Final Exam - Review

Differentiate #1 – 8:

1. $f(x) = (2x^2 + x)^3$

2. $h(x) = \left(x + \frac{1}{x}\right)^2$

3. $f(x) = \frac{x}{e^x}$

4. $f(x) = \frac{e^x}{e^{3x+1}}$

5. $y = \ln(e^{4x} + 3)$

6. $f(x) = ln\left[\frac{(2x^3+1)(x^2+2)^3}{\sqrt[3]{x^5+3x^2-6}}\right]$

7. Logarithmically: $f(x) = \left[\frac{(2x^3+1)(x^2+2)^3}{\sqrt[3]{x^5+3x^2-6}}\right]$

8. $f(x) = (2x^3 + 1)(x^2 + 2)^3$

9. $\int \left(e^{-\pi x} + 7 - \frac{1}{x} - \frac{3}{7x^4}\right) dx$

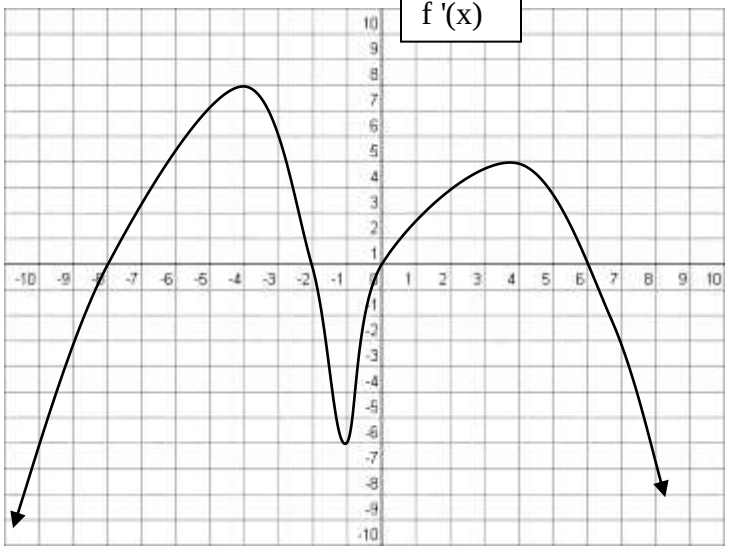
10. Find the average value of the function: $f(x) = \left(\frac{x^3-2}{(x^4-8x+3)^3}\right);\ [-1, 1]$

11. $\int_4^9 \left(5x\sqrt{x}\right) dx$

12. What is the equation of the tangent line, in slope-intercept form, to $y = e^{2x-3}$ at $x = \frac{3}{2}$

13. Graph: $y = x^3 - \frac{3}{2}x^2 - 6x$. Tell me everything about the graph.

14. Dragon-Iguana:

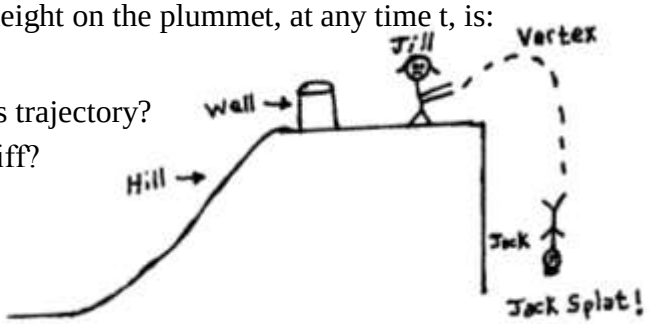


f(x) increasing
f(x) decreasing
f(x) relative maximum(s)
f(x) relative minimum(s)
f(x) concave up (smile)
f(x) concave down (frown)
f(x) inflection points
degree of f(x)
graph f(x)

15. Jack and Jill charge $\mathbf{p = 20 - 2x}$, for each bucket, x, of water. Jill figures the cost of obtaining, fetching water and maintaining the well to be: $\mathbf{C(x) = 4x + 12}$. Calculate the number of buckets of water and the price per bucket necessary to maximize her profits. What is that maximum profit?

16. After $\boldsymbol{t}$ hours of operation, Jack can fetch water at the rate of $\boldsymbol{r(t) = 26 - \frac{2}{3}t}$ buckets per hour. How many buckets are fetched between t = 3 and t = 6 hours?

17. Jill discovers Jack is embezzling from the "up the hill" water company. She takes Jack up to the top of the 768 foot hill, picks him up and bodily hurls him over the sheer drop-off on the other side of the well (Jack was never really a **well** man!). Jill figures Jack's height on the plummet, at any time t, is: $\mathbf{s(t) = -96t^2 + 192t + 768}$ feet from the ground.



(a) How long does it take Jack to hit the apex (vertex) of his trajectory?
(b) What is Jack's maximum height as he is flung off the cliff?
(c) How long does it take Jack to hit the ground?
(d) What was Jack's final speed when he splattered?

18. To celebrate Jack's untimely demise, Jill decides to go tavern hopping. The vast quantities of alcohol Jill consumes is purged from her system according to: $\boldsymbol{B^2 = \frac{2}{5}V^2\sqrt{V}}$, where **B** is blood alcohol and **V** is shots of Grey Goose consumed. Jill has had **4 shots** and is imbibing vodka at **3 shots/min.**, with a pre-existing blood alcohol level of **0.3 ml**. Alcohol toxicity occurs when blood alcohol reaches 120ml. How long does Jill have to live if she doesn't stop bending her elbow?

19. Aliens from a far distant place and time travel to earth and excavate the festering skeleton of your beloved Calculus teacher whom you brutally murdered for putting too many log and e problems on your final exam. These kindly, math-loving, creatures discover there is only 72% of the naturally occurring ^{14}C in the putrefied bones. How long ago did the heinous and most unjustified homicide occur? (the half-life for ^{14}C is **5776** years)

20. $1230 are deposited in a savings account at 4.5% interest compounded continuously.
(a) How many years are required for the balance in the account to reach $3000?
(b) At what rate will the funds be growing when the account reaches $7600?

21. You are designing a mural to cover the side of a large office building. The mural itself will be 1800 ft^2 and will have 2ft. borders on the left and right, and 4ft. borders top and bottom. What are the smallest possible dimensions of the mural?