

This test is closed-book and closed-notes. No calculator is allowed for this test. For full credit show all of your work (legibly!), unless otherwise specified. Answers should be simplified down to arithmetic expressions whenever possible – only unsimplifiable trigonometric, exponential, and trigonometric functions may be left unevaluated.

The problems are in no particular order, and it is suggested that you look at all of them before beginning to answer any.

1. **(10 points)** Answer the following questions about growth and decay.
 - (a) **(3 points)** Market analysis suggests that an investment in Tessier-Ashpool S.A. will have a relative growth rate of 6% per year. If you invest \$5000 in this corporation, how long will it take your investment to grow to a value of \$6000?

 - (b) **(3 points)** Miraclo is a drug with a half-life in the body of 5 hours. Produce a function describing the quantity still in the body t hours after administration of a 40mg dose.

 - (c) **(2 points)** Miraclo becomes ineffective when there is less than 15mg in the body. Using your result from the above question, determine how long after taking a 40mg dose this will occur.

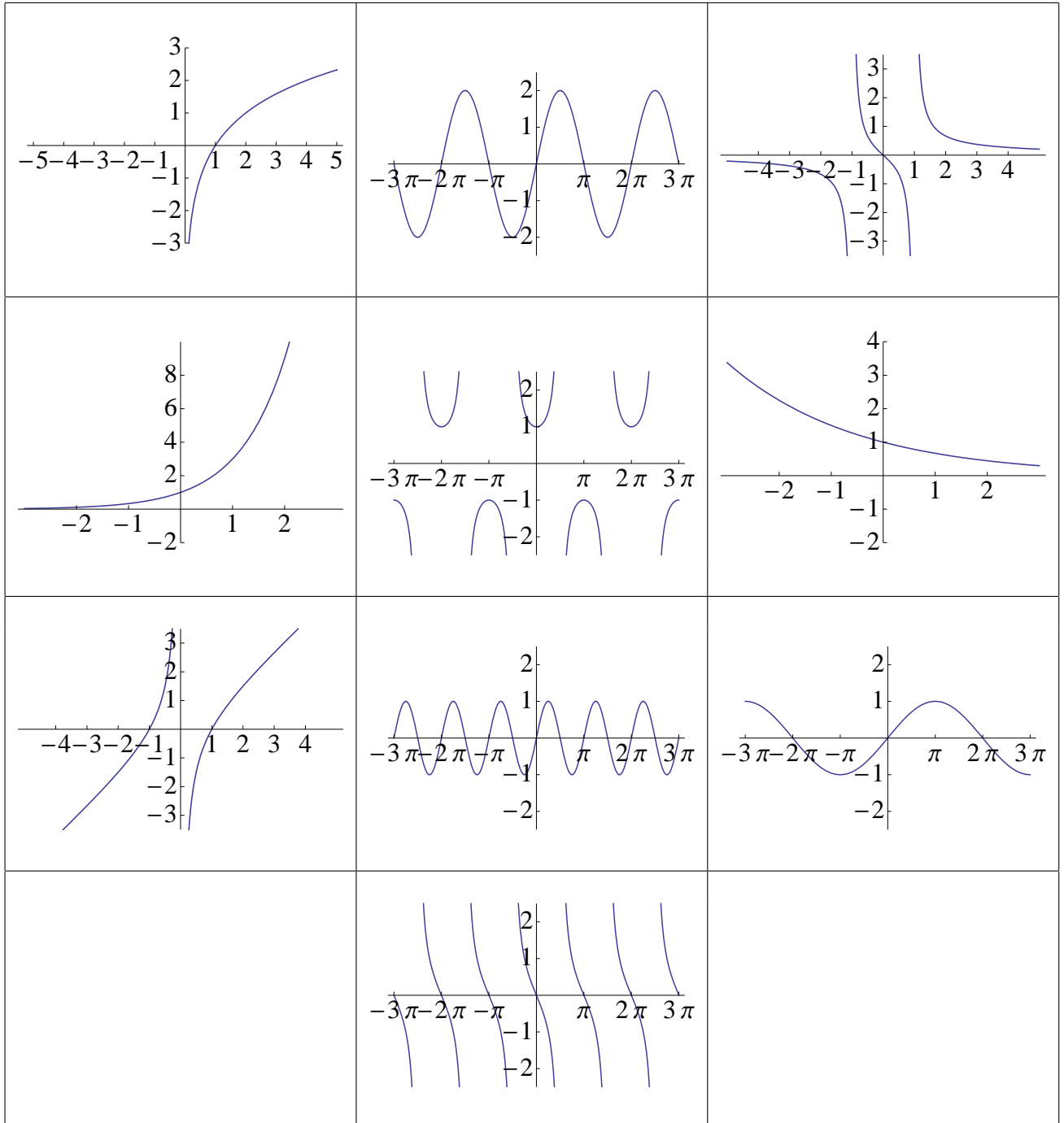
 - (d) **(2 points)** An alien spacecraft, red-hot from its entry into the atmosphere, lands on a warm summer day. Its temperature in degrees Fahrenheit t minutes after impact is given by the function $f(t) = 80 + 1600e^{-0.015t}$. A science team can begin experiments on it after it has cooled to 400°F. How many minutes will they need to wait?

1	/10
2	/10
3	/15
4	/ 5
5	/10
6	/10
Σ	/60

2. (10 points) The following ten graphs are of the following functions:

$$\begin{array}{llll}
 A(x) = 3^x & B(x) = \left(\frac{2}{3}\right)^x & C(x) = \log_2 x & D(x) = \sin 2x \\
 E(x) = 2 \sin x & F(x) = \sin \frac{x}{2} & G(x) = \tan(-x) & H(x) = \sec x \\
 I(x) = \frac{x}{x^2 - 1} & J(x) = \frac{x^2 - 1}{x} & &
 \end{array}$$

Label each picture with the letter of the appropriate function.



3. (15 points) Answer the following questions about trigonometry.

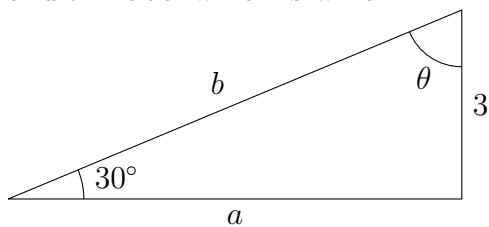
(a) (2 points) Evaluate $\csc \frac{17\pi}{6}$.

(b) (2 points) Evaluate $\sin 270^\circ$.

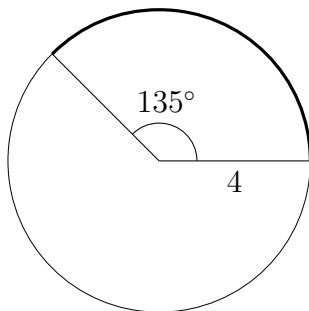
(c) (3 points) Identify the period, amplitude, and vertical shift of the periodic function $g(x) = \frac{1}{3} \cos(\frac{3}{5}x) + 8$.

(d) (3 points) If $\sec x = \frac{-13}{12}$ and x describes a terminal point in the second quadrant, what is $\cot x$?

(e) (3 points) In the following right triangle (not drawn to scale), find the values of a , b , and θ . Label which is which.



(f) (2 points) Find the length of the indicated arc (not drawn to scale).



4. **(5 points)** Answer the following questions about complex numbers.

(a) **(3 points)** Express $(2 + 3i)(1 - i) - (1 + i)(4i)$ in the form $a + bi$.

(b) **(2 points)** Express $\frac{1+2i}{3-i}$ in the form $a + bi$.

5. **(10 points)** Answer the following questions concerning logarithms.

(a) **(2 points)** Express $5 \ln(xy^2) - \frac{1}{4} \ln x - 3 \ln\left(\frac{yz^3}{x}\right)$ as a single logarithm.

(b) **(3 points)** Find the domain of the function $f(x) = \frac{x^2-9}{\log_{10}(x-1)}$.

(c) **(3 points)** Determine the value of $\log_5 30 - \frac{1}{2} \log_5 144 + \log_5 10$.

(d) **(2 points)** Solve for x in the exponential equation $3 \cdot 2^{3x-1} = 48$.

6. **(10 points)** Answer the following questions preparatory to sketching the rational function

$$h(x) = \frac{3(x+2)(x-1)}{x(x+4)}.$$

(a) **(2 points)** What is the function's domain?

(b) **(2 points)** Does this function have x -intercepts, and if so, what are they?

(c) **(2 points)** Where are this function's vertical asymptotes?

(d) **(3 points)** How does this function behave as x becomes very large? How does it behave as x becomes very highly negative? Label which is which.

(e) **(1 point)** Does this function have a maximum or minimum value? Why or why not?