Instructions: Calculators are *not* allowed to be used on this test. There are 100 points. Show all work and simplify your answers unless otherwise specified! Correct answers without work will receive zero points. Also, points will be taken from messy solutions. **Good Luck!** ☺

Question	Points	Score
1	6	
2	5	
3	8	
4	5	
5	6	
6	9	
7	6	
8	6	
9	6	
10	7	
11	8	
12	8	
13	8	
14	12	
Total:	100	

Tests have error codes on each problem.

p or ✓ means perfect!

1. **(6 points)** Suppose the graph of $f(x)$ is given in Figure 1 below.

   a. At what x-value(s) does $f'(x)$ not exist?

   b. Where is $f'(x) > 0$?

   c. What is $f'(-3)$?

A = missing a
B = missing b
C = missing c
D = only c*
E = not A, ½ B
F = not B or C
G = not B or C
H = only C*

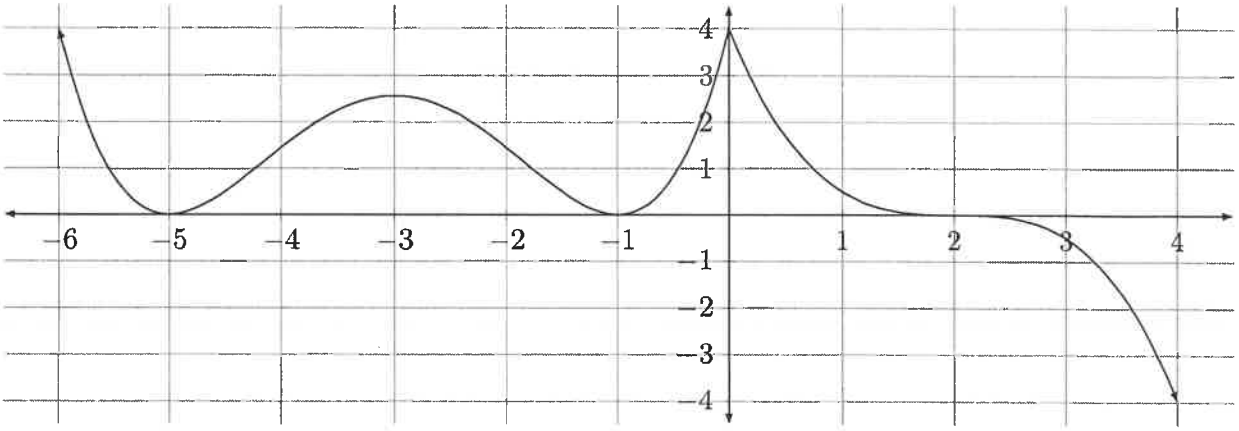

Figure 1: Graph for Questions 1 and 2

2. **(5 points)** Suppose the graph of $g'(x)$ is given in Figure 1 above.

   a. What is $g'(0)$?

   b. At what values does g have horizontal tangent lines?

   c. Where is $g'(x) < 0$?

A = missed 1
B = missed 2
C = missed 3
D = missed 4
E = missed 5

3. (8 points) Use the limit definition of the derivative to compute $f'(x)$ when $f(x) = x^2 + 3x$. (If you do not use the limit definition of the derivative, you will not receive any credit for this problem.)

A: incorrect def., but has answer

B: stopped at $\lim_{h\to 0} 2x+h+3$

C: lost limit

D: kept limit in answer

E: incorrect

F: no work

G: no limit in def, no work to answer, has answer

switched

H: correct def, no work, has answer

4. (5 points) The function $T(x)$ gives the temperature in Knoxville on October 23 at x hours after midnight. Would you expect $T'(8)$ or $T'(16)$ to be larger? Explain your answer.

A: $T(8) < T(16)$

B: depends on function

C: no credit

D: correct answer, wrong logic

5. (6 points) Suppose $f'(4) = 1$, $g(4) = 2$, and $g'(4) = 6$. Do we have enough information to compute $F'(4)$ where $F(x) = f(g(x))$? If so, what is $F'(4)$. If not, what information is missing?

A: functions missing

B: plugged in 1 for f

E: missing $f(4)$

C: missing value but nonspecific/no work

D: $F'(x) = f'(x)g(x)g'(x)$

F: Product rule

G: Close, didn't sub $g(4)$

Find the derivatives of the following functions. You do **not** have to simplify. **(24 points)**

6. $f(x) = e^{x^2} + e^5 + x\sec x$

A: $f'(x) = (2xe^{x^2}) \cdot 0 \cdot (\sec x + x\sec x \tan x)$

B: no product rule

C: $\frac{d}{dx} e^5 = e^5$

D: incorrect $\frac{d}{dx}\sec x$, extra e^x

E: incorrect $\frac{d}{dx}\sec x$

F: no answer

G: only e^{x^2} correct

H: $e^{x^2} = e^x \cdot e^x$ + no product rule

7. $f(x) = \dfrac{x^2 + 2x - 1}{2x^3 + 1}$

A: Derivative of top + bottom

B: no "−" in QR

C: $\frac{d}{dx}(2x^3+1)^{-1} = (6x^2)^{-1}$

8. $f(x) = (x^2 + 6)^4$

A: $f'(x) = (2x)^4$

B: added chain

9. $f(x) = \sec^{-1}(2x)$

A: incorrect $\frac{d}{dx}\sec^{-1} x$

B: no 1·1

C: $2x^2 - 1$

D: missing $|2x|$

E: other

F: no 4 in $\sqrt{\ }$ and no chain

G: no chain

10. (7 points) Find the equation of the tangent line to $f(x) = \sin(\pi x) + 4x$ at $x = \frac{1}{2}$.

A: + instead of − in tan line, incorrect $f'(\frac{1}{2})$

B: incorrect $f'(x)$, $y - f'(x) = f(x)(x - \frac{1}{2})$

C: $f'(x) = \pi x \cos(\pi x) + 4$

D: $f(\frac{1}{2}) = 1$

E: $y - f'(x) = f(x)(x - \frac{1}{2})$

F: didn't evaluate $\sin(\frac{\pi}{2})$ or $\cos(\frac{\pi}{2})$ or did it incorrectly

11. (8 points) Find the second derivative of $f(x) = -\ln(\cos x)$. Make sure to simplify your answer.

A: incorrect $\frac{d}{dx} \tan x$

B: off by negative, didn't simplify

C: not simplified

D: no chain on f', incorrect or omitted f''

E: $\frac{d}{dx} \cos x = \sin x$

F: $\frac{d}{dx} \ln(\cos x) = \frac{1}{-\sin x}$, correct after

12. (8 points) Use logarithmic differentiation to find the derivative of $f(x) = x^{\tan x}$.

A: incorrect ~~derivative~~ $\ln x \quad x^{\tan x} \sec^2 x$

B: ~~no PR~~ $x^{\tan x} \ln(\tan x) \sec^2 x$

C: $\frac{d}{dx}$ ~~cot~~ $\ln x \quad x^{\tan x} \quad \tan x \sec^2 x$

D: $x^{\tan x} (\ln(x + \tan x \sec x)) \sec x \tan x$

E: just set up

F: $x^{\tan x} (\sec^2 x \ln x + \tan^2 x \cdot \frac{1}{x})$

G. incorrect $\frac{d}{dx} \tan x$

H: no credit

13. (8 points) Find $\frac{dy}{dx}$ given $xy + \cot x = 7$.

A: incorrect $\frac{d}{dx} \cot x$

B: no PR

C: $\frac{d}{dx} \cot x = +\csc^2 x$

D: $\frac{d}{dx} \cot x = -\csc x$

I: too many $\frac{dy}{dx}$

J: $\frac{d}{dx} y = yy'$

14. (12 points) Bellwar is not doing well. He just realized that Grimlock the tyrannosaurus rex is running straight at him at a rate of 16 ft/s, and Grimlock's mouth is always exactly 30 ft in the air. Bellwar has one last request. Find the rate of change of the angle between the ground and the line of sight into Grimlock's mouth at the exact moment when the distance from Grimlock's feet to Bellwar is 40 ft. You might as well treat Bellwar as lying on the ground, since it just really is not his day.

A: correct, but #s messed up

B: Just pic/vars

*C: up to derivative correct

D: pic + $\cos\theta = 50$

E: got up to eqn, but not eqn through

F: no x'

G: $x' > 0$, $\tan^{-1}(\theta) = \frac{30}{40}$

H: $\theta = 3/4$

I: incorrect $\sec^2\theta$

J: no particulars

K: x' in denom, no $\sec^2\theta$ value

L: $\frac{d}{dx}\tan x = \tan x$, flipped def of $\tan\theta$

M: sin instead of tan, + for chain

N: $+16 = x'$

O: no credit