Remainder Theorem: Substitute the opposite of what you're dividing by in for x. → set factor equal to zero

To determine if a binomial is a factor:
- Find the remainder
- If remainder = 0, it is a factor
- If remainder is not 0, it is not a factor

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Algebra II

# The Remainder Theorem

1. What is the remainder when $p(x) = x^3 - 9x^2 + 21x - 5$ is divided by $x - 5$? Is $x - 5$ a factor of $p(x)$? Explain your answer.

$p(5) = (5)^3 - 9(5)^2 + 21(5) - 5$
$p(5) = 0$
remainder = 0

Yes, it is a factor because the remainder is 0.

2. What is the remainder when $p(x) = x^4 - 8x^2 + 3x$ is divided by $x + 4$? Is $x + 4$ a factor of $p(x)$? Explain your answer.

$p(-4) = (-4)^4 - 8(-4)^2 + 3(-4)$
$p(-4) = 116$
remainder = 116

No, it is not a factor because the remainder is not 0.

3. What is the remainder when $p(x) = x^3 - 2x^2 + 6x - 2$ is divided by $x - 3$? Is $x - 3$ a factor of $p(x)$? Explain your answer.

$p(3) = (3)^3 - 2(3)^2 + 6(3) - 2$
$p(3) = 25$
remainder = 25

No, it is not a factor because the remainder is not 0.

4. What is the remainder when $p(x) = x^3 - 5x^2 - 5x + 25$ is divided by $x + 2$? Is $x + 2$ a factor of $p(x)$? Explain your answer.

$p(-2) = (-2)^3 - 5(-2)^2 - 5(-2) + 25$
$p(-2) = 7$
remainder = 7

No, it is not a factor because the remainder is not 0.

5. What is the remainder when $p(x) = x^3 - 6x^2 + 4x - 1$ is divided by $x - 6$? Is $x - 6$ a factor of $p(x)$? Explain your answer.

$p(6) = (6)^3 - 5(6)^2 + 4(6) - 1$
$p(6) = 23$
remainder = 23

No, it is not a factor because the remainder is not 0.

6. What is the remainder when $p(x)=x^3-3x^2-8x+4$ is divided by $x+2$? Is $x+2$ a factor of $p(x)$? Explain your answer.

$p(-2)=(-2)^3-3(-2)^2-8(-2)+4$

$p(-2)=0$

remainder $=0$

Yes, it is a factor because the remainder equals 0.

7. What is the remainder when $p(x)=2x^3+5x+2$ is divided by $2x+1$. Is $2x+1$ a factor of $p(x)$? Explain your answer.

$2x+1=0$ $\quad x=-\frac{1}{2}$

$-1\ -1$

$\frac{2x}{2}=\frac{-1}{2}$

$p(-\frac{1}{2})=2(-\frac{1}{2})^3+5(-\frac{1}{2})+2$

$p(-\frac{1}{2})=-\frac{3}{4}$

remainder $=-\frac{3}{4}$

No, it is not a factor because the remainder is not 0.

8. What is the remainder when $p(x)=3x^3-2x^2-27x+18$ is divided by $3x-2$. Is $3x-2$ a factor of $p(x)$? Explain your answer.

$3x-2=0$

$+2\ +2$

$\frac{3x}{3}=\frac{2}{3}$

$x=\frac{2}{3}$

$p(\frac{2}{3})=3(\frac{2}{3})^3-2(\frac{2}{3})^2-27(\frac{2}{3})+18$

$p(\frac{2}{3})=0$

remainder $=0$

Yes, it is a factor because the remainder equals 0.

9. What is the remainder when $p(x)=2x^3-2x^2+3$ is divided by $4x+1$. Is $4x+1$ a factor of $p(x)$? Explain your answer.

$4x+1=0$ $\quad x=-\frac{1}{4}$

$-1\ -1$

$\frac{4x}{4}=\frac{-1}{4}$

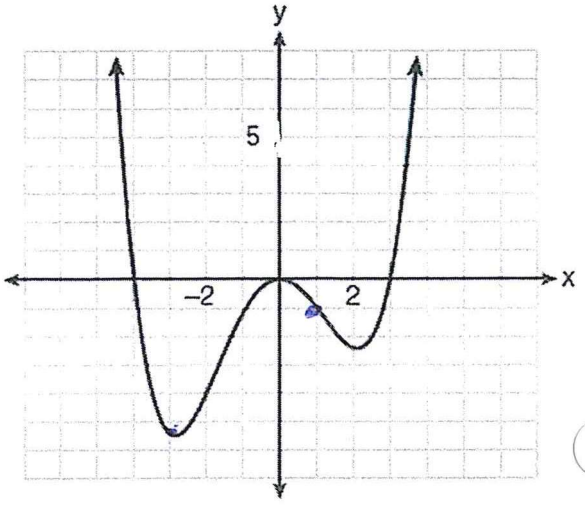
$p(-\frac{1}{4})=2(-\frac{1}{4})^3-2(-\frac{1}{4})^2+3$

$p(-\frac{1}{4})=\frac{91}{32}$

remainder $=\frac{91}{32}$

No, it is not a factor because the remainder is not 0.

**Use the graph below to the right to answer the following two questions.**




10. What is the remainder when the following polynomial is divided by $x-1$? Is $x-1$ a factor? Explain your answer.

$p(1)=-1$

remainder $=-1$

No, the remainder is not 0.

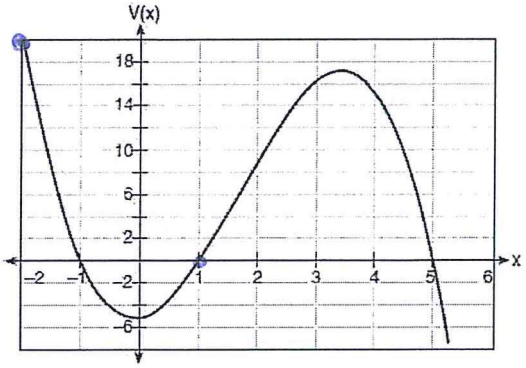
11. What is the remainder when the following polynomial is divided by $x+3$? Is $x+3$ a factor? Explain your answer.

$p(-3)\approx -5.2$

remainder $\approx -5.2$

No, the remainder is not 0.

**Use the graph below to the right to answer the following two questions.**




12. What is the remainder when the following polynomial is divided by $x-1$? Is $x-1$ a factor? Explain your answer.

$P(1)=0$ Yes, the remainder is 0.

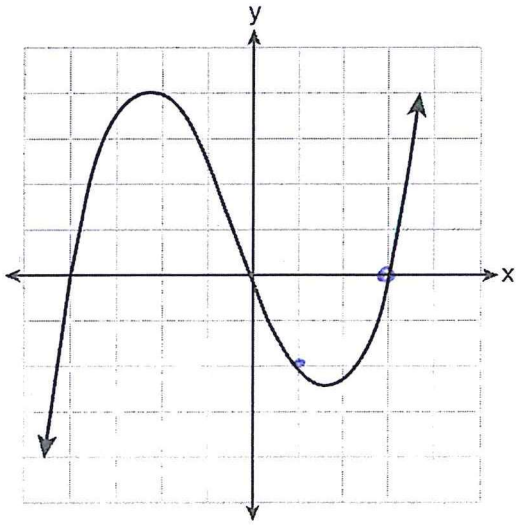
remainder=0

13. What is the remainder when the following polynomial is divided by $x+2$? Is $x+2$ a factor? Explain your answer.

$P(-2)=20$ No, the remainder is not 0.

remainder=20

**Use the graph below to the right to answer the following two questions.**




14. What is the remainder when the following polynomial is divided by $x-1$? Is $x-1$ a factor? Explain your answer.

$P(1)=-2$ No, the remainder is not 0.

remainder=-2

15. What is the remainder when the following polynomial is divided by $x-3$? Is $x-3$ a factor? Explain your answer.

$P(3)=0$ Yes, the remainder is 0.

remainder=0

16. Which binomial is a factor of $x^4-4x^2-4x+8$?

1) $x-2$ $P(2)=0$
2) $x+2$ $P(-2)=16$
3) $x-4$ $P(4)=184$
4) $x+4$ $P(-4)=216$

17. Which binomial is *not* a factor of the expression $x^3-11x^2+16x+84$?

1) $x+2$ $P(-2)=0$
2) $x+4$ $P(-4)=-220$
3) $x-6$ $P(6)=0$
4) $x-7$ $P(7)=0$

18. Which binomial is *not* a factor of the expression $x^3-6x^2-49x-66$?

1) $x-11$ $P(11)=0$
2) $x+2$ $P(-2)=0$
3) $x+6$ $P(-6)=-204$
4) $x+3$ $P(-3)=0$

19. Which binomial is a factor of the expression $x^3 - 7x - 6$?

1) $x+3$ $P(-3) = -12$
2) $x-1$ $P(1) = -12$
3) $x-2$ $P(2) = -12$
4) $x+2$ $P(-2) = 0$

20. Which binomial is *not* a factor of the expression $x^3 - 4x^2 - 25x + 28$?

1) $x+6$ $P(-6) = -182$
2) $x-7$ $P(7) = 0$
3) $x-1$ $P(1) = 0$
4) $x+4$ $P(-4) = 0$

21. Which binomial is not a factor of $p(x) = 2x^3 + 7x^2 - 5x - 4$?

1) $x+4$ $P(-4) = 0$
2) $x+1$ $P(-1) = 6$
3) $x-1$ $P(1) = 0$
4) $2x+1$ $2x+1=0$, $-1\ -1$, $\frac{2x}{2} = \frac{-1}{2}$, $x = -\frac{1}{2}$ $P(-\frac{1}{2}) = 0$

22. Which binomial is not a factor of $p(x) = 2x^3 - 5x^2 + 6x - 2$?

1) $x-1$ $P(1) = 1$
2) $x-2$ $P(2) = 6$
3) $2x-1$ $2x-1=0$, $+1\ +1$, $\frac{2x}{2} = \frac{1}{2}$, $x = \frac{1}{2}$ $P(\frac{1}{2}) = 0$
4) $2x+1$ $2x+1=0$, $-1\ -1$, $\frac{2x}{2} = \frac{-1}{2}$, $x = -\frac{1}{2}$ $P(-\frac{1}{2}) = -\frac{13}{2}$

23. Given $P(x) = x^3 - 3x^2 - 2x + 4$, which statement is true?

1) $(x-1)$ is a factor because $P(-1) = 2$.
2) $(x+1)$ is a factor because $P(-1) = 2$.
3) $(x+1)$ is a factor because $P(1) = 0$.
4) $(x-1)$ is a factor because $P(1) = 0$.

24. If $f(x) = 2x^4 - x^3 - 16x + 8$, then $f\left(\frac{1}{2}\right) = 0$

1) equals 0 and $2x+1$ is a factor of $f(x)$
2) equals 0 and $2x-1$ is a factor of $f(x)$ $2x-1=0$, $+1\ +1$, $\frac{2x}{2} = \frac{1}{2}$, $x = \frac{1}{2}$
3) does not equal 0 and $2x+1$ is not a factor of $f(x)$
4) does not equal 0 and $2x-1$ is a factor of $f(x)$

25. Consider the function $f(x) = 2x^3 + x^2 - 18x - 9$. Which statement is true?

$2x-1=0$, $+1\ +1$, $\frac{2x}{2} = \frac{1}{2}$, $x = \frac{1}{2}$

1) $2x-1$ is a factor of $f(x)$. $P(\frac{1}{2}) = -\frac{35}{2}$
2) $x-3$ is a factor of $f(x)$. $P(3) = 0$
3) $f(3) \neq f\left(-\frac{1}{2}\right)$ $0 \neq 0$
4) $f\left(\frac{1}{2}\right) = 0$ $P(-\frac{1}{2}) =$