

2.1 Derivative Basics: Form D Key

Tutor copy. Every answer was checked by symbolic computation (SymPy, `verify_set.py`). All problems are original; see the notes file for provenance. Prepared with assistance from Claude, an AI model made by Anthropic.

General grading rules

- **Answer-only items** (Q1, Q9, Q13): all or nothing, except where a row below says otherwise.
- **Value vs. derivative.** Giving a derivative where a function value was asked (or the reverse) earns 0 for that part.
- **Show-work items** (Parts II–IV other than Q9): a bare correct answer earns at most half credit.
- **Definition items** (Q6, Q7): the problem states the required method. A correct answer by differentiation rules earns at most 2 of the 8 points.
- **Method is not graded for efficiency.** A correct answer reached by long but valid work gets full credit; the time it costs is the penalty.

Form D

Item	Answer	Rubric / trap
1(a)	2	<i>Trap:</i> giving the height $f(3) = -1$; earns 0.
1(b)	-1	<i>Trap:</i> the tangent drawn there invites the slope, -2; earns 0.
1(c)	0	<i>Trap:</i> giving the height -3 of the low point; earns 0.
1(d)	DNE	Corner at $(-1, -1)$: one-sided slopes 2 and -2. <i>Trap:</i> 0, because $(-1, -1)$ is a high point.
1(e)	$(-5, -2)$ and $(-1, 1)$	3 pts, all or nothing; union notation is fine. Endpoints may not be included. <i>Trap:</i> $(-5, 1)$, which includes the rising stretch $(-2, -1)$.
1(f)	$f'(-3) < 0 < f'(3)$	$f'(3) = 2$, $f'(-3) = -2$. 3 pts, all or nothing.
2	$y - 2 = 3(x + 2)$, i.e. $y = 3x + 8$	1 pt $f(-2) = 2$; 2 pts $f'(x)$; 1 pt $f'(-2) = 3$; 1 pt equation in any correct form. <i>Trap:</i> $f(-2) = -8 + 8 + 2$ and $f'(-2) = 12 - 8 - 1$: sign slips at a negative input. Writing $x - 2$ for $x - (-2)$ earns 3 of 5.
3	-8 (the point $(0, -8)$)	1 pt $g(4) = 32$; 2 pts $g'(x) = 2x + \frac{4}{\sqrt{x}}$; 1 pt $g'(4) = 10$; 1 pt the intercept from $y = 32 + 10(x - 4) = 10x - 8$. <i>Trap:</i> stopping at the equation (4 of 5), or giving $g(0) = 0$, the graph's own intercept (2 of 5).
4(a)	2	3 pts. Simplifies to $y = 2x + 8$. <i>Trap:</i> -2, the coefficient in the familiar slope position; earns 0.
4(b)	10	2 pts. Substitute $x = 1$. <i>Trap:</i> 6; earns 0.
5	π^2	<i>Trap:</i> k' is printed and invites $k'(\pi) = 2\pi - 2$; earns 0.
6	$f'(x) = -\frac{2}{(2x+1)^2}$	2 pts $f(x+h) = \frac{1}{2(x+h)+1} = \frac{1}{2x+2h+1}$, substituted correctly and in parentheses; 2 pts common denominator, numerator $(2x+1) - (2x+2h+1) = -2h$; 2 pts cancel h to get $\frac{-2}{(2x+2h+1)(2x+1)}$; 2 pts let $h \rightarrow 0$. <i>Trap:</i> writing $f(x)+h$ for $f(x+h)$, or losing a sign across the subtraction. Rules only: at most 2.

Item	Answer	Rubric / trap
7	7	1 pt $g(1) = 3$; 1 pt setup; 3 pts factoring out $x - 1$ to get $x^2 + 3x + 3$, by any valid method. Synthetic or long division by $x - 1$ works (on 1, 2, 0, -3, with the zero placeholder). So does grouping with the difference of cubes: $x^3 + 2x^2 - 3 = (x^3 - 1) + 2(x^2 - 1) = (x - 1)(x^2 + x + 1) + 2(x - 1)(x + 1) = (x - 1)(x^2 + 3x + 3)$. No particular method is required. 3 pts value. <i>Trap</i> : a student who divides and drops the 0x placeholder gets a wrong quotient. Rules only: at most 2.
8(a)	-4	$f'(-1)$ for $f(x) = x^4$: $4(-1)^3 = -4$. <i>Trap</i> : 4, from $(-1)^3 = 1$; earns 0. 3 pts for recognizing which derivative the limit is (or a correct algebraic setup), 3 pts for the value.
8(b)	-1	$\cos x = \cos x - \cos \frac{\pi}{2}$, so this is the derivative of $\cos$ at $\frac{\pi}{2}$: $-\sin \frac{\pi}{2} = -1$. <i>Trap</i> : "0/0, DNE" or 1; earns 0. 3 pts for recognizing which derivative the limit is (or a correct algebraic setup), 3 pts for the value.
9	(a) 0 (b) 0	3 each. <i>Traps</i> : (a) $2 \cos(\pi/6) = \sqrt{3}$; (b) $f'(3) = 1$. In (b), $m(x)$ is the same number for every x , so $m'(x) = 0$; the problem says "for every x ".
10(a)	$-50x^{-6} + 2 \sin x$	1 pt rewriting $10x^{-5}$; 2 pts derivative. <i>Trap</i> : the exponent $-5 - 1 = -6$; the derivative of $-2 \cos x$ is $+2 \sin x$.
10(b)	$3x^2$	1 pt rewriting $x^3 - 3$ (for $x \neq 0$); 2 pts derivative. <i>Trap</i> : differentiating top and bottom separately earns 0.
10(c)	$2x^{-2/3} - 2x^{-3}$	1 pt rewriting $6x^{1/3} + x^{-2}$; 2 pts derivative. <i>Trap</i> : $\frac{1}{3} - 1 = -\frac{2}{3}$.
10(d)	$2x + 5 \cos x$	1 pt rewriting $x^2 - 16 + 5 \sin x$; 2 pts derivative. <i>Trap</i> : $(x - 4)(x + 4) = x^2 - 16$; the constant drops out.
11	$-\frac{5\sqrt{3}}{2} - \frac{4\pi}{3}$	3 pts $f'(x) = -5 \sin x - 4x$; 2 pts value. <i>Trap</i> : $\sin \frac{\pi}{3} = \frac{\sqrt{3}}{2}$; the derivative of $5 \cos x$ is $-5 \sin x$. Using $\cos \frac{\pi}{3}$ earns 3.
12	$x = 2$	2 pts $f'(x) = 3x^2 - 12$; 2 pts $x^2 = 4$; 2 pts the solutions in the interval. <i>Trap</i> : $x = -2$ also solves $3x^2 - 12 = 0$ but lies outside $[-1, 3]$; listing it costs 2.
13(a)	III	u' is a line crossing zero at $x = \frac{3}{2}$, where u turns, with the sign of u 's slope on each side. <i>Trap</i> : II, the same line with the opposite sign, or a parabola because u is a parabola.
13(b)	I	v' is a parabola with zeros at $x = -\frac{3}{2}$ and $x = \frac{5}{2}$, where v turns. <i>Trap</i> : IV, which has the right zeros and the wrong signs.
14	see sketch description	$k' = -1$ for $x < -1$; $k' = 1$ for $-1 < x < 1$; $k' = -1$ for $x > 1$. Open circles at the ends of each segment, at $x = -1$ and $x = 1$. 2 pts per horizontal piece (correct height and interval); -1 once if the open circles are missing or replaced by closed dots. <i>Trap</i> : drawing k 's shape again, or joining the pieces with vertical segments.

Points: $14 + 5 + 5 + 5 + 2 + 8 + 8 + 12 + 6 + 12 + 5 + 6 + 6 + 6 = 100$.