Past-paper walk-through

Function Model Selection and Assumption Articulation ▪ 1.13

eXercise

Questions in this set

- 2026 Q2
- 2025 Q1
- 2025 Q2
- 2024 Q2

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- // separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = "or words to that effect" – the wording need not match.

Question 2

2026 ▪ Q2

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 $V(t)$.

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

Question 2

2026 ▪ Q2

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.

(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.

(b)(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.

Question 2

(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 $1 \leq t \leq 6$. 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.

Question 2

2026 ▪ Q2

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.

(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.

Question 1

2025 ▪ Q1

The function f is decreasing and is defined for all real numbers. The table gives values for $f(x)$ at selected values of x.

x	-2	-1	0	1	2
$f(x)$	14	7	3.5	1.75	0.875

The function g is given by $g(x) = -0.167x^3 + x^2 - 1.834$.

Question 1

(a)(i) The function h is defined by $h(x) = (g \circ f)(x) = g(f(x))$. Find the value of $h(1)$ as a decimal approximation, or indicate that it is not defined. Show the work that leads to your answer.

(a)(ii) Find the value of $f^{-1}(3.5)$, or indicate that it is not defined.

(b)(i) Find all values of x, as decimal approximations, for which $g(x) = 0$, or indicate that there are no such values.

(b)(ii) Determine the end behavior of g as x increases without bound. Express your answer using the mathematical notation of a limit.

(c)(i) Based on the table, which of the following function types best models function f: linear, quadratic, exponential, or logarithmic?

Question 1

(c)(ii) Give a reason for your answer in part C (i) based on the relationship between the change in the output values of f and the change in the input values of f. Refer to the values in the table in your reasoning.

Question 1

x	-2	-1	0	1	2
$f(x)$	14	7	3.5	1.75	0.875

The function g is given by $g(x) = -0.167x^3 + x^2 - 1.834$.

A.

i. The function h is defined by $h(x) = (g \circ f)(x) = g\big(f(x)\big)$. Find the value of $h(1)$ decimal approximation, or indicate that it is not defined. Show the work that le

Solution 1

(a)(i)

Mark scheme

- $h(1) = g(f(1)) = g(1.75)$. From the table, $f(1) = 1.75$. Then $g(1.75) = -0.167(1.75)^3 + (1.75)^2 - 1.834 \approx 0.333$. So $h(1) = 0.333$ (decimal approximation, accurate to three places). The point is earned for the correct decimal approximation of 0.333 with supporting work showing $f(1)$ or $g(1.75)$ or 1.75.

(a)(ii)

Mark scheme

- From the table, $f(0) = 3.5$, so $f^{-1}(3.5) = 0$. No supporting work is required for this point; a response of "0" earns it.

Solution 1

(b)(i)

Mark scheme

- Solve $g(x) = 0$: $-0.167x^3 + x^2 - 1.834 = 0$. The three real solutions (decimal approximations) are $x = -1.233$, $x = 1.578$, $x = 5.643$. No supporting work is required; all three values must be given.

Solution 1

(b)(ii)

Mark scheme

- As x increases without bound, the output values of g decrease without bound (the leading term $-0.167x^3$ dominates and is negative). So $\lim_{x\to\infty} g(x) = -\infty$. The correct limit statement needs four components: "lim", "$x \to \infty$", the function g, and $-\infty$.

Solution 1

(c)(i)

Mark scheme

- An exponential function best models f.

Solution 1

(c)(ii) Mark scheme

- In the table, the input-value intervals all have length 1, and the ratios of successive output values are constant: $\frac{f(-1)}{f(-2)} = \frac{f(0)}{f(-1)} = \frac{f(1)}{f(0)} = \frac{f(2)}{f(1)} = 0.5$. Because the successive output values over equal-length input intervals are proportional (by a constant factor of 0.5), an exponential model is best. The reasoning must reference the table values and show the 0.5 ratio applies to more than one pair of successive outputs; referencing "exponential regression" or r/r^2 values alone is not sufficient.

Question 2

2025 ▪ Q2

A musician released a new song on a streaming service. A streaming service is an online entertainment source that allows users to play music on their computers and mobile devices.

Several months later, the musician began using an app (at time $t = 0$) that counts the total number of plays for the song since its release. A "play" is a single stream of the song on the streaming service. The table gives the total number of plays, in thousands, for selected times t months after the musician began using the app. At $t = 0$, the total number of plays was 25 thousand. At $t = 2$, the total number of plays was 30 thousand. At $t = 4$, the total number of plays was 34 thousand.

Question 2

Months after the musician began using the app	0	2	4
Total number of plays for the song since its release (thousands)	25	30	34

The total number of plays, in thousands, for the song since its release can be modeled by the function D given by $D(t) = at^2 + bt + c$, where $D(t)$ is the total number of plays, in thousands, for the song since its release, and t is the number of months after the musician began using the app.

Question 2

(a)(i) Use the given data to write three equations that can be used to find the values for constants a, b, and c in the expression for $D(t)$.
(a)(ii) Find the values for a, b, and c as decimal approximations.

Question 2

Months after the musician began using the app	0	2	4
Total number of plays for the song since its release (thousands)	25	30	34