Past-paper walk-through

Interpreting the Meaning of the Derivative in Context ▪ 4.1

eXercise

Questions in this set

- 2026 Q3
- 2023 Q1
- 2019 Q5
- 2018 Q2
- 2018 Q4
- 2014 Q1

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 3

2026 ▪ Q3

A pie is taken from a hot oven and put on a table. The internal temperature of the pie at time t minutes can be modeled by the function H that satisfies the differential equation

$$\frac{dH}{dt} = -\frac{1}{15}(H - 20),$$

where $H(t)$ is measured in degrees Celsius and $H(0) = 75$. For $t > 0$, it is known that $20 < H(t) < 75$.

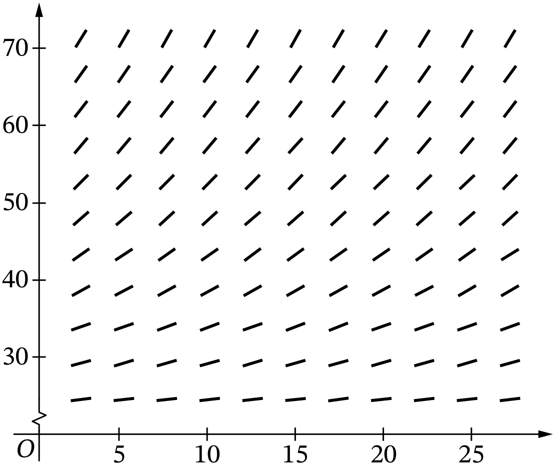
(a) Explain why the following could not be a slope field for the differential equation $\frac{dH}{dt} = -\frac{1}{15}(H - 20)$.

[Slope field graph: horizontal axis t from 0 to about 28 (gridlines at 5, 10, 15, 20, 25), vertical axis H from about 25 to 70 (gridlines at 30, 40, 50, 60, 70). Short line

Question 3

segments are drawn at each grid point. Near the top of the grid (around $H = 70$) the segments are steep, close to vertical, positive slope; moving down the grid the segments rotate, becoming shallow near $H = 30$, with negative slope by the bottom rows. At a given height H, the segments look the same regardless of t (slopes vary only with H, not with t, matching the autonomous equation) — but the segments are shown with a mix of orientations inconsistent with the required sign pattern of $\dfrac{dH}{dt} = -\frac{1}{15}(H - 20)$.]

Question 3



Question 3

2026 ▪ Q3

A pie is taken from a hot oven and put on a table. The internal temperature of the pie at time t minutes can be modeled by the function H that satisfies the differential equation

$$\frac{dH}{dt} = -\frac{1}{15}(H - 20),$$

where $H(t)$ is measured in degrees Celsius and $H(0) = 75$. For $t > 0$, it is known that $20 < H(t) < 75$.

(b) Find the slope of the line tangent to the graph of H at time $t = 0$. Show the work that leads to your answer.

Question 3

2026 ▪ Q3

A pie is taken from a hot oven and put on a table. The internal temperature of the pie at time t minutes can be modeled by the function H that satisfies the differential equation

$$\frac{dH}{dt} = -\frac{1}{15}(H - 20),$$

where $H(t)$ is measured in degrees Celsius and $H(0) = 75$. For $t > 0$, it is known that $20 < H(t) < 75$.

(c) It can be shown that $\frac{d^2H}{dt^2} = \frac{1}{225}(H - 20)$. The line tangent to the graph of H at time $t = 0$ is used to approximate $H(5)$, the internal temperature of the pie at time $t = 5$. Is this approximation an overestimate or an underestimate for the actual value of $H(5)$? Give a reason for your answer.

Question 3

2026 ▪ Q3

A pie is taken from a hot oven and put on a table. The internal temperature of the pie at time t minutes can be modeled by the function H that satisfies the differential equation

$$\frac{dH}{dt} = -\frac{1}{15}(H - 20),$$

where $H(t)$ is measured in degrees Celsius and $H(0) = 75$. For $t > 0$, it is known that $20 < H(t) < 75$.

(d) Use separation of variables to find an expression for $H(t)$, the particular solution to the given differential equation with initial condition $H(0) = 75$.

Question 1

2023 ▪ Q1

A customer at a gas station is pumping gasoline into a gas tank. The rate of flow of gasoline is modeled by a differentiable function f, where $f(t)$ is measured in gallons per second and t is measured in seconds since pumping began. Selected values of $f(t)$ are given in the table.

t **(seconds)**	**0**	**60**	**90**	**120**	**135**	**150**
$f(t)$ (gallons per second)	0	0.1	0.15	0.1	0.05	0

Question 1

(a) Using correct units, interpret the meaning of $\int_{60}^{135} f(t)\,dt$ in the context of the problem. Use a right Riemann sum with the three subintervals $[60, 90]$, $[90, 120]$, and $[120, 135]$ to approximate the value of $\int_{60}^{135} f(t)\,dt$.

Question 1

t (seconds)	0	60	90	120	135	150
$f(t)$ (gallons per second)	0	0.1	0.15	0.1	0.05	0