

Math  
Released Item 2019

Algebra II

Determine Characteristics of a  
Function  
M41740

Anchor Set  
A1–A10

With Annotations

## Prompt

A function  $f(x)$  is defined as  $f(x) = x^2 + x - 6$ .

Determine:

- the  $x$ -intercepts
- the  $y$ -intercept
- the coordinates of any maximum or minimum
- intervals of increase and decrease

# Rubric

#18 M41740 Rubric	
Score	Description
4	<p>Student response includes each of the following 4 elements:</p> <ul style="list-style-type: none"> <li>• Correctly determines the <math>x</math>-intercepts of the function</li> <li>• Correctly determines the <math>y</math>-intercept of the function</li> <li>• Correctly determines the coordinates at the minimum of the quadratic function</li> <li>• Correctly determines when the function is increasing or decreasing</li> </ul> <p>Sample Student Response:</p> <p>To determine the <math>x</math>-intercepts, use factoring. The factors will reveal the <math>x</math>-intercepts.</p> $x^2 + x - 6 = (x + 3)(x - 2)$ <p>Set each factor equal to 0. Use the zero-product property to solve two simple linear equations.</p> $(x + 3)(x - 2) = 0$ $x + 3 = 0 \quad \text{OR} \quad x - 2 = 0$ $x = -3 \quad \text{OR} \quad x = 2$ <p>The <math>x</math>-intercepts are 2 and <math>-3</math>.</p> <p>To determine the <math>y</math>-intercept, find <math>f(0)</math>.</p> $f(0) = 0^2 + 0 - 6$ $= -6$ <p>The <math>y</math>-intercept is <math>-6</math>.</p> <p>To determine the coordinates of any local maximum or minimum, complete the square.</p> $x^2 + x - 6 = \left(x^2 + x + \frac{1}{4}\right) - 6 - \frac{1}{4}$ $= \left(x + \frac{1}{2}\right)^2 - \frac{25}{4}$ $= \left(x - \left(-\frac{1}{2}\right)\right)^2 - \frac{25}{4}$ <p>The graph opens upward. The expression <math>x - \left(-\frac{1}{2}\right)</math> reveals the <math>x</math>-coordinate of any local minimum. The coordinates of the local minimum are <math>\left(-\frac{1}{2}, -\frac{25}{4}\right)</math>.</p> <p>If <math>x &lt; -\frac{1}{2}</math>, the function is decreasing. If <math>x &gt; -\frac{1}{2}</math>, the function is increasing.</p> <p><b>Note:</b> If the individual answers are unlabeled, they can be credited if they are in the same order as listed in the prompt.</p>
3	Student response includes 3 of the above elements.
2	Student response includes 2 of the above elements.

# Rubric

<b>1</b>	Student response includes 1 of the above elements.
<b>0</b>	Student response is incorrect or irrelevant.

A function  $f(x)$  is defined as  $f(x) = x^2 + x - 6$ .

Determine:

- the  $x$ -intercepts
- the  $y$ -intercept
- the coordinates of any maximum or minimum
- intervals of increase and decrease

$$f(x) = (x + 3)(x - 2)$$

X intercepts are  $x = -3$  and  $x = 2$

y intercept is  $y = -6$

minimum occurs at  $(-0.5, -6.25)$

increasing function  $-0.5 < x < \infty$

decreasing function  $-\infty < x < -0.5$

## Annotation

### **Anchor Paper 1**

#### **Score Point 4**

This response receives full credit. The student includes each of the four required elements:

- The student correctly determines the x-intercepts [ $x = -3$  and  $x = 2$ ].
- The student correctly determines the y-intercept [ $y = -6$ ].
- The student correctly determines the coordinates at the minimum [minimum occurs at  $(-0.5, -6.25)$ ].
- The student correctly determines when the function is increasing [increasing function  $-0.5 < x < \infty$ ] and when it is decreasing [decreasing function  $-\infty < x < -0.5$ ].

A function  $f(x)$  is defined as  $f(x) = x^2 + x - 6$ .

Determine:

- the  $x$ -intercepts
- the  $y$ -intercept
- the coordinates of any maximum or minimum
- intervals of increase and decrease

$x$  intercepts:  $(-3, 0)$  ,  $(2, 0)$

$y$  intercept:  $(0, -6)$

minimum:  $(-.5, -6.25)$

inc. interval:  $x > -.5$

dec. interval:  $x < -.5$



## Annotation

### **Anchor Paper 2**

#### **Score Point 4**

This response receives full credit. The student includes each of the four required elements:

- The student correctly determines the x-intercepts [x intercepts:  $(-3, 0)$ ,  $(2, 0)$ ].
- The student correctly determines the y-intercept [ $(0, -6)$ ].
- The student correctly determines the coordinates at the minimum [minimum:  $(-0.5, -6.25)$ ].
- The student correctly determines when the function is increasing [inc. interval:  $x > -0.5$ ] and when it is decreasing [dec. interval:  $x < -0.5$ ].

A3

Score Point 4

A function  $f(x)$  is defined as  $f(x) = x^2 + x - 6$ .

Determine:

- the  $x$ -intercepts
- the  $y$ -intercept
- the coordinates of any maximum or minimum
- intervals of increase and decrease

$-3$  and  $2$

$-6$

$(-0.5, -6.25)$

$(-0.5, \infty)$

$(-\infty, -0.5)$

## Annotation

### **Anchor Paper 3**

#### **Score Point 4**

This response receives full credit. The student includes each of the four required elements:

- The student correctly determines the x-intercepts  $[-3$  and  $2]$ .
- The student correctly determines the y-intercept  $[-6]$ .
- The student correctly determines the coordinates at the minimum  $[(-.5, -6.25)]$ .
- The student correctly determines when the function is increasing  $[(-.5, \infty)]$  and when it is decreasing  $[(-\infty, -.5)]$ .

The answers are in the correct order, so they are credited, even though they are unlabeled.

A function  $f(x)$  is defined as  $f(x) = x^2 + x - 6$ .

Determine:

- the  $x$ -intercepts
- the  $y$ -intercept
- the coordinates of any maximum or minimum
- intervals of increase and decrease

$$x = \left( -1 \pm \sqrt{1^2 - 4 \times -6} \right) \div 2$$

$$x = 2 \text{ or } -3 \quad x - \text{intercepts } (2, 0) \text{ or } (-3, 0)$$

$$y = 0^2 + 0 - 6$$

$$y = -6 \quad y - \text{intercept } (0, -6)$$

The lowest point is  $(-.5, -6.25)$  this is because it is the vertex of a parabola opening upward. I found this by averaging the  $x$  intercepts and then plugging that into the equation to solve for  $y$ . The interval of increase is 1 because there isn't a number in front of  $x^2$

## Annotation

### **Anchor Paper 4 Score Point 3**

This response receives partial credit. The student includes three of the four required elements:

- The student correctly determines the x-intercepts [ $x = 2$  or  $-3$  *x-intercepts*  $(2, 0)$  or  $(-3, 0)$ ]. Because multiple sets answers are presented and labeled, all must be correct for credit.
- The student correctly determines the y-intercept [ $y = -6$  *y-intercept*  $(0, -6)$ ]. Because multiple sets answers are presented and labeled, all must be correct for credit.
- The student correctly determines the coordinates at the minimum [The lowest point is  $(-0.5, -6.25)$ ].

No credit is given for the intervals of increase and decrease: an incorrect answer is given (The interval of increase is 1).

A function  $f(x)$  is defined as  $f(x) = x^2 + x - 6$ .

Determine:

- the  $x$ -intercepts
- the  $y$ -intercept
- the coordinates of any maximum or minimum
- intervals of increase and decrease

$$y \text{ intercept} = (0, -6)$$

$$\text{minimum} = (-.5, -6.25)$$

$$x \text{ intercepts} = (-3, 0) \text{ and } (2, 0)$$

$$\text{increases at: } x > 0$$

$$\text{decreases at: } x < 0$$

## Annotation

### **Anchor Paper 5 Score Point 3**

This response receives partial credit. The student includes three of the four required elements:

- The student correctly determines the x-intercepts [*x intercepts* =  $(-3, 0)$  and  $(2, 0)$ ]. [The extra symbol next to the 0 is ignored.]
- The student correctly determines the y-intercept [*y intercept* =  $(0, -6)$ ].
- The student correctly determines the coordinates at the minimum [*minimum* =  $(-1.5, -6.25)$ ].

No credit is given for the intervals of increase and decrease: an incorrect answer is given (increases at:  $x > 0$ ; decreases at:  $x < 0$ ).

The individual elements are presented in a different order than the prompt. This is acceptable when the elements are labeled.

A function  $f(x)$  is defined as  $f(x) = x^2 + x - 6$ .

Determine:

- the x-intercepts
- the y-intercept
- the coordinates of any maximum or minimum
- intervals of increase and decrease

$$(-3, 0) \quad (2, 0)$$

$$(0, -6)$$

$$\left(-\frac{1}{2}, -\frac{25}{4}\right)$$



## Annotation

### Anchor Paper 6

#### Score Point 3

This response receives partial credit. The student includes three of the four required elements:

- The student correctly determines the x-intercepts  $[(-3, 0) (2, 0)]$ .
- The student correctly determines the y-intercept  $[(0, -6)]$ .
- The student correctly determines the coordinates at the minimum  $\left[-\frac{1}{2}, -\frac{25}{4}\right]$ .

No intervals of increase and decrease are presented.

The answers are in the correct order, so they are credited, even though they are unlabeled.

A function  $f(x)$  is defined as  $f(x) = x^2 + x - 6$ .

Determine:

- the  $x$ -intercepts
- the  $y$ -intercept
- the coordinates of any maximum or minimum
- intervals of increase and decrease

$(0, -6)$

$(2, 0)$

Minimum:  $(-0.5, -6.25)$



## Annotation

### Anchor Paper 7

#### Score Point 1

This response receives partial credit. The student includes one of the four required elements:

- The student correctly determines the coordinates at the minimum [Minimum:  $(-0.5, -6.25)$ ].

No credit is given for the x-intercepts

$[(0, -6)]$ : incorrect values are given. [This could have been credited for the y-intercept if it had been the second answer presented or if it had been labeled.]

No credit is given for the y-intercept  $[(2, 0)]$ : incorrect values are given.

No intervals of increase and decrease are presented.

A function  $f(x)$  is defined as  $f(x) = x^2 + x - 6$ .

Determine:

- the  $x$ -intercepts
- the  $y$ -intercept
- the coordinates of any maximum or minimum
- intervals of increase and decrease

$$x = -3, 2$$

$$y = 6$$

$$\text{min: } -0.500, -6.25$$



## Annotation

### **Anchor Paper 8**

#### **Score Point 2**

This response receives partial credit. The student includes two of the four required elements:

- The student correctly determines the x-intercepts [ $x = -3, 2$ ].
- The student correctly determines the coordinates at the minimum [min:  $(-0.500, -6.25)$ ].  $-0.500$  is equivalent to  $-0.5$ .

No credit is given for the y-intercept ( $y = 6$ ): the response is missing a negative sign.

No intervals of increase and decrease are presented.

A9

Score Point 2

A function  $f(x)$  is defined as  $f(x) = x^2 + x - 6$ .

Determine:

- the  $x$ -intercepts
- the  $y$ -intercept
- the coordinates of any maximum or minimum
- intervals of increase and decrease

$x$  intercepts are  $-3$  and  $2$ .

$y$  intercepts is  $-6$ .

minimum is  $6.25$

## Annotation

### **Anchor Paper 9**

#### **Score Point 2**

This response receives partial credit. The student includes two of the four required elements:

- The student correctly determines the x-intercepts [x intercepts are  $-3$  and  $2$ ].
- The student correctly determines the y-intercept [y intercepts is  $-6$ ].

No credit is given for the coordinates at the minimum (minimum is  $6.25$ ): both coordinates must be listed and the y-coordinate is missing a negative sign.

No intervals of increase and decrease are presented.

A10

Score Point 1

A function  $f(x)$  is defined as  $f(x) = x^2 + x - 6$ .

Determine:

- the  $x$ -intercepts
- the  $y$ -intercept
- the coordinates of any maximum or minimum
- intervals of increase and decrease

*Zeros =  $(-3, 0)$   $(2, 0)$*   
*Minimum =  $(-5, -6.25)$*



## Annotation

### Anchor Paper 10

#### Score Point 1

This response receives partial credit. The student includes one of the four required elements:

- The student correctly determines the x-intercepts [*Zeros* =  $(-3, 0)$   $(2, 0)$ ].

No credit is given for the coordinates at the minimum [*Minimum*  $-(-5, -6.25)$ ]: the x-coordinate is missing a decimal point. [The dash in front of the ordered pair can be interpreted as a dash setting off the answer rather than a negative sign.]

No y-intercept or intervals of increase and decrease are presented.

# Practice Set

P1–P7

No Annotations Included

A function  $f(x)$  is defined as  $f(x) = x^2 + x - 6$ .

Determine:

- the  $x$ -intercepts
- the  $y$ -intercept
- the coordinates of any maximum or minimum
- intervals of increase and decrease

*x*intercept:  $-6$

*y*intercept:  $1$

a decrease

A function  $f(x)$  is defined as  $f(x) = x^2 + x - 6$ .

Determine:

- the  $x$ -intercepts
- the  $y$ -intercept
- the coordinates of any maximum or minimum
- intervals of increase and decrease

$X$ 's – 2 and negative 3

$Y$  – (-6)

*Minimum* – (-.5, -6.25)

A function  $f(x)$  is defined as  $f(x) = x^2 + x - 6$ .

Determine:

- the  $x$ -intercepts
- the  $y$ -intercept
- the coordinates of any maximum or minimum
- intervals of increase and decrease

*y* - intercept:  $(0, -6)$   
*x* - intercepts:  $(-3, 0)$   
 $(2, 0)$   
minimum:  $(-0.5, -6.25)$

A function  $f(x)$  is defined as  $f(x) = x^2 + x - 6$ .

Determine:

- the  $x$ -intercepts
- the  $y$ -intercept
- the coordinates of any maximum or minimum
- intervals of increase and decrease

−6

A function  $f(x)$  is defined as  $f(x) = x^2 + x - 6$ .

Determine:

- the  $x$ -intercepts
- the  $y$ -intercept
- the coordinates of any maximum or minimum
- intervals of increase and decrease

$(-3, 0)$   $(2, 0)$   
 $(0, -6)$



A function  $f(x)$  is defined as  $f(x) = x^2 + x - 6$ .

Determine:

- the  $x$ -intercepts
- the  $y$ -intercept
- the coordinates of any maximum or minimum
- intervals of increase and decrease

The  $x$  intercepts are  $(-3, 0)$  and  $(2, 0)$ .

The  $y$  intercept is  $(-6, 0)$ .

The minimum is  $(-0.5, -6.25)$ .

Decreasing from  $(-\infty, -0.5)$ .

Increasing from  $(-0.5, +\infty)$ .



A function  $f(x)$  is defined as  $f(x) = x^2 + x - 6$ .

Determine:

- the  $x$ -intercepts
- the  $y$ -intercept
- the coordinates of any maximum or minimum
- intervals of increase and decrease

$(0, -6)$

$(2, 0)$

$(-3, 0)$



# Practice Set

<b>Paper</b>	<b>Score</b>
<b>P1</b>	<b>0</b>
<b>P2</b>	<b>3</b>
<b>P3</b>	<b>3</b>
<b>P4</b>	<b>0</b>
<b>P5</b>	<b>2</b>
<b>P6</b>	<b>3</b>
<b>P7</b>	<b>0</b>