

Write your responses on the pages provided or attach additional pages, as needed. No notes are allowed. A scientific calculator is allowed, but not a graphing calculator. You can specify here which one (1) problem you'd prefer to exclude:

1. Find all zeros for each polynomial function.

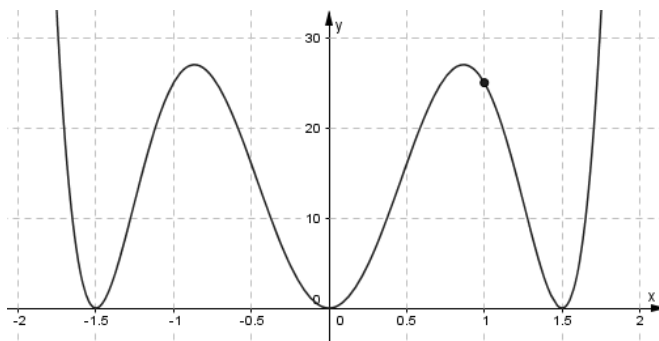
(a)  $f(x) = 2x^3 + x^2 - 3x + 1$ .

(b)  $p(x) = x^5 - 3x^3 + x = x(x^2 + x - 1)(x^2 - x - 1)$ .

2. We seek a formula for the polynomial function with integer coefficients whose graph is shown.

(a) What does the  $y$ -axis symmetry tell you about the polynomial?

(b) What can you deduce about the polynomial from its behavior at  $(0,0)$ ?



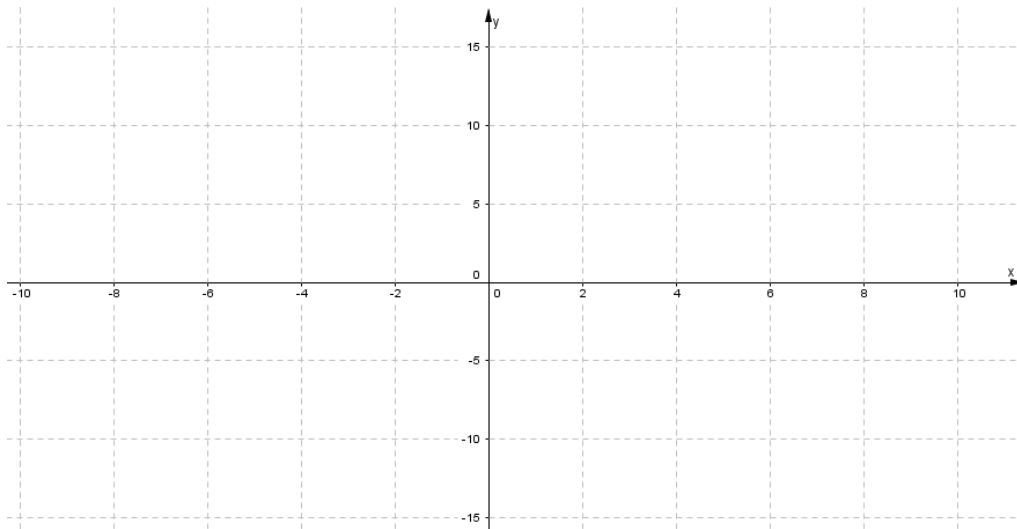
(c) What does the root at  $(1.5, 0)$  tell you about the polynomial (given there are integer coefficients.)?

(d) Find an expression for the polynomial.  
*Hint:* it passes through  $(1, 25)$ .

3. Consider the rational function  $R(x) = \frac{4x^3 - 9x}{x^3 - 1}$

- (a) What are the  $x$ -intercepts of the function?
- (b) What is the  $y$ -intercept?
- (c) What vertical asymptote(s) are there, if any?
- (d) What is the horizontal asymptote?
- (e) Complete the table of values (approximate, as appropriate) and sketch a graph.

$x$	-10	-2	-1.5	-1	0	0.5	1.1	2	10
$y$									



4. Solve each equation.

(a)  $\log_2(x^2 - 32) - \log_2(x + 8) = 1$

(b)  $4 = \frac{10}{1 + 4e^{-0.8t}}$

5. The half-life of polonium-210 is 138 days. Suppose we have a 100-g sample.
- (a) Find a function  $m(t) = m_0 2^{-t/h}$  that models the mass remaining after  $t$  days.
  
  - (b) Find a function  $m(t) = m_0 e^{-rt}$  that models the mass remaining after  $t$  days.
  
  - (c) How much of the sample will remain after 400 days?
  
  - (d) After how many days will only 20 g of the sample remain?
6. For the angles  $\alpha = \arctan(3/4)$ ,  $\beta = \arctan(\sqrt{3})$  simplify each of the following.
- (a)  $\sin(\alpha + \beta)$ .
  
  
  
  
  
  
  
  
  
  
  - (b)  $\cos(2\alpha + \beta)$ .

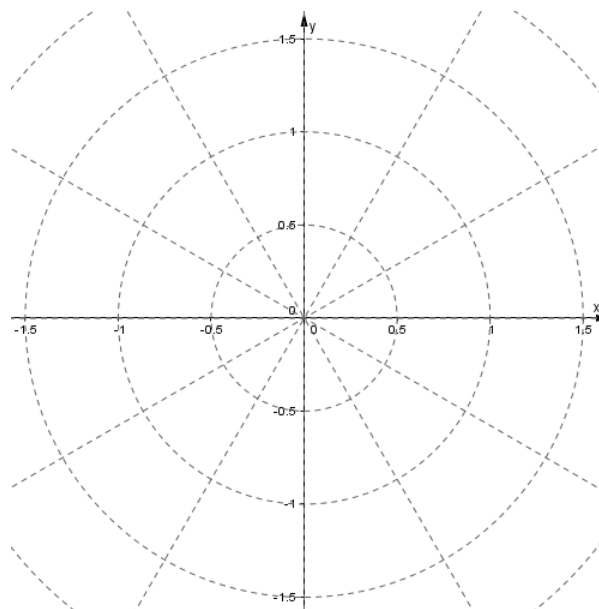
7. Find all solutions to each equation.

(a)  $8\sin^3(x) - 4\sin^2(x) - 6\sin(x) + 3 = 0$  *Hint: factor by grouping.*

(b)  $\sec \theta + \tan \theta = \frac{5}{3}$

8. Complete the table of values and plot the polar function.  $r = \sin \theta + \cos \theta$

$\theta$	0	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$	$\frac{2\pi}{3}$	$\frac{3\pi}{4}$	$\frac{5\pi}{6}$	$\pi$
$r$									



9. Consider the ellipse whose equation is  $\frac{x^2}{9} + \frac{(y-2)^2}{16} = 1$

- (a) Find the coordinates of center.
- (b) Find the  $x$ -intercepts of the ellipse.
- (c) Find the coordinates of the two foci.
- (d) Write parametric equations for the ellipse.
- (e) Sketch a graph for the ellipse

10. Consider the parametric equations

$$x = 2 \tan(t)$$

$$y = 3 + 4 \sec(t)$$

- (a) Eliminate the parameter to find an equation relating  $x$  and  $y$  directly. *Hint:*  
 $\sec^2(t) - \tan^2(t) = 1.$
- (b) Tabulate values for  $t, x$  and  $y$  and use these to sketch a graph for the relation.