

Polynomial and Rational Functions Review: math practice, Grade 12 – download the PDF

22 problems graded by difficulty (★ easy, ★★ medium, ★★★ hard). Try first, without looking at the solutions!

1 Degree and end behavior



Let $f(x) = -2x^5 + 4x^2 - 7$. Give its degree, leading coefficient, and y -intercept, then describe its end behavior.

2 Four end behaviors



Describe the end behavior of each function: (a) $f(x) = 4x^3 - x + 1$; (b) $g(x) = -x^4 + 3x^2$; (c) $h(x) = -6x^3 + x^2$; (d) $k(x) = x^6 - 2x$.

3 Zeros and multiplicities



Find the zeros of $f(x) = x^2(x - 4)(x + 1)^3$, give each multiplicity, and say whether the graph crosses or touches the x -axis there. What is the degree of f ?

4 A first synthetic division



Use synthetic division to divide $x^3 - 4x^2 + x + 6$ by $x - 2$. State the quotient and the remainder, then write the polynomial as a product.

5 Remainders by evaluating



Let $P(x) = x^3 - 5x + 4$. Without dividing, find the remainder when $P(x)$ is divided by (a) $x - 3$ and (b) $x + 1$.

6 Simple asymptotes



Find the vertical and horizontal asymptotes of $f(x) = \frac{3x}{x + 4}$.

7 A quick inequality



Solve $(x - 5)(x + 2) < 0$ and write the answer in interval notation.

8 True or false?



Decide whether each statement is true or false, and justify it. (a) A degree-4 polynomial with real coefficients can have no real zeros. (b) A degree-3 polynomial with real coefficients always has at least one real zero. (c) $f(x) = \frac{x^2 - 1}{x - 1}$ has a vertical asymptote at $x = 1$.

9 Factor Theorem



Show that $x + 3$ is a factor of $P(x) = x^3 + 2x^2 - 5x - 6$, then factor $P(x)$ completely.

10 Finding a missing coefficient



The polynomial $P(x) = x^3 + kx^2 - 3x - 10$ has $x - 2$ as a factor. Find k , then find all the zeros of P , real and complex.

11 Rational Root Theorem at work



List all possible rational zeros of $2x^3 + x^2 - 13x + 6$, then find all of its zeros.

12 An open-top box



A square sheet of cardboard measures 12 inches (about 30.5 cm) on each side. Squares of side x inches are cut from the four corners, and the sides are folded up to make an open box. (a) Show that the volume is $V(x) = x(12 - 2x)^2$. (b) Find the value of x that gives a volume of 128 cubic inches.

13 Hole or asymptote?



Let $f(x) = \frac{2x^2 - 8}{x^2 - x - 6}$. Factor, then find the hole, the vertical asymptote, the horizontal asymptote, and both intercepts.

14 Sign chart for a quotient



Solve $\frac{x + 4}{x - 2} \geq 0$.

15 Slant asymptote



Find the slant asymptote and the vertical asymptote of $f(x) = \frac{2x^2 + 3x - 5}{x + 2}$.

16 Build a polynomial

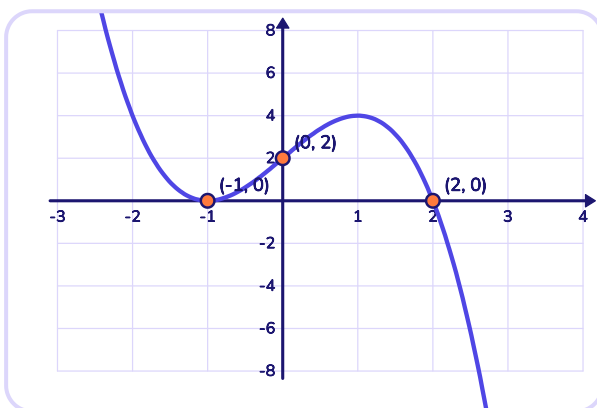
★★★

Write a polynomial P with real coefficients, with zeros -3 , 1 (multiplicity 2), and $2 - i$, of smallest possible degree, and with $P(0) = 30$. Give its degree and end behavior.

17 From a graph to an equation

★★★

The graph of a cubic polynomial f is shown.



(a) Use the zeros and their multiplicities to write $f(x) = a(\dots)$. (b) Use the y -intercept to find a . (c) Expand $f(x)$.

18 Zero given, find the rest

★★★

The polynomial $P(x) = x^4 + x^3 - 5x^2 + x - 6$ has the zero i . Find all its zeros.

19 A rational inequality with a twist

★★★

Solve $\frac{x+1}{x-2} \geq 2$. Explain why you should not multiply both sides by $x-2$.

20 A quartic inequality

★★★

Solve $x^4 - 5x^2 + 4 \leq 0$.

21 Average cost

A workshop has a fixed cost of 1,200 dollars and spends 8 dollars on materials for each item. The average cost per item for x items is $A(x) = \frac{8x + 1200}{x}$, $x > 0$. (a) Find the horizontal asymptote and interpret it. (b) How many items must be made so that the average cost is at most 10 dollars?

22 Missing term, fractional divisor

Let $P(x) = 2x^3 - 5x + 1$. Use synthetic division with $c = \frac{1}{2}$ to divide $P(x)$ by $x - \frac{1}{2}$. What is $P(\frac{1}{2})$? Is $x - \frac{1}{2}$ a factor?

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