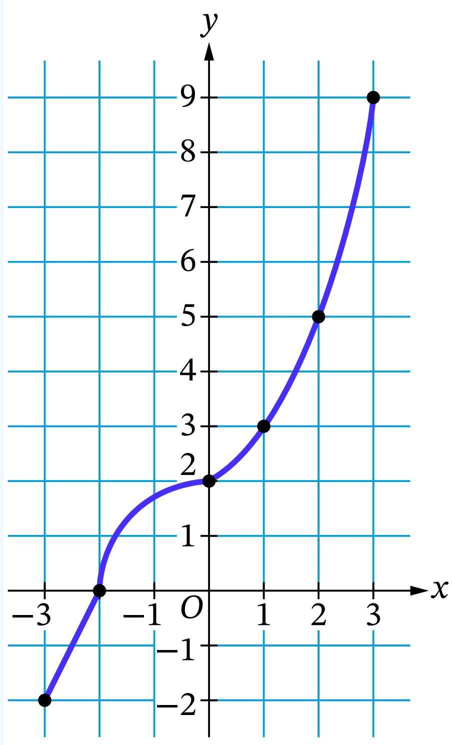
2026

AP® Precalculus

Scoring Guidelines

Question 1: Function Concepts
Part A: Graphing Calculator Required — 6 points

The figure shows the graph of the increasing function f on its domain of $-3 \le x \le 3$.



Graph of f

The function g is given by $g(x) = -4.792 + \ln(6x - 6)$.

	Model Solution	Scoring	
A	i. The function h is defined by $h(x) = (g \circ f)(x) = g(f(x))$. Find the value of $h(2)$ as a decimal approximation, or indicate that it is not defined. Show the work that leads to your answer. ii. Find all values of x for which $f(x) = 3$, or indicate that there are no such values.		
	i. $h(2) = g(f(2)) = g(5) = -1.614$ (or -1.613)	Value	**Point A1**
	ii. From the graph, $f(x) = 3$ when $x = 1$.	Value	**Point A2**

General Scoring Notes for Question 1 Parts A, B, and C

- Decimal approximations must be accurate to three places after the decimal point by rounding or truncating. Decimal values of 0 in final digits need not be reported ($2.000 = 2.00 = 2.0 = 2$).
- A **decimal presentation error** occurs when a response is complete and correct, but either (1) the answer is reported to fewer digits than required or (2) the answer uses exact values rather than decimal form.
- The first decimal presentation error in Question 1 does not earn the point. For each additional part of Question 1 that requires a decimal approximation and contains a decimal presentation error, the response is eligible to earn the point.

Scoring Notes for Part A

- **Point A1** is earned for a correct decimal approximation of -1.614 (or -1.613) with supporting work of " $f(2)$ " OR " $g(5)$ " OR "5."
- **Point A2** does not require supporting work. **Point A2** is earned with a response of "1." [The use of " $x =$ " or $(1, 3)$ is not required.]

Partial Credit for Part A

A response that **does not** earn either **Point A1** or **Point A2** is eligible for **partial credit** in part A if the response has one criterion from the first column AND one criterion from the second column.

Partial credit response is scored **0** for **Point A1** and **1** for **Point A2**.

First Column	**Second Column**
Correct value in part A (i) without supporting work	Indicates one value exists in part A (ii) without giving a specific value
Correct value in part A (i) with a decimal presentation error	

B

i. Find all values of x, as decimal approximations, for which $g(x) = -1.5$, or indicate that there are no such values.

ii. Determine the behavior of g as x-values decrease and get arbitrarily close to 1. Express your answer using the mathematical notation of a limit.

i. $g(x) = -1.5 \Rightarrow -4.792 + \ln(6x - 6) = -1.5$ $x = 5.483$ (or $x = 5.482$)	Value	**Point B1**
ii. As x decreases toward 1, the output values of g decrease without bound. Therefore, $\lim_{x \to 1^+} g(x) = -\infty$.	Behavior with limit notation	**Point B2**

Scoring Notes for Part B

- **Point B1** does not require supporting work. **Point B1** is earned with the correct decimal approximation of 5.483 or 5.482. The use of "$x =$" is not required.
- **Point B2** requires a correct limit statement with four components: "lim", "$x \to 1^+$", the function g, and $-\infty$. Examples that earn **Point B2** include:
  - $\lim_{x \to 1^+} g(x) = -\infty$ or $\lim_{x \to 1^+} g = -\infty$
  - $\lim_{x \to 1^+} g(x) \to -\infty$ or $\lim_{x \to 1^+} g \to -\infty$
  - $\lim_{x \to 1^+} g(x) \quad -\infty$ or $\lim_{x \to 1^+} g \quad -\infty$
- If the response includes an additional, complete limit statement (e.g., $\lim_{x \to \infty} g(x) = \infty$), the limit statement must be correct.

Partial Credit for Part B

A response that **does not** earn either **Point B1** or **Point B2** is eligible for **partial credit** in part B if the response has one criterion from the first column AND one criterion from the second column.
Partial credit response is scored **1** for **Point B1** and **0** for **Point B2**.

First Column	**Second Column**
Correct value in part B (i) with a decimal presentation error	Correct behavior statement in part B (ii) without use of limit notation
	Correct behavior statement in part B (ii) with incorrect limit notation
	Limit statement in part B (ii) that uses "$x \to 1$" or "$x \to 1^-$"

C

i. Is the function f invertible?

ii. Give a reason for your answer in part C (i) based on properties of the function f. Refer to points on the graph of f in your reasoning.

i. Yes, f is invertible (f has an inverse function).	Answer	**Point C1**
ii. No two points on the graph of f have the same y-coordinate. Therefore, there are no repeated $f(x)$ values, and each output value of f is mapped from a unique input value.	Reasoning	**Point C2**

Scoring Notes for Part C

- **Point C1** is earned for a correct answer of "Yes."
- Both **Point C1** and **Point C2** may be earned for a response that appears only in part C (i) or only in part C (ii) AND provides the correct answer and a correct reason, with no errors in either part C (i) or part C (ii).
- **Point C2** requires an implicit or explicit reference to the properties of f AND support for the reason by referencing specific function values or points on the graph of f.
- A response such as "f is one-to-one" OR "f passes the horizontal line test" is not sufficient to earn **Point C2**.
- A response that successfully connects the property that "f is increasing" to "f is invertible" earns **Point C2**. An example response that earns **Point C2** is "Because f is increasing on its domain, there are no repeated $f(x)$ values on the graph."
- Special case: A response that indicates that f **is not** invertible in part C (i) without a reason in part C (i) combined with a response in part C (ii) that provides both the correct answer and a correct reason is scored **0** for **Point C1** and **1** for **Point C2**.

Question 2: Modeling a Non-Periodic Context
Part A: Graphing Calculator Required — 6 points

A person purchased a car at the end of the year 2019 ($t = 0$). The car's value decreases over time. At the end of the year 2020 ($t = 1$), the car was valued at 27.2 thousand dollars. At the end of the year 2025 ($t = 6$), the car was valued at 14.8 thousand dollars.

The value of the car can be modeled by the function V given by $V(t) = ab^t$, where $V(t)$ is the value of the car, in thousands of dollars, at time t, and t is the number of years since the end of 2019.

A

i. Use the given data to write two equations that can be used to find the values for constants a and b in the expression for $V(t)$.

ii. Find the values for a and b as decimal approximations.

Model Solution	Scoring	
i. Because $V(1) = 27.2$ and $V(6) = 14.8$, two equations to find a and b are $ab^1 = 27.2$ $ab^6 = 14.8$	Two equations	**Point A1**
ii. $\dfrac{ab^6 = 14.8}{ab^1 = 27.2} \Rightarrow b^5 = \dfrac{14.8}{27.2}$ $b = 0.885398 \Rightarrow b = 0.885$ $a = 30.720646 \Rightarrow a = 30.721$ (or 30.720) $V(t) = 30.721 \cdot (0.885)^t$ OR $V(t) = 30.720 \cdot (0.885)^t$	Values of a and b	**Point A2**

General Scoring Notes for Question 2 Parts A, B, and C
• Decimal approximations must be accurate to three places after the decimal point by rounding or truncating. Decimal values of 0 in final digits need not be reported ($2.000 = 2.00 = 2.0 = 2$). • A **decimal presentation error** occurs when a response is complete and correct, but either (1) the answer is reported to fewer digits than required or (2) the answer uses exact values rather than decimal form. • The first decimal presentation error in Question 2 does not earn the point. For each additional part of Question 2 that requires a decimal approximation and contains a decimal presentation error, the response is eligible to earn the point.

Scoring Notes for Part A
• **Point A1** is earned for presenting two equations involving *a* and *b* that use the given input-output pairs. • **Point A2** is earned for correct values of *a* and *b* **with or without** supporting work. If correct values are identified, work should be ignored. • **Point A2** is earned for correct values of *a* and *b* presented as either standalone values OR in an expression for $V(t)$. • A response is eligible to earn both **Point A1** and **Point A2** with a correct translation to "thousands." Use of 27,200 and 14,800 results in values of $a = 30{,}720.6458$ and $b = 0.885398$.

Partial Credit for Part A
A response that **does not** earn either **Point A1** or **Point A2** is eligible for **partial credit** in part A if the response has one correct equation in the presence of two equations involving *a* and *b* AND one correct value. Partial credit response is scored **1** for **Point A1** and **0** for **Point A2**.

B

i. Use the given data to find the average rate of change of the value of the car, in thousands of dollars per year, from $t = 1$ to $t = 6$ years. Express your answer as a decimal approximation. Show the computations that lead to your answer.

ii. Use the average rate of change found in part B (i) to estimate the value of the car, in thousands of dollars, at $t = 3$ years. Show the work that leads to your answer.

i. $\dfrac{V(6)-V(1)}{6-1} = \dfrac{(14.8-27.2)}{5} = -2.48$ The average rate of change of the value of the car is -2.48 thousand dollars per year.	Average rate of change	**Point B1**

ii. Using the average rate of change and $V(1) = 27.2$, estimates can be given by $y = 27.2 - 2.48(t - 1)$. For $t = 3$, $y = 27.2 - 2.48(2) = 22.24$. The estimate of the value of the car at $t = 3$ years is 22.24 thousand dollars.	Estimate using average rate of change	**Point B2**

Scoring Notes for Part B (i–ii)

- **Point B1** and **Point B2** both require supporting work.
- **Point B1** is earned for a correct decimal approximation in the presence of a quotient with a difference that uses the given data values. In part B (i), units are not needed and are ignored if presented.
- Another form of the secant line, derived from $V(6) = 14.8$, is $y = 14.8 - 2.48(t - 6)$.
- Eligibility for **Point B2**:
  - If a response in part B (i) has a decimal presentation error **OR** if a response in part B (i) is incorrect:
    - The reported value in part B (i) as the average rate of change can be used to arrive at an estimate in part B (ii). To earn **Point B2**, the estimate in part B (ii) must be consistent with both the reported value in part B (i) and the endpoint used in the supporting work in part B (ii).
- The final number in part B (ii) may be reported as 22 thousand dollars provided the supporting work has a correct decimal approximation for the estimate.
- If a response has a correct translation to "thousands":
  - The response is eligible to earn both **Point B1** and **Point B2**.
  - Use of 14,800 and 27,200 results in an answer of -2480 in part B (i).
  - If a response earned **Point B1** without a decimal presentation error, then an estimate of 22,240 earns **Point B2** in the presence of supporting work.
  - If a response in part B (i) has a decimal presentation error **OR** if a response in part B (i) is incorrect:
    - The reported value in part B (i) as the average rate of change can be used to arrive at an estimate in part B (ii). To earn **Point B2**, the estimate in part B (ii) must be consistent with both the reported value in part B (i) and the endpoint used in the supporting work in part B (ii).

Partial Credit for Part B (i–ii)

A response that **does not** earn either **Point B1** or **Point B2** is eligible for **partial credit** in part B if the response has one criterion from the first column AND one criterion from the second column.

Partial credit response is scored **1** for **Point B1** and **0** for **Point B2**.

First Column	**Second Column**
Correct quotient in part B (i) that uses the given data values and has a decimal presentation error	Correct estimate of 22.24 (thousand) in part B (ii) that does not include supporting work
Correct average rate of change in part B (i) that does not include supporting work	Correct or consistent supporting work in part B (ii) that does not provide an estimate

B

iii. The average rate of change found in part B (i) can be used to determine the secant line for the graph of V on the interval $1 \le t \le 6$. Let $A(t)$ represent the estimate of the value of the car, in thousands of dollars, at time t years, using the secant line. For $A(3)$, found in part B (ii), it can be shown that $A(3) > V(3)$.

In general, $A(t) > V(t)$ for all t, where $1 < t < 6$. Use the secant line and the graph of V to explain why this is true.

iii. The estimate $A(t)$ is the y-coordinate of a point on the secant line that passes through $(1, V(1))$ and $(6, V(6))$. Because the graph of V is concave up everywhere, this secant line is above the graph of V on the interval $1 < t < 6$. Therefore, the estimate $A(t)$ is greater than the value of $V(t)$ for all t on the interval $1 < t < 6$.	Explanation	**Point B3**

Scoring Notes for Part B (iii)

To earn **Point B3**, the explanation must include:

- "The graph of V is concave up" OR "the rate of change of V is increasing."
- An implicit or explicit reference to an appropriate interval.

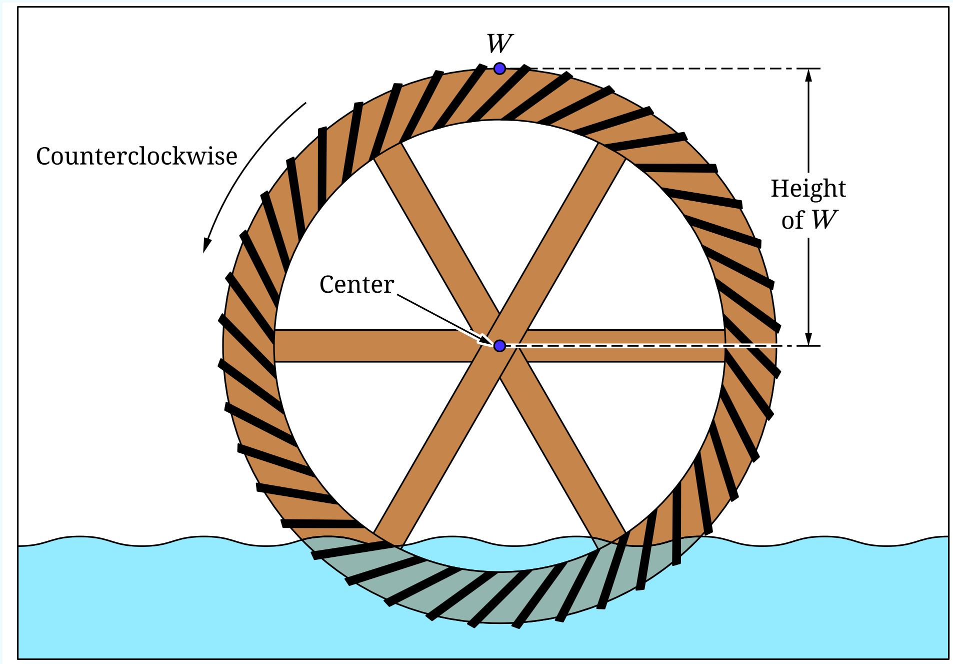
C	When the value of the car reaches 2 thousand dollars, the car's owner plans to donate it to an auto mechanic school. As a result, the car will immediately lose all of its value. Explain how this information can be used to determine a domain limitation for the model V.		
	For $t > 0$, the function V is positive and decreases. Because the car loses all of its value when the value of the car reaches 2 thousand dollars, the model V cannot apply outside the domain $[0, k]$, where $V(k) = 2$. Here, $k = 22.444$ years.	Explanation	**Point C1**

Scoring Notes for Part C

- To earn **Point C1**, the explanation must indicate implicitly or explicitly that the right endpoint of the domain is k, where $V(k) = 2$.
- The value of k is not required but must be correct if included in the response. Acceptable values for k are in the interval $[22.36, 22.444]$.

Question 3: Modeling a Periodic Context
Part B: Graphing Calculator Not Allowed — 6 points

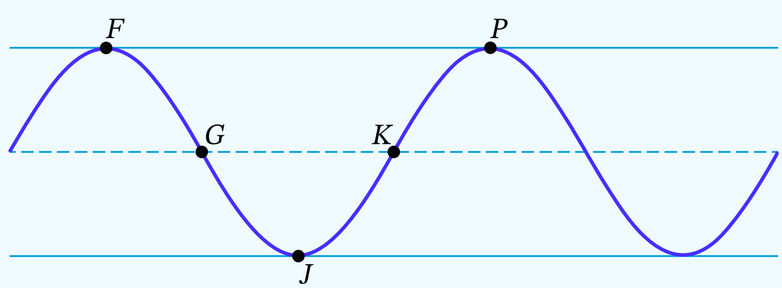
The figure shows a circular waterwheel that rotates in a counterclockwise direction at a constant rate and completes 1 revolution in 10 seconds. At time $t = 0$, point W on the edge of the waterwheel is at a height of 6 feet directly above the center of the waterwheel. The height of point W from the horizontal line through the center of the waterwheel periodically decreases and increases as the waterwheel moves.

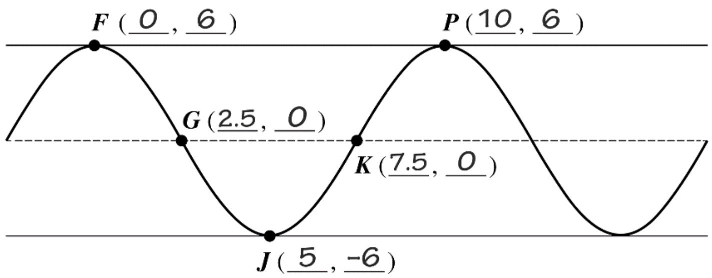


Note: Figure not drawn to scale.

The sinusoidal function h models the height of point W from the horizontal line through the center of the waterwheel, in feet, as a function of time t, in seconds. A positive value of $h(t)$ indicates W is above the line through the center; a negative value of $h(t)$ indicates W is below the line through the center.

	Model Solution	Scoring
A	The graph of h and its dashed midline for two full cycles is shown. Five points, F, G, J, K, and P, are labeled on the graph. No scale is indicated, and no axes are presented. Determine possible coordinates $(t, h(t))$ for the five points: F, G, J, K, and P.	





Note: t-coordinates will vary. A correct set of coordinates for one full cycle of h as pictured is acceptable.

$h(t)$-coordinates	**Point A1**
t-coordinates	**Point A2**

Scoring Notes for Part A

- No supporting work is required.
- $h(t)$-coordinates and/or t-coordinates may appear in a list.
- Negative t-coordinates are acceptable. Fractions do not need to be reduced; equivalent fractions and exact decimal values are acceptable.
- t-coordinates must be $0 + 10k$, $2.5 + 10k$, $5 + 10k$, $7.5 + 10k$, $10 + 10k$ for a specific integer k.
- If the graph is used to record coordinates, that work is scored. In this case, other work is considered scratchwork and is not scored. Use of the graph is not required.

Partial Credit for Part A

A response that **does not** earn either **Point A1** or **Point A2** is eligible for **partial credit** in part A if the response meets one of the following criteria:

- All 5 points are in the form $(h(t), t)$ with correct input values and correct output values swapped.
- 3 out of the 5 points are correct.
- All 5 points $(t, h(t))$ meet these requirements:
  - t-coordinates are in arithmetic sequence with $\Delta t = \frac{5}{2}$.
  - $h(t)$-coordinates are such that:
    1. F and P have **same** $h(t)$-coordinate.
    2. G and K have **same** $h(t)$-coordinate, which is **less than** $h(t)$-coordinate of F and P.
    3. Difference in $h(t)$-coordinates for F and G **equals** Difference in $h(t)$-coordinates for G and J.

Partial credit response is scored **0** for **Point A1** and **1** for **Point A2**.

B The function h can be written in the form $h(t) = a\sin(b(t+c)) + d$. Find values of constants a, b, c, and d.

$\frac{2\pi}{b} = 10$, so $b = \frac{\pi}{5}$

$d = 0$

Method 1

Using $a = 6$:

$c = \frac{5}{2}$ OR $c = \frac{5}{2} + 10k$, for any integer k

$a =$	6
$b =$	$\frac{\pi}{5}$
$c =$	$\frac{5}{2}$
$d =$	0

For example, $h(t) = 6\sin\left(\frac{\pi}{5}\left(t + \frac{5}{2}\right)\right)$. Based on horizontal shifts, there are other correct forms for $h(t)$.

Vertical transformations: Values of a and d — **Point B1**

Horizontal transformations: Values of b and c — **Point B2**

Method 2

Using $a = -6$:

$c = -\frac{5}{2}$. OR $c = -\frac{5}{2} + 10k$, for any integer k

$a =$	-6
$b =$	$\frac{\pi}{5}$
$c =$	$-\frac{5}{2}$
$d =$	0

For example, $h(t) = -6\sin\left(\frac{\pi}{5}\left(t - \frac{5}{2}\right)\right)$. Based on horizontal shifts, there are other correct forms for $h(t)$.

Scoring Notes for Part B

- No supporting work is required.
- Points are earned for correct values in a list OR for correct values in an expression for $h(t)$. Only one of these answer presentations is required.
- Fractions do not need to be reduced; equivalent fractions and exact decimal values are acceptable.
- If the answer box is used to record values, that work is scored. In this case, other work is considered scratchwork and is not scored. Use of the answer box is not required.
- **Point B1** and **Point B2** may be earned based on the correct use of an imported response from part A that meets these criteria:
  - $a \neq 1$, $b \neq 1$, and $c \neq 0$.
  - All 5 points $(t, h(t))$ from part A meet these requirements:
    - t-coordinates are in arithmetic sequence with $\Delta t = \frac{5}{2}$.
    - $h(t)$-coordinates are such that:
      1. *F* and *P* have **same** $h(t)$-coordinate.
      2. *G* and *K* have **same** $h(t)$-coordinate, which is **less than** $h(t)$-coordinate of *F* and *P*.
      3. Difference in $h(t)$-coordinates for *F* and *G* **equals** Difference in $h(t)$-coordinates for *G* and *J*.

Partial Credit for Part B

A response that **does not** earn either **Point B1** or **Point B2** is eligible for **partial credit** in part B if the response meets one of the following criteria:

- Correct values of *a* and *b* [Values of *a* and *b* could be $\pm$].
- Correct values of *b* and *d* [Value of *b* could be $\pm$].
- Response uses $h(t) = a\cos(b(t+c)) + d$ with values as follows:
  - $a = 6$; $b = \frac{\pi}{5}$; $c = 0 + 10k$, for a specific integer *k*; $d = 0$.
  - $a = -6$; $b = \frac{\pi}{5}$; $c = -5 + 10k$, for a specific integer *k*; $d = 0$.

Partial credit response is scored **1** for **Point B1** and **0** for **Point B2**.

C

Refer to the graph of h in part A. The t-coordinate of J is t_1, and the t-coordinate of K is t_2.

i. On the interval (t_1, t_2), which of the following is true about h?

a. h is positive and increasing.

b. h is positive and decreasing.

c. h is negative and increasing.

d. h is negative and decreasing.

ii. On the interval (t_1, t_2), describe the concavity of the graph of h and determine whether the rate of change of h is increasing or decreasing.

i. Choice c	Function behavior	**Point C1**
ii. The graph of h is concave up on the interval (t_1, t_2), and the rate of change of h is increasing on the interval (t_1, t_2).	Concavity of graph and behavior of rate of change	**Point C2**

Scoring Notes for Part C

- No supporting work is required.
- **Point C1** is earned only for a correct answer of "c" OR "negative and increasing." If both the letter choice and written description are included, the written description is scored.
- To earn **Point C2**, both descriptions must be correct. **Point C2** is not earned for a response that only includes "the graph of h is concave up" or only includes "the rate of change of h is increasing."
- To earn **Point C2**, "concave up" AND "increasing" is acceptable.
- To earn **Point C2**, "concave up" AND "function h is increasing at an increasing rate" is acceptable.
- A response with an isolated statement "increasing at an increasing rate" does not earn **Point C2**. The implied subject is "the rate of change of h."
- A response with a statement that "the rate of change of h is increasing at a decreasing (or increasing) rate" does not earn **Point C2**. Analysis to make such a conclusion requires calculus.
- **Point C2** cannot be earned if there are any errors in part C (ii).

Question 4: Symbolic Manipulations
Part B: Graphing Calculator Not Allowed — 6 points

Directions:

- Unless otherwise specified, the domain of a function f is assumed to be the set of all real numbers x for which $f(x)$ is a real number. Angle measures for trigonometric functions are assumed to be in radians.
- Solutions to equations must be real numbers. Determine the exact value of any expression that can be obtained without a calculator. For example, $\log_2 8$, $\cos\left(\frac{\pi}{2}\right)$, and $\sin^{-1}(1)$ can be evaluated without a calculator.
- Unless otherwise specified, combine terms using algebraic methods and rules for exponents and logarithms, where applicable. For example, $2x + 3x$, $5^2 \cdot 5^3$, $\frac{x^5}{x^2}$, and $\ln 3 + \ln 5$ should be rewritten in equivalent forms.
- For each part of the question, show the work that leads to your answers.

A

The functions g and h are given by

$g(x) = e^{2x}$

$h(x) = \log_2(5x)$

i. Solve $g(x) = \frac{1}{e^6}$ for values of x in the domain of g.

ii. Solve $h(x) = 3$ for values of x in the domain of h.

Model Solution	Scoring	
i. $g(x) = \frac{1}{e^6}$ $e^{2x} = \frac{1}{e^6}$ $e^{2x} = e^{-6}$ $2x = -6$ $x = -3$	Solution to $g(x) = \frac{1}{e^6}$	**Point A1**
ii. $h(x) = 3$ $\log_2(5x) = 3$ $2^3 = 5x$ $x = \frac{2^3}{5} = \frac{8}{5}$	Solution to $h(x) = 3$	**Point A2**

Scoring Notes for Part A

- **Point A1** and **Point A2** both require supporting work. "Scratchwork" can be ignored; the use of a variable other than x is acceptable. Arithmetic errors following a complete and correct solution may be considered scratchwork. The use of "$x =$" is not required.
- A logarithmic expression that is missing one or both parentheses around the full argument of the logarithm is eligible to earn **Point A2**.
- Where applicable, answers that have not been evaluated according to bullets two and three in the Directions do not earn the point. Rationalizing denominators is not required.

Partial Credit for Part A

A response that **does not** earn either **Point A1** or **Point A2** is eligible for **partial credit** in part A if the response has one criterion from the first column AND one criterion from the second column.

Partial credit response is scored **1** for **Point A1** and **0** for **Point A2**.

First Column	**Second Column**
Correct answer in part A (i) without supporting work.	Correct answer in part A (ii) without supporting work.
Correct answer in part A (i) with supporting work, but the answer has not been evaluated according to bullets two and three in the Directions (e.g., $x = \frac{1}{2}\ln\left(\frac{1}{e^6}\right)$). No incorrect work.	Correct answer in part A (ii) with supporting work, but the answer has not been evaluated according to bullets two and three in the Directions (e.g., $x = \frac{2^3}{5}$). No incorrect work.
Answer in part A (i) is reported as $2x = -6$. No incorrect work follows.	Answer in part A (ii) is reported as $2^3 = 5x$. No incorrect work follows.

B The functions j and k are given by

$j(x) = 7^{(3x+1)} \cdot 7^x$

$k(x) = \sin(2x)\sec x$

i. Rewrite $j(x)$ as an expression of the form $7^{(\text{expression})}$.

ii. Rewrite $k(x)$ as an expression in which $\sin x$ appears exactly once and no other trigonometric functions are involved.

i. $j(x) = 7^{(3x+1)} \cdot 7^x$ $j(x) = 7^{(3x+1+x)}$ $j(x) = 7^{(4x+1)}$	Expression for $j(x)$	**Point B1**

ii. $k(x) = \sin(2x)\sec x$ $k(x) = 2\sin x\cos x \cdot \dfrac{1}{\cos x}$ $k(x) = 2\sin x,\ \cos x \neq 0$	Expression for $k(x)$	**Point B2**

Scoring Notes for Part B

- **Point B1** is earned with a correct expression for $j(x)$ without supporting work, provided no incorrect work is included. "Scratchwork" can be ignored; the use of a variable other than x is acceptable. The use of "$j(x) =$" is not required.
- **Point B2** requires supporting work. Scratchwork can be ignored; the use of a variable other than x is acceptable. The use of "$k(x) =$" is not required.
- Domain restrictions are not required to be included and are not scored whether correct or incorrect.
- Where applicable, answers that have not been evaluated according to bullets two and three in the Directions do not earn the point.
- If a response is presented as a complex fraction, the complex fraction must be unambiguous in structure. Parentheses must be used correctly, and/or the fraction bars must be clearly and correctly proportioned.

Partial Credit for Part B

A response that **does not** earn either **Point B1** or **Point B2** is eligible for **partial credit** in part B if the response has one criterion from the first column AND one criterion from the second column.
Partial credit response is scored **1** for **Point B1** and **0** for **Point B2**.

First Column	**Second Column**
Expression in part B (i) is reported in the form $7^{(\text{expression})}$, but the answer has not been evaluated according to bullets two and three in the Directions. No incorrect work follows.	Correct expression in part B (ii) without supporting work.
	Expression in part B (ii) is reported as $2\sin x\cos x \cdot \dfrac{1}{\cos x}$. No incorrect work follows.
	Expression in part B (ii) includes a correct application of the double angle identity for sine with no incorrect work.

C The function m is given by $m(x) = \tan^2(3x)$.

Find all input values for m in the interval $\left[0, \frac{\pi}{2}\right]$ that yield an output value of 1.

$m(x) = 1 \Rightarrow \tan^2(3x) = 1$ $\tan(3x) = \pm 1$ Therefore, $3x = \frac{\pi}{4} + \pi n$ or $3x = \frac{3\pi}{4} + \pi n$, where n is any integer	One value of $3x$ for which $\tan(3x) = \pm 1$	**Point C1**
$x = \frac{\pi}{12} + \frac{\pi}{3}n$ or $x = \frac{\pi}{4} + \frac{\pi}{3}n$, where n is any integer Because x is in $\left[0, \frac{\pi}{2}\right]$, $x = \frac{\pi}{12}$, $x = \frac{5\pi}{12}$, and $x = \frac{\pi}{4}$.	All values of x	**Point C2**

Scoring Notes for Part C

- **Point C1** and **Point C2** both require supporting work. "Scratchwork" can be ignored; the use of a variable other than x is acceptable. The use of "$x =$" is not required.
- **Point C1** is earned for having a correct value for $3x$ or for x (e.g., $3x = \frac{\pi}{4}$ or $x = \frac{\pi}{12}$). It is not required to include $+\pi n$ or $+\frac{\pi}{3}n$ for **Point C1**.
- **Point C1** is earned for correct equivalent forms such as $3x = -\frac{3\pi}{4}$ OR $x = -\frac{\pi}{4}$.
- **Point C1** and **Point C2** are both earned for a response with supporting work that gives the three correct values for x.
- Supporting work does not need to include a general solution for all values for x. If included, a general solution does not require "where n is any integer." If included, the response can use i, k, n, or any letter except x, which is the variable used in the function.
- To earn **Point C2**, no incorrect values for x are included.
- A correct general solution for all values for x is not sufficient to earn **Point C2**. The three correct values for x in the interval $\left[0, \frac{\pi}{2}\right]$ must be included to earn **Point C2**.