

Example Items

Pre-Calculus

Pre-Calculus Example Items are a **representative set** of items for the ACP. Teachers may use this set of items along with the test blueprint as guides to prepare students for the ACP. On the last page, the correct answer, content SE and SE justification are listed for each item.

*The specific part of an SE that an Example Item measures is **NOT** necessarily the only part of the SE that is assessed on the ACP.* None of these Example Items will appear on the ACP.

Teachers may provide feedback regarding Example Items.

(1) Download the [Example Feedback Form](#) and email it. The form is located on the homepage of the [Assessment website](https://assessment.dallasisd.org): <https://assessment.dallasisd.org>.

OR

(2) To submit directly, click “Example Feedback – online form” **after** you click the Example Items link under ACP Resources on the ACP tab on the [Assessment website](#).

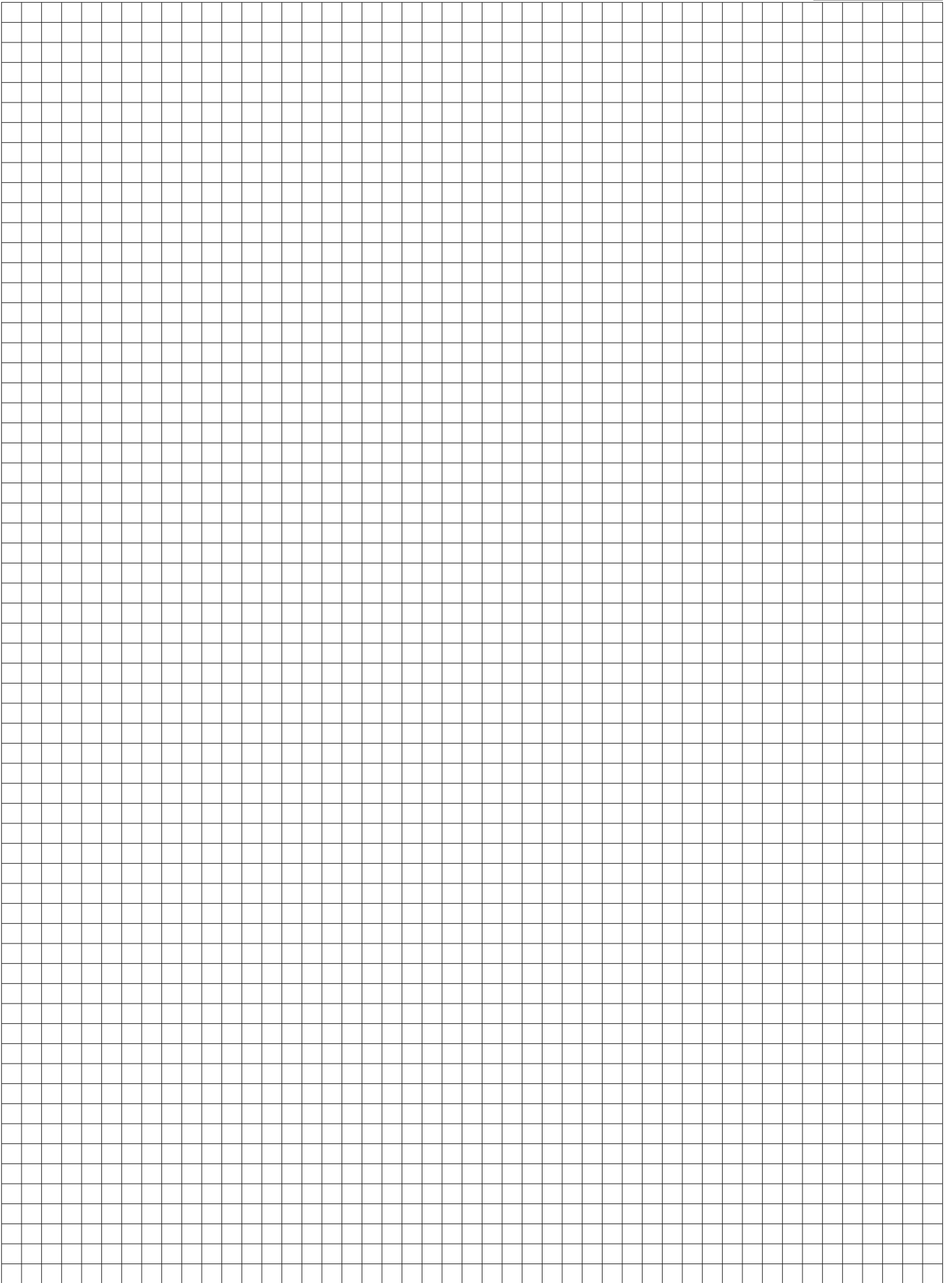
First Semester
2020–2021
Code #: 1121

ACD Formulas
Pre-Calculus/Pre-Calculus PAP
2020-2021

Trigonometric Functions and Identities			
Pythagorean Theorem:	$a^2 + b^2 = c^2$		
Special Right Triangles:	30° - 60° - 90°		$x, x\sqrt{3}, 2x$
	45° - 45° - 90°		$x, x, x\sqrt{2}$
Law of Sines:	$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$	Heron's Formula:	$A = \sqrt{s(s-a)(s-b)(s-c)}$
Law of Cosines:	$a^2 = b^2 + c^2 - 2bc \cos A$	$b^2 = a^2 + c^2 - 2ac \cos B$	$c^2 = a^2 + b^2 - 2ab \cos C$
Linear Velocity:	$v = r \cdot \omega$ $v = r \cdot \frac{\theta}{t}$	Angular Velocity:	$\omega = \frac{\theta}{t}$
Reciprocal Identities:	$\sin \theta = \frac{1}{\csc \theta}$	$\cos \theta = \frac{1}{\sec \theta}$	$\tan \theta = \frac{1}{\cot \theta}$
	$\csc \theta = \frac{1}{\sin \theta}$	$\sec \theta = \frac{1}{\cos \theta}$	$\cot \theta = \frac{1}{\tan \theta}$
Pythagorean Identities:	$\sin^2 \theta + \cos^2 \theta = 1$	$1 + \tan^2 \theta = \sec^2 \theta$	$1 + \cot^2 \theta = \csc^2 \theta$
Sum & Difference Identities:	$\cos(\alpha + \beta) = \cos \alpha \cos \beta - \sin \alpha \sin \beta$	$\sin(\alpha + \beta) = \sin \alpha \cos \beta + \cos \alpha \sin \beta$	
	$\cos(\alpha - \beta) = \cos \alpha \cos \beta + \sin \alpha \sin \beta$	$\sin(\alpha - \beta) = \sin \alpha \cos \beta - \cos \alpha \sin \beta$	
Double-Angle Identities:	$\sin 2\theta = 2 \sin \theta \cos \theta$		$\cos 2\theta = \cos^2 \theta - \sin^2 \theta$
	$\cos 2\theta = 2 \cos^2 \theta - 1$		$\cos 2\theta = 1 - 2 \sin^2 \theta$
Sequences and Series			
The n^{th} Term of an Arithmetic Sequence:	$a_n = a_1 + (n-1)d$	The n^{th} Term of a Geometric Sequence:	$a_n = a_1 r^{n-1}$
Sum of a Finite Arithmetic Series:	$\sum_{k=1}^n a_k = \frac{n}{2}(a_1 + a_n)$	$S_n = \frac{n}{2}[2a_1 + (n-1)d]$	
Sum of a Finite Geometric Series:	$\sum_{k=1}^n a_k = \frac{a_1(1-r^n)}{1-r}, r \neq 1$	$S_n = \frac{a_1 - a_n r}{1-r}, r \neq 1$	
Sum of an Infinite Geometric Series:	$\sum_{n=1}^{\infty} a_n = \frac{a_1}{1-r}, r < 1$		
Binomial Theorem:	$(a+b)^n = {}_n C_0 a^n b^0 + {}_n C_1 a^{n-1} b^1 + {}_n C_2 a^{n-2} b^2 + \dots + {}_n C_r a^{n-r} b^r + \dots + {}_n C_n a^0 b^n$		
Permutations:	${}_n P_r = \frac{n!}{(n-r)!}$	Combinations:	${}_n C_r = \frac{n!}{(n-r)!r!}$
Projectile Motion			
Vertical Position:	$y = tv_0 \sin \theta - \frac{1}{2}gt^2 + h_0$	Horizontal Distance:	$x = tv_0 \cos \theta$
Vertical Free-Fall Motion:	$s(t) = -\frac{1}{2}gt^2 + v_0 t + s_0$	$v(t) = -gt + v_0$	$g \approx 32 \frac{\text{ft}}{\text{sec}^2} \approx 9.8 \frac{\text{m}}{\text{sec}^2}$

ACD Formulas
Pre-Calculus/Pre-Calculus PAP
2020-2021

Conic Sections	
Circle:	Standard Form: $(x - h)^2 + (y - k)^2 = r^2$
Parabola:	Standard Form: $(x - h)^2 = 4p(y - k)$ $(y - k)^2 = 4p(x - h)$
	Focus: $(h, k + p)$ $(h + p, k)$
	Directrix: $y = k - p$ $x = h - p$
Ellipse:	Standard Form: $\frac{(x - h)^2}{a^2} + \frac{(y - k)^2}{b^2} = 1$ $\frac{(x - h)^2}{b^2} + \frac{(y - k)^2}{a^2} = 1$
	Foci: $(h \pm c, k)$ $(h, k \pm c)$
	a, b, c Relationship: $c^2 = a^2 - b^2$ $c^2 = a^2 - b^2$
Hyperbola:	Standard Form: $\frac{(x - h)^2}{a^2} - \frac{(y - k)^2}{b^2} = 1$ $\frac{(y - k)^2}{a^2} - \frac{(x - h)^2}{b^2} = 1$
	Foci: $(h \pm c, k)$ $(h, k \pm c)$
	Asymptotes: $(y - k) = \pm \frac{b}{a}(x - h)$ $(y - k) = \pm \frac{a}{b}(x - h)$
	a, b, c Relationship: $c^2 = a^2 + b^2$ $c^2 = a^2 + b^2$
	Eccentricity: $e = \frac{c}{a}$ $e = \frac{c}{a}$
Exponential Functions	
Simple Interest:	$I = prt$
Compound Interest:	$A = P\left(1 + \frac{r}{n}\right)^{nt}$
Exponential Growth or Decay:	$N = N_0(1 + r)^t$
Continuous Compound Interest:	$A = Pe^{rt}$
Continuous Exponential Growth or Decay:	$N = N_0e^{kt}$
Coordinate Geometry	
Distance Formula:	$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
Slope of a Line:	$m = \frac{y_2 - y_1}{x_2 - x_1}$
Midpoint Formula:	$M = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$
Quadratic Equation: $ax^2 + bx + c = 0$	Quadratic Formula: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
Slope-Intercept Form of a Line:	$y = mx + b$
Point-Slope Form of a Line:	$y - y_1 = m(x - x_1)$
Standard Form of a Line:	$Ax + By = C$



EXAMPLE ITEMS Pre-Calculus, Sem 1

- 1 A soccer player kicks a ball at an angle. The height of the ball, in feet, varies with time and is given by the function

$$h(t) = -16t^2 + 33t$$

where t is the time in seconds. What is the maximum height of the soccer ball to the nearest foot?

Record the answer and fill in the bubbles on the grid provided. Be sure to use the correct place value.

+	0	0	0	0	0	0	0
-	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
	3	3	3	3	3	3	3
	4	4	4	4	4	4	4
	5	5	5	5	5	5	5
	6	6	6	6	6	6	6
	7	7	7	7	7	7	7
	8	8	8	8	8	8	8
	9	9	9	9	9	9	9

- 2 The Texas Department of Public Safety collected data on the stopping distances for a number of different types of cars. They found that one brand's stopping distance could be modeled by the equation

$$y = 0.05x^2 + 0.10x + 5.0$$

where y is the stopping distance in feet and x is the speed of the car in miles per hour. If a car required 100 feet to stop, what was its approximate speed just before beginning to brake?

- A 42.6 mph
- B 44.6 mph
- C 176.0 mph
- D 515.0 mph

EXAMPLE ITEMS Pre-Calculus, Sem 1

- 3** A radioactive substance, Cesium-137, has a half-life of about 30 years. This means that, after every 30 years, half of the amount of Cesium-137 present turns into something else. If the initial amount of Cesium-137 was 70 grams, which exponential decay function represents the amount of Cesium-137 remaining over time, t , in years?

A $f(t) = 30(0.5)^{\frac{-t}{70}}$

B $f(t) = 70(0.5)^{\frac{t}{30}}$

C $f(t) = 30(2)^{\frac{t}{70}}$

D $f(t) = 70 \ln\left(\frac{t}{30}\right)$

- 4** A function is shown.

$$f(x) = \frac{x^2 - 9}{x - 3}$$

Which statement best describes the discontinuities in the graph of $f(x)$?

- A** The graph of $f(x)$ has no discontinuities.
- B** The graph of $f(x)$ has an infinite discontinuity at $x = 3$.
- C** The graph of $f(x)$ has a jump discontinuity at $x = 3$.
- D** The graph of $f(x)$ has a removable discontinuity at $x = 3$.

- 5** If $f(x) = \frac{x-1}{3}$, what is $f^{-1}(x)$?

A $-3x$

B $3x + 1$

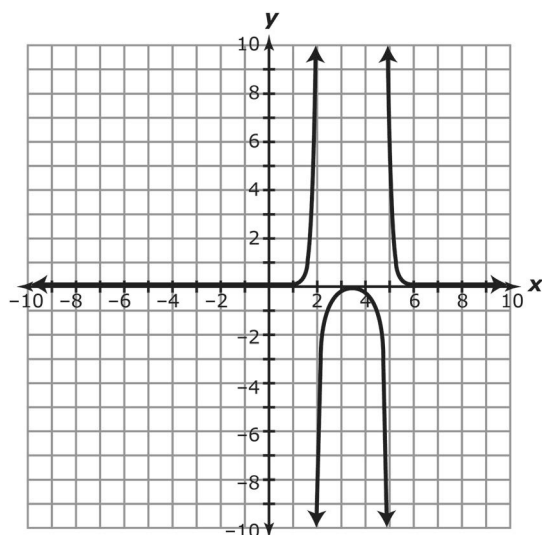
C $3x + 3$

D $\frac{3}{x-1}$

EXAMPLE ITEMS Pre-Calculus, Sem 1

6

A function is graphed on the coordinate grid as shown.



What are the domain and range for this function?

- A** Domain: $(-\infty, 2) \cup (2, 5) \cup (5, \infty)$
Range: $(-\infty, 0) \cup (0, \infty)$
- B** Domain: $(-\infty, 2) \cup (5, \infty)$
Range: $(-\infty, \infty)$
- C** Domain: $(-\infty, \infty)$
Range: $(-\infty, \infty)$
- D** Domain: $(-\infty, \infty)$
Range: $(-\infty, 0) \cup (0, \infty)$

7

If the function $f(x) = x^3$ is changed to $g(x) = (x + 2)^3 + 1$, how is the graph of the function transformed?

- A** The graph of $f(x)$ is translated 2 units right and 1 unit up to create the graph of $g(x)$.
- B** The graph of $f(x)$ is translated 2 units right and 1 unit down to create the graph of $g(x)$.
- C** The graph of $f(x)$ is translated 2 units left and 1 unit up to create the graph of $g(x)$.
- D** The graph of $f(x)$ is translated 2 units left and 1 unit down to create the graph of $g(x)$.

EXAMPLE ITEMS Pre-Calculus, Sem 1

- 8 What is the sum of the arithmetic series $\sum_{k=1}^{15} (3k - 2)$?

Record the answer and fill in the bubbles on the grid provided. Be sure to use the correct place value.

+	•	•	•	•	•	•	•	•
-	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1
	2	2	2	2	2	2	2	2
	3	3	3	3	3	3	3	3
	4	4	4	4	4	4	4	4
	5	5	5	5	5	5	5	5
	6	6	6	6	6	6	6	6
	7	7	7	7	7	7	7	7
	8	8	8	8	8	8	8	8
	9	9	9	9	9	9	9	9

- 9 If $f(x) = 3x + 2$ and $g(x) = 2x^2$, what is $(g \circ f)(-4)$?

- A -320
- B 98
- C 200
- D 392

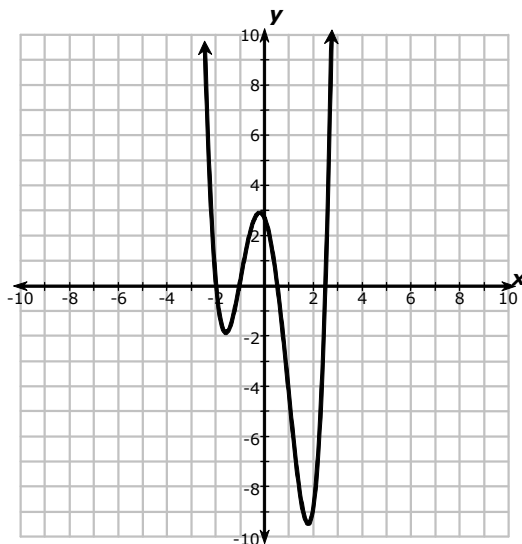
- 10 A theater has 38 rows of seats. The first row has 25 seats, the second row has 29 seats, the third row has 33 seats, and so on. What is the total number of seats in the theater?

- A 3,762
- B 3,838
- C 7,524
- D 7,676

EXAMPLE ITEMS Pre-Calculus, Sem 1

11

The function, $f(x)$, is graphed as shown.



Based on this graph, $f(x)$ has —

- A three real roots and one absolute maximum
- B four real roots and three local maxima
- C four real roots and three local extrema
- D five real roots and three local extrema

12

Newton's Law of Cooling models the temperature, T , of an object over time, t , in minutes, using the function

$$T(t) = T_m + (T_0 - T_m)e^{-kt}$$

where T_0 is the initial temperature of the object, T_m is the temperature of the surrounding medium, and k is a constant for that particular medium. A cookie was taken from the oven and placed on a cooling rack with a surrounding air temperature of 20°C . After five minutes, the cookie cooled to 48°C . If $k = 0.35$, what was T_0 , the initial temperature of the cookie?

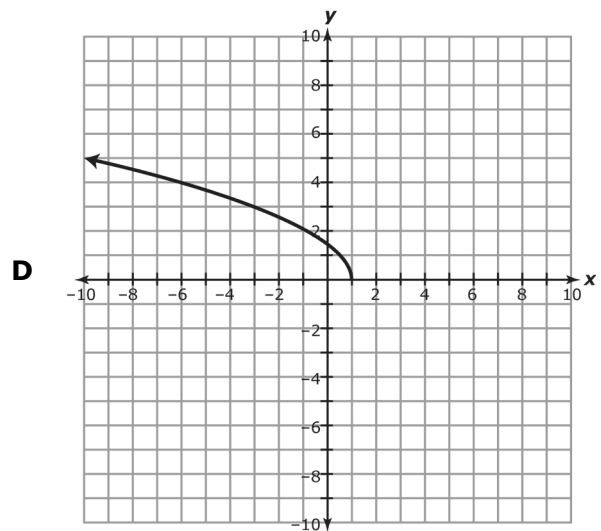
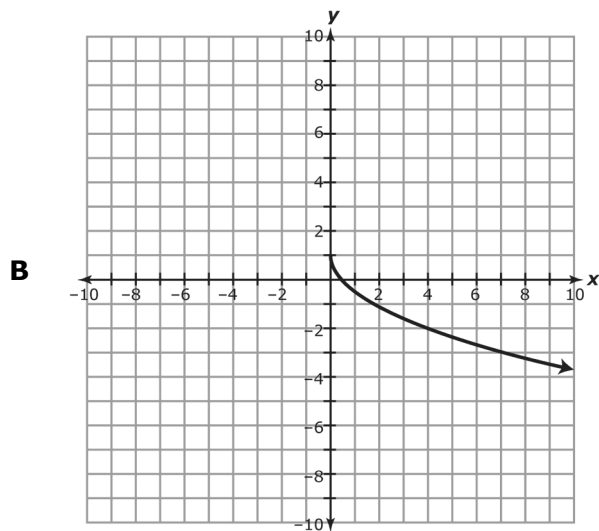
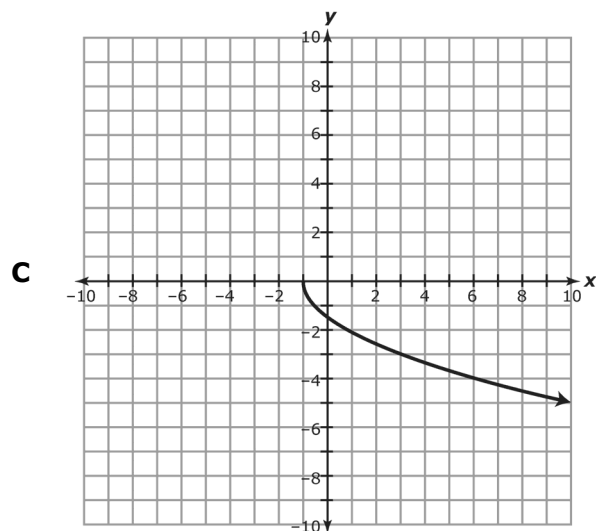
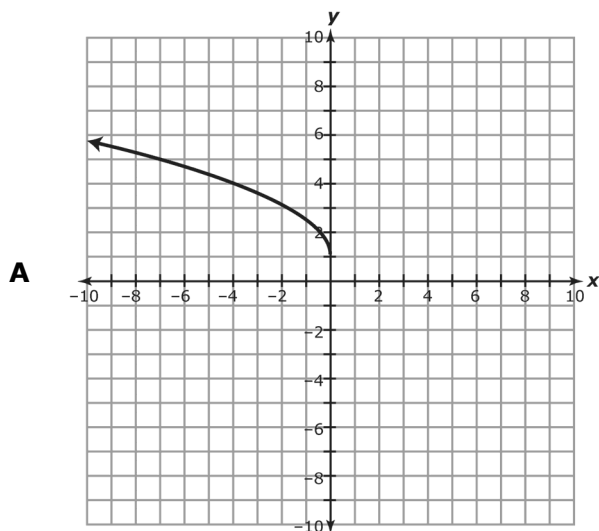
- A About 25°C
- B About 60°C
- C About 181°C
- D About 276°C

EXAMPLE ITEMS Pre-Calculus, Sem 1

- 13** The graph of the function $f(x) = \sqrt{x}$ is transformed using the given steps, in the order shown, to create the graph of $g(x)$.

- Reflect across the x -axis
- Vertically stretch by a factor of 1.5
- Translate 1 unit up

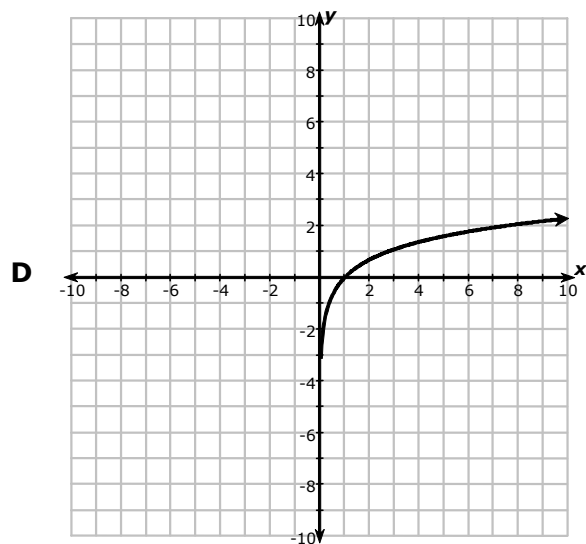
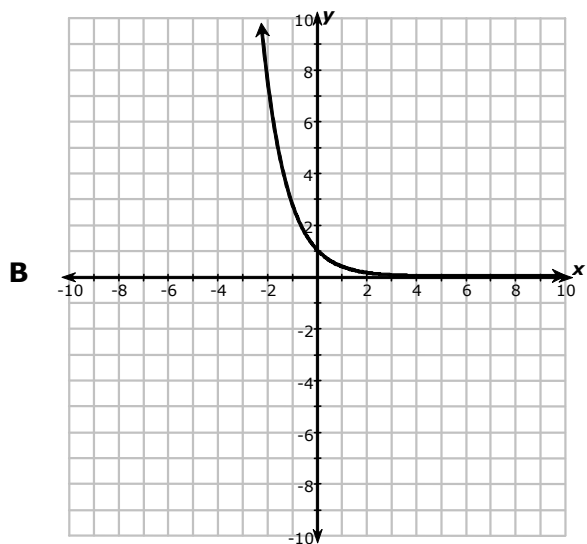
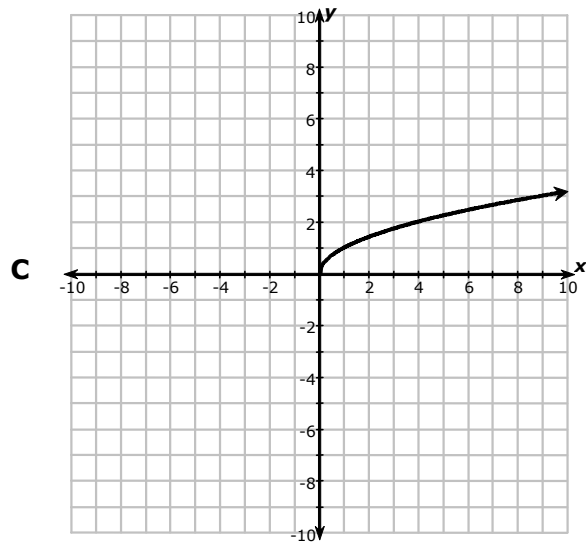
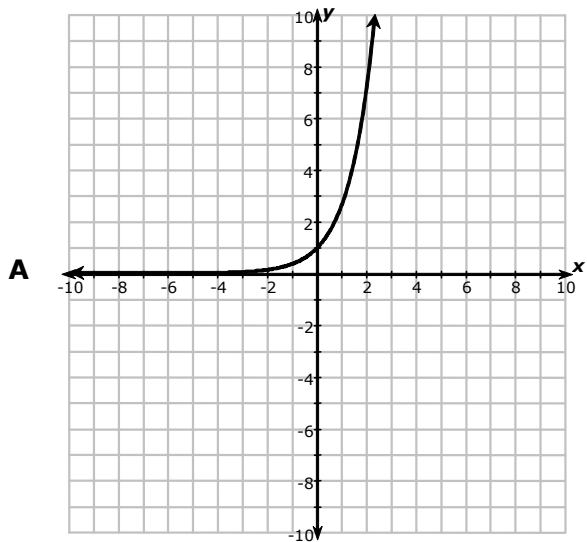
Which graph represents $g(x)$?



EXAMPLE ITEMS Pre-Calculus, Sem 1

14

Which coordinate grid represents the graph of the natural logarithmic function?



15

What is the fourth term in the expansion of $(3x - 2y)^8$?

- A** $-108,864x^5y^3$
- B** $-90,720x^4y^4$
- C** $90,720x^4y^4$
- D** $108,864x^5y^3$

EXAMPLE ITEMS Pre-Calculus, Sem 1

- 16** The Richter scale is used to calculate the intensity of an earthquake based on the amount of observed motion. An earthquake's Richter scale measurement is calculated using the formula

$$R = 3.75 + \log (a)$$

where a is the amplitude of the observed motion in micrometers (μm). What is the amplitude, a , of an earthquake that measures 5.75 on the Richter scale?

- A** 2 μm
- B** 7.4 μm
- C** 10 μm
- D** 100 μm

- 17** What is the sum of the infinite geometric series $-\frac{9}{8} + \frac{3}{4} - \frac{1}{2} + \frac{1}{3} + \dots$?

- A** $-\frac{27}{8}$
- B** $-\frac{27}{40}$
- C** $-\frac{9}{20}$
- D** $\frac{9}{4}$

- 18** The population of a small town is modeled by the equation

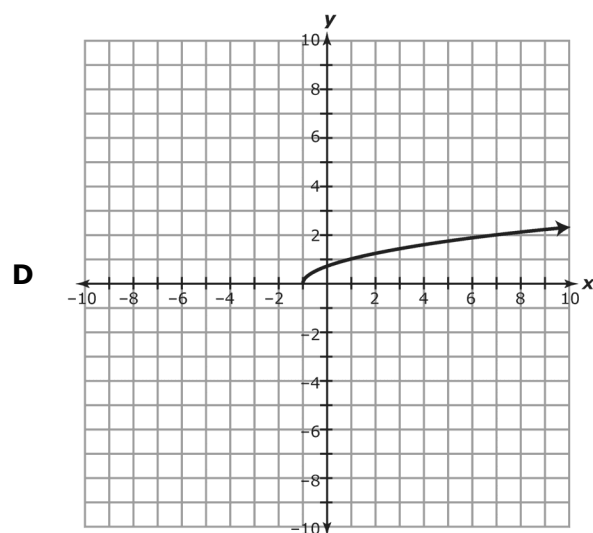
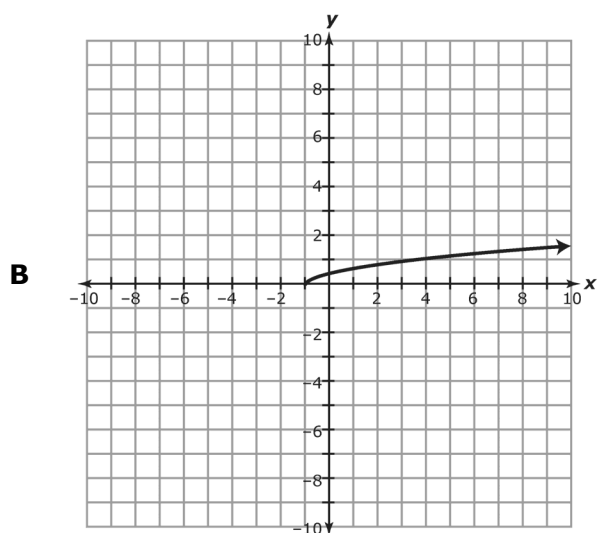
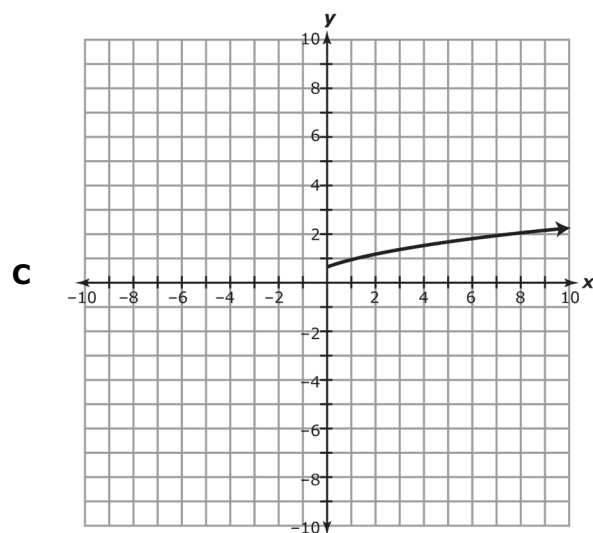
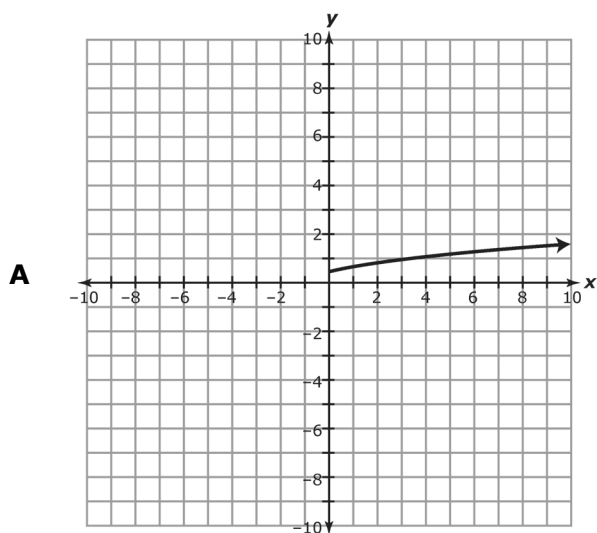
$$P(n) = P_0(1 + r)^n$$

where n is the number of years. In 2004 the population was 45,000. If the annual rate of increase was 7.5%, which equation determines the number of years it takes to double the population?

- A** $P(n) = 90000(1 + 0.075)^n$
- B** $45000 = 90000(1 + r)^{7.5}$
- C** $90000 = 45000(1 + 0.075)^n$
- D** $90000 = 45000(1 + 7.5)^n$

EXAMPLE ITEMS Pre-Calculus, Sem 1

- 19 If the domain of $f(x) = 2x^2 - 1$ is restricted to $[0, \infty)$, which graph represents $f^{-1}(x)$?



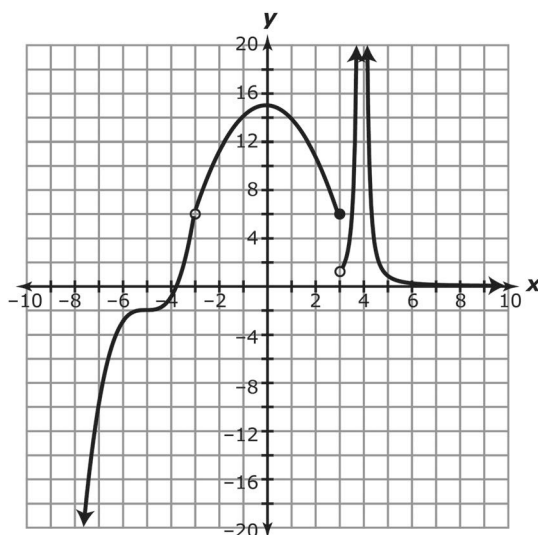
- 20 Which equation represents a horizontal asymptote for the graph of the function $f(x) = \frac{-6x^3 - 11x^2 + 8}{2x^3 + 5x - 4}$?

- A** $y = -3$
B $y = 2$
C $y = 3$
D $y = 5$

EXAMPLE ITEMS Pre-Calculus, Sem 1

21

The graph of a piecewise function is shown.



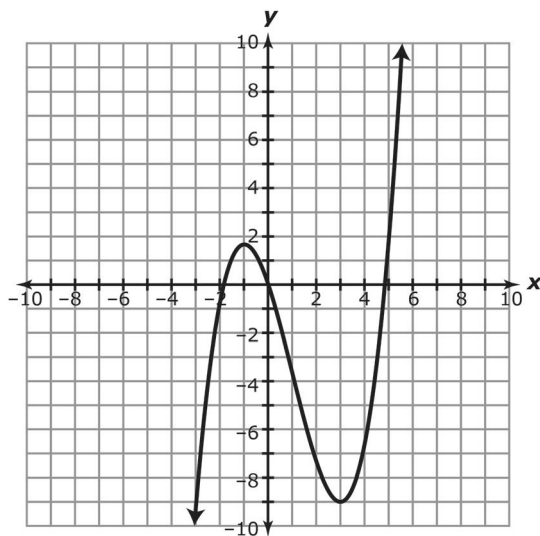
Which statements describe the discontinuities in this graph?

- A** Infinite discontinuities at $x = -8, 4$
Removable discontinuity at $x = -3$
Jump discontinuity at $x = 3$
- B** Removable discontinuity at $x = -3$
Jump discontinuity at $x = 3$
Infinite discontinuity at $x = 4$
- C** Jump discontinuity at $x = 3$
Infinite discontinuity at $x = 4$
No removable discontinuity
- D** Infinite discontinuity at $x = -8$
Removable discontinuities at $x = -3, 3$
Jump discontinuity at $x = 4$

EXAMPLE ITEMS Pre-Calculus, Sem 1

22

A polynomial function is shown on the coordinate grid.



On what interval(s) is the function either increasing or decreasing?

- A** Increasing: $(-2, 0) \cup (5, \infty)$
Decreasing: $(-\infty, -2) \cup (0, 5)$
- B** Increasing: $(1, \infty)$
Decreasing: $(-\infty, 1)$
- C** Increasing: $(-\infty, -1) \cup (3, \infty)$
Decreasing: $(-1, 3)$
- D** Increasing: $(-\infty, \frac{5}{3}) \cup (-9, \infty)$
Decreasing: $(\frac{5}{3}, -9)$

EXAMPLE ITEMS Pre-Calculus Key, Sem 1

Item#	Key	SE	SE Justification
1	17	P.2N	Analyze situations modeled by functions, including exponential, logarithmic, rational, polynomial, and power functions, to solve real-world problems.
2	A	P.5J	Solve polynomial equations with real coefficients in real-world problems.
3	B	P.2N	Analyze situations modeled by functions, including exponential and power functions, to solve real-world problems.
4	D	P.2L	Determine various types of discontinuities in the interval $(-\infty, \infty)$ as they relate to functions.
5	B	P.2E	Determine an inverse function, for a given function over its domain.
6	A	P.2I	Determine the key features of such as domain and range.
7	C	P.2G	Graph functions, including exponential functions and their transformations, including $f(x) + d$, $f(x - c)$, for specific values of c and d , in mathematical problems.
8	330	P.5A	Evaluate finite sums and geometric series, written in sigma notation.
9	C	P.2C	Represent a given function as a composite function of two or more functions.
10	A	P.5C	Calculate the n th partial sum of an arithmetic series in real-world problems.
11	C	P.2I	Analyze the key features of exponential functions such as relative maximum, relative minimum, and zeros.
12	C	P.5I	Solve exponential equations in real-world problems.
13	B	P.2G	Graph functions, including exponential, and their transformations, including $af(x)$, $f(x) + d$, $f(x - c)$, $f(bx)$ for specific values of a , b , c and d , in mathematical problems.
14	D	P.2F	Graph logarithmic functions.
15	A	P.5F	Apply the Binomial Theorem for the expansion of $(a + b)^n$ in powers of a and b for a positive integer n , where a and b are any numbers.
16	D	P.5H	Solve logarithmic equations in real-world problems.
17	B	P.5E	Calculate the sum of an infinite geometric series when it exists.
18	C	P.5I	Generate exponential equations in real-world problems.
19	D	P.2E	Determine an inverse function, when it exists, for a given function over its domain or a subset of its domain and represent the inverse using multiple representations.
20	A	P.2I	Determine the key features of rational functions such as asymptotes.
21	B	P.2L	Determine various types of discontinuities in the interval $(-\infty, \infty)$ as they relate to functions.
22	C	P.2I	Analyze the key features of polynomial functions such as intervals over which the function is increasing or decreasing.