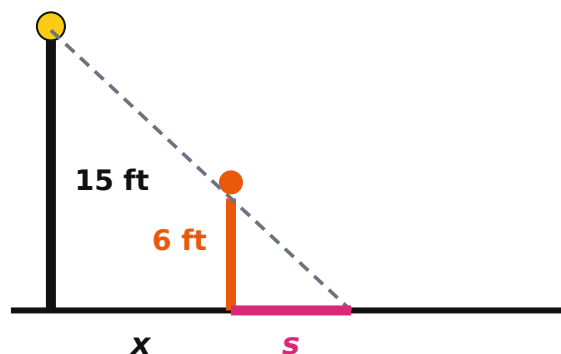
Diego walks east at 4 mph and Aisha walks south at 3 mph, both starting from the same corner. How fast is the distance between them changing after 2 hours?



After 2 hours: legs 8 mi and 6 mi, hypotenuse 10 mi.

Problem 23: Shadow of a walker

A 6-foot-tall person walks away from a 15-foot lamp post at 4 ft/s. Find the speed of the tip of the shadow and the rate at which the shadow is lengthening.



Similar triangles: $s/6 = (x + s)/15$.

Problem 24: Marginal cost

The cost in dollars to make x bracelets at a craft fair is $C(x) = 0.02x^2 + 4x + 500$. Find $C'(100)$, interpret it, and compare it with $C(101) - C(100)$.

Problem 25: Pool volume

The volume of water in a pool, in gallons, is $V(t) = 600 + 40t - t^2$ for t minutes. Find when the volume is changing at -10 gallons per minute, and the volume then.

How to use this ap calculus contextual applications worksheet

Print this ap calculus contextual applications worksheet as a PDF, solve every problem on paper, then compare with the answer key.

