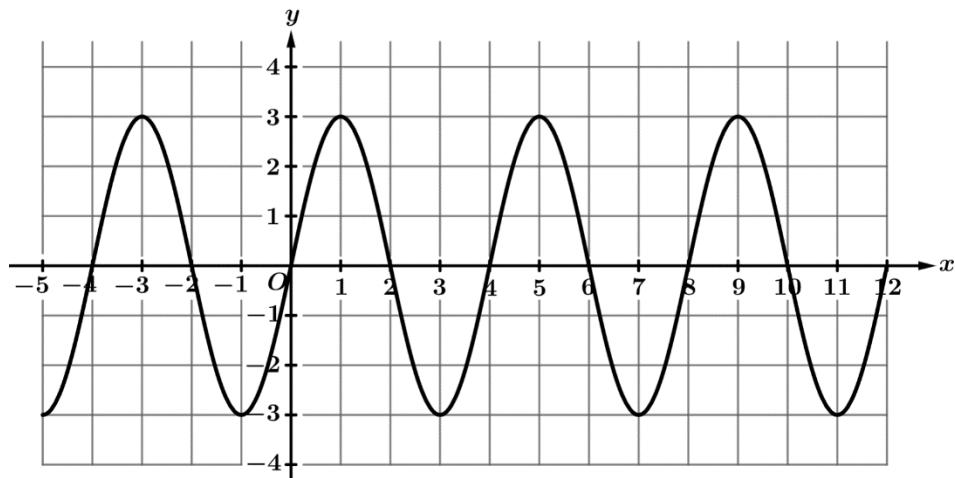
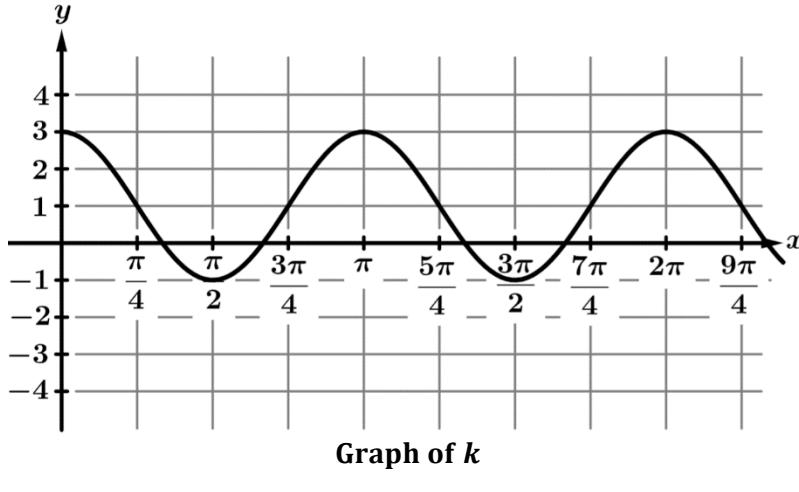
**Graph of f**

1. The figure shows the graph of a sinusoidal function f . what are the values of the period and amplitude of f ?
- (A) The period is 3, and the amplitude is 4.
 - (B) The period is 3, and the amplitude is 8.
 - (C) The period is 6, and the amplitude is 4.
 - (D) The period is 6, and the amplitude is 8.

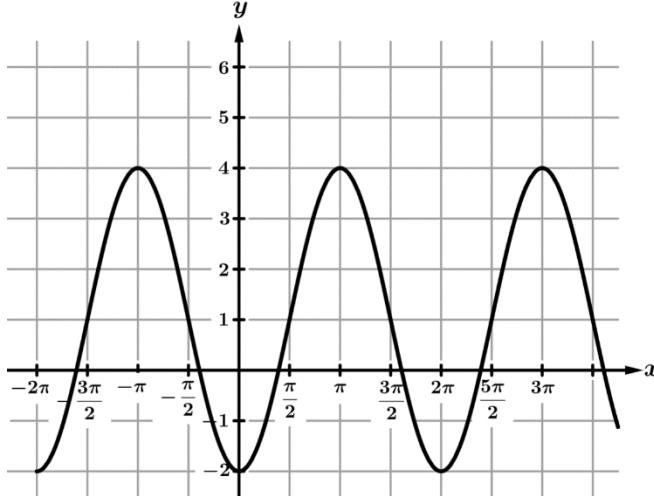
**Graph of h**

2. The figure shows the graph of a sinusoidal function h . what are the values of the period and amplitude of h ?
- (A) The period is 2, and the amplitude is 3.
 - (B) The period is 2, and the amplitude is 6.
 - (C) The period is 4, and the amplitude is 3.
 - (D) The period is 4, and the amplitude is 6.



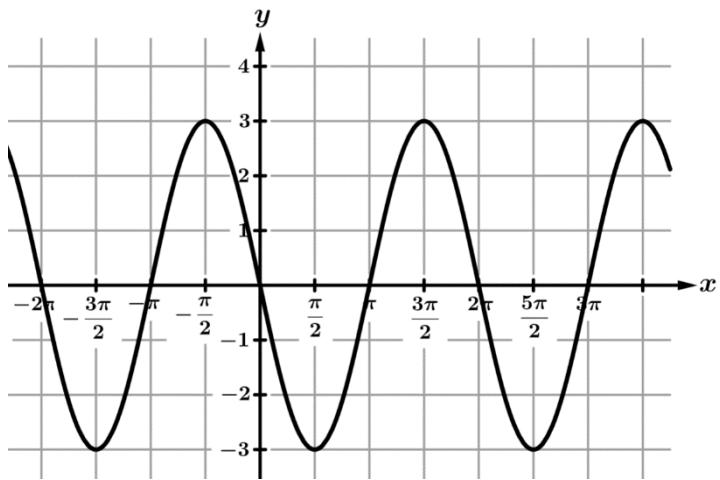
3. The figure shows the graph of a sinusoidal function k . what are the values of the period and amplitude of k ?

- (A) The period is $\frac{\pi}{2}$, and the amplitude is 2.
- (B) The period is $\frac{\pi}{2}$, and the amplitude is 4.
- (C) The period is π , and the amplitude is 2.
- (D) The period is π , and the amplitude is 4.



4. The figure shows the graph of a trigonometric function f . Which of the following could be an expression for $f(x)$?

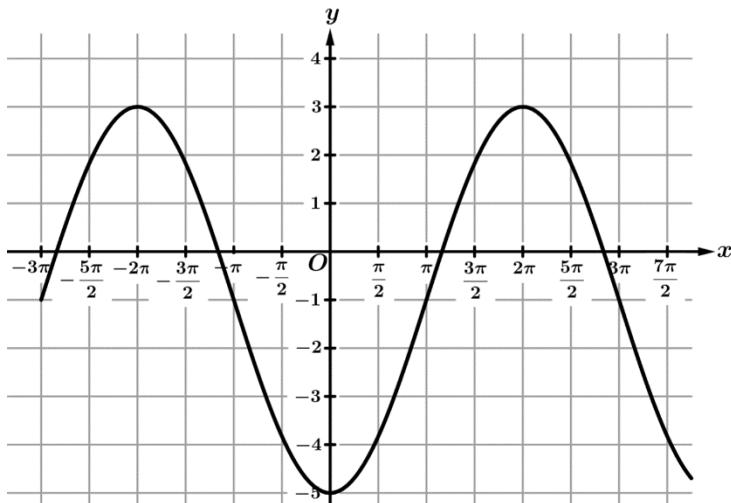
- (A) $3\cos(x)+1$
- (B) $3\cos\left(x-\frac{\pi}{2}\right)+1$
- (C) $3\sin\left(x-\frac{3\pi}{2}\right)+1$
- (D) $3\sin\left(x-\frac{5\pi}{2}\right)+1$



Graph of g

5. The figure shows the graph of a trigonometric function g . Which of the following could be an expression for $g(x)$?

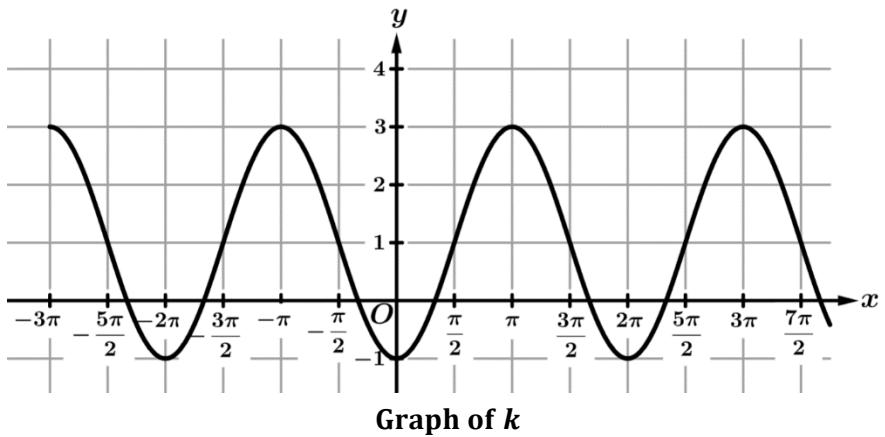
- (A) $3\cos\left(x - \frac{\pi}{2}\right)$
- (B) $3\cos\left(x + \frac{\pi}{2}\right)$
- (C) $3\sin(x - 2\pi)$
- (D) $-3\sin(x - \pi)$



Graph of h

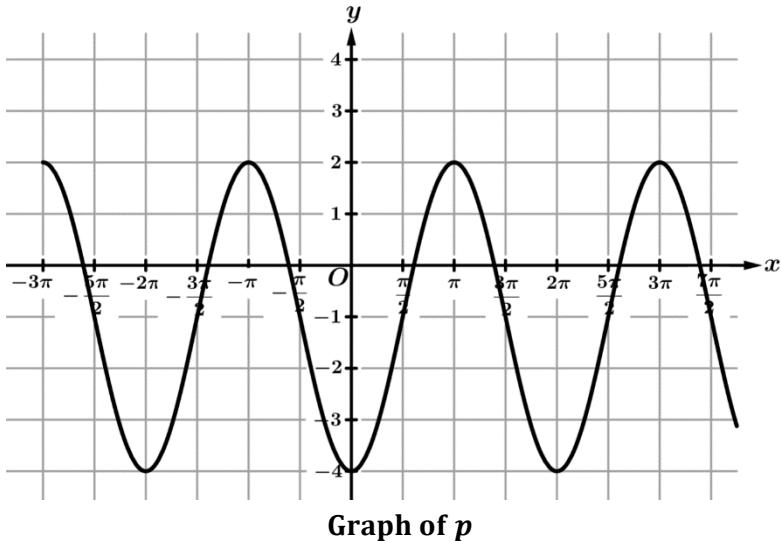
6. The figure shows the graph of a trigonometric function h . Which of the following could be an expression for $h(x)$?

- (A) $-4\cos\left(\frac{1}{2}(x + \pi)\right) - 1$
- (B) $-4\cos\left(\frac{1}{2}(x - 2\pi)\right) - 1$
- (C) $4\sin\left(\frac{1}{2}(x + \pi)\right) - 1$
- (D) $4\sin\left(\frac{1}{2}(x - \pi)\right) - 1$



7. The figure shows the graph of a trigonometric function k . Which of the following could be an expression for $k(x)$?

- (A) $2\cos(x) + 1$
- (B) $-2\cos(x - \pi) + 1$
- (C) $2\sin\left(x + \frac{\pi}{2}\right) + 1$
- (D) $-2\sin\left(x - \frac{3\pi}{2}\right) + 1$



8. The figure shows the graph of a trigonometric function p . Which of the following could be an expression for $p(x)$?

- (A) $-3\cos(x - \pi) - 1$
- (B) $-3\cos(x - 2\pi) - 1$
- (C) $3\sin\left(x - \frac{3\pi}{2}\right) - 1$
- (D) $-3\sin\left(x - \frac{\pi}{2}\right) - 1$

9. In a particular city, the amount of daylight hours is modeled by the function D , defined by $D(t) = 2.715 \cos(0.017t) + 12.250$ for $0 \leq t \leq 365$ days. Based on the model, which of the following is true?

- (A) The maximum amount of daylight hours is 12.250 hours.
- (B) The maximum amount of daylight hours occurs at $t = 0$ days.
- (C) The minimum amount of daylight hours is 12.250 hours.
- (D) The minimum amount of daylight hours occurs at $t = 0$ days.

10. For a given city, the average high temperature, in $^{\circ}\text{C}$, in a given month can be modeled by the function C , defined by $C(t) = 3.9 \cos(0.475(t-1)) + 14.1$ for $0 \leq t \leq 12$ months. Based on the model, which of the following is true?

- (A) The maximum average high temperature is $14.1 ^{\circ}\text{C}$.
- (B) The maximum average high temperature occurs at $t = 0$ months.
- (C) The minimum average high temperature is $10.2 ^{\circ}\text{C}$.
- (D) The minimum average high temperature occurs at $t = 1$ months.

11. In Myrtle Beach, South Carolina, the height of the tide, in feet (ft), is modeled by the function H , defined by $H(t) = 2.1 \sin\left(\frac{\pi}{6}(t-1)\right) + 2.6$ for $0 \leq t \leq 12$ hours. Based on this model, which of the following is true?

- (A) The maximum height of the tide is 4.7 feet.
- (B) The maximum height of the tide occurs at $t = 1$ hours.
- (C) The minimum height of the tide is 2.6 feet.
- (D) The minimum height of the tide occurs at $t = 1$ hours.

12. The population of trout in a particular pond can be modeled by the function F , defined by $F(t) = 3000 - 1200 \cos(2\pi t)$ for $0 \leq t \leq 10$ years. Based on the model, which of the following is true?

- (A) The maximum number of trout is 3000.
- (B) The maximum number of trout occurs at $t = 0$ years.
- (C) The minimum number of trout is 1200.
- (D) The minimum number of trout occurs at $t = 0$ years.

13. The function f is defined by $f(x) = a \sin(b(x+c)) + d$, for constants a, b, c , and d . In the xy -plane, the points $(4, 1)$ and $(8, 5)$ represent a minimum value and a maximum value, respectively, on the graph of f . What are the values of a and d ?

- (A) $a = 2$ and $d = 1$
- (B) $a = 2$ and $d = 3$
- (C) $a = 4$ and $d = 1$
- (D) $a = 4$ and $d = 3$

14. The function g is defined by $g(x) = a \sin(b(x+c)) + d$, for constants a, b, c , and d . In the xy -plane, the points $(0, -4)$ and $(2\pi, 8)$ represent a minimum value and a maximum value, respectively, on the graph of g . What are the values of a and d ?

- (A) $a = 3$ and $d = 2$
- (B) $a = 3$ and $d = 4$
- (C) $a = 6$ and $d = 2$
- (D) $a = 6$ and $d = 4$

15. The function h is defined by $h(x) = a \sin(b(x+c)) + d$, for constants a, b, c , and d . In the xy -plane, the points $(0, 0)$ and $(2\pi, 6)$ represent a minimum value and a maximum value, respectively, on the graph of h . What is the value of b ?

- (A) $b = \frac{1}{2}$
- (B) $b = 1$
- (C) $b = 2$
- (D) $b = 4\pi$

16. The function k is defined by $k(x) = a \cos(bx) + d$, for constants a, b, c , and d . In the xy -plane, the points $(0, -4)$ and $(4, 4)$ represent a minimum value and a maximum value, respectively, on the graph of k . What are the values of a and b ?

- (A) $a = 4$ and $b = \frac{\pi}{4}$
- (B) $a = 4$ and $b = 8$
- (C) $a = -4$ and $b = \frac{\pi}{4}$
- (D) $a = -4$ and $b = 8$

Starting Position For Gear

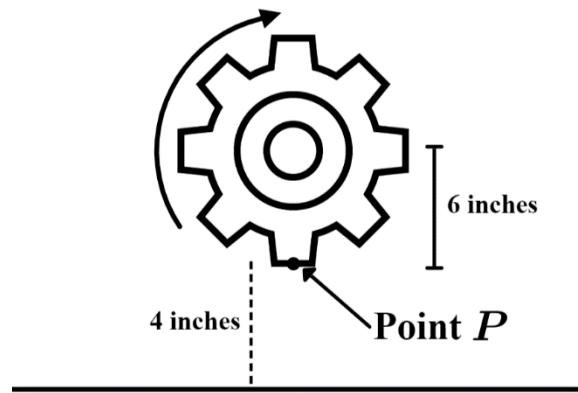
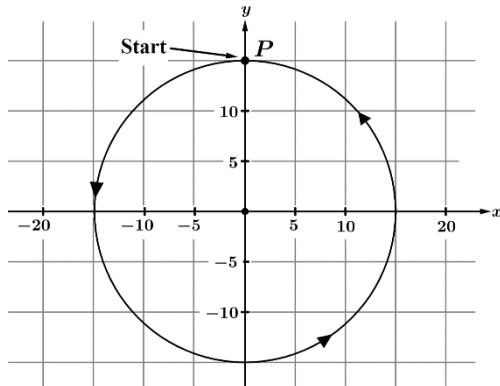


Figure NOT drawn to scale

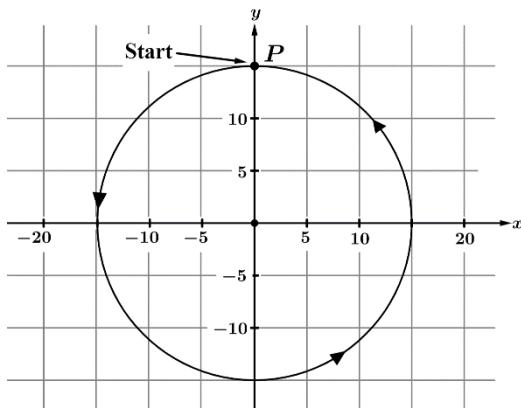
17. Point P is located at the end of a large gear. At time $t = 0$ seconds, the point P is directly below the center of the gear and is 4 inches above a level surface, as shown in the figure. Point P is 6 inches from the center of the gear. The height of point P, in inches, above the level surface periodically increases and decreases as the gear rotates at a constant speed in the clockwise direction. The gear completes 1 revolution in 2 seconds. Which of the following could be an expression for $h(t)$, the height, in inches, of point P above the level ground at time t seconds?

- (A) $6 - 4\cos(2t)$ (B) $10 - 6\cos(2t)$ (C) $6 - 4\cos(\pi t)$ (D) $10 - 6\cos(\pi t)$



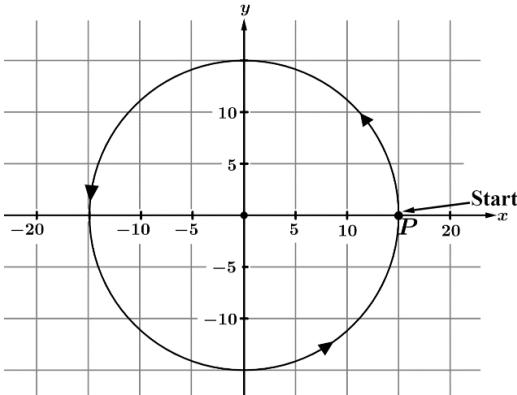
18. A game show uses a large spinner of radius 15 feet that rotates at a constant rate to determine which prizes contestants win. The figure above provides a representation of the wheel in the xy -plane with the direction of rotation indicated. At time $t = 0$ seconds, the spinner begins to rotate. Point P on the wheel is at the "Start" position in the figure. At time $t = 5$ seconds, 20 rotations of the spinner have been completed, and P is in the same position as it was at time $t = 0$. A sinusoidal function is used to model the x -coordinate of the position of P as a function of time t in seconds. Which of the following functions is an appropriate model for this situation?

- (A) $f(t) = -15 \sin(4t)$ (B) $f(t) = -15 \sin(8\pi t)$ (C) $f(t) = 15 \sin\left(\frac{1}{4}t\right)$ (D) $f(t) = 15 \sin(8\pi t)$



19. A game show uses a large spinner of radius 15 feet that rotates at a constant rate to determine which prizes contestants win. The figure above provides a representation of the wheel in the xy -plane with the direction of rotation indicated. At time $t = 0$ seconds, the spinner begins to rotate. Point P on the wheel is at the “Start” position in the figure. At time $t = 10$ seconds, 30 rotations of the spinner have been completed, and P is in the same position as it was at time $t = 0$. A sinusoidal function is used to model the y -coordinate of the position of P as a function of time t in seconds. Which of the following functions is an appropriate model for this situation?

- (A) $f(t) = 15 \cos(3t)$
- (B) $f(t) = 15 \cos(6\pi t)$
- (C) $f(t) = 15 \cos\left(\frac{2\pi}{3}t\right)$
- (D) $f(t) = 15 \cos\left(\frac{1}{3}t\right)$



20. A game show uses a large spinner of radius 15 feet that rotates at a constant rate to determine which prizes contestants win. The figure above provides a representation of the wheel in the xy -plane with the direction of rotation indicated. At time $t = 0$ seconds, the spinner begins to rotate. Point P on the wheel is at the “Start” position in the figure. At time $t = 8$ seconds, 4 rotations of the spinner have been completed, and P is in the same position as it was at time $t = 0$. A sinusoidal function is used to model the x -coordinate of the position of P as a function of time t in seconds. Which of the following functions is an appropriate model for this situation?

- (A) $f(t) = 15 \cos\left(\frac{1}{2}t\right)$
- (B) $f(t) = 15 \cos(2t)$
- (C) $f(t) = 15 \cos(\pi t)$
- (D) $f(t) = 15 \cos(4\pi t)$

t	1	3	4	7	9	11
$F(t)$	29.1	42.3	50.6	88.4	76.8	46.9

21. The average high temperature, in degrees Fahrenheit ($^{\circ}\text{F}$), in a city for a given month is modeled by the function F , where $0 \leq t \leq 12$ months. The table gives values for the function F at selected values of t . A sinusoidal regression $y = a \sin(bx + c) + d$ is used to model these data. Based on the sinusoidal model, what was the average high temperature, to the nearest degree ($^{\circ}\text{F}$), at time $t = 6$ months.

(A) 70

(B) 76

(C) 81

(D) 85

t	1	6	13	18	24	29
$H(t)$	48.2	37.1	24.5	28.5	43.0	50.4

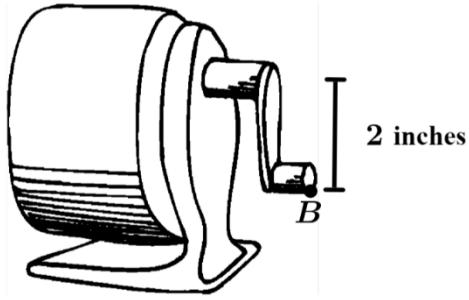
22. The height, in feet, of a remote-controlled drone can be modeled by the function H , for $0 \leq t \leq 30$ seconds. The table gives values for the function H at selected values of t . A sinusoidal regression $y = a \sin(bx + c) + d$ is used to model these data. Based on the sinusoidal model, what is the height of the drone, to the nearest tenth of a foot, at time $t = 21$ seconds?

(A) 32.7

(B) 35.4

(C) 35.8

(D) 39.5

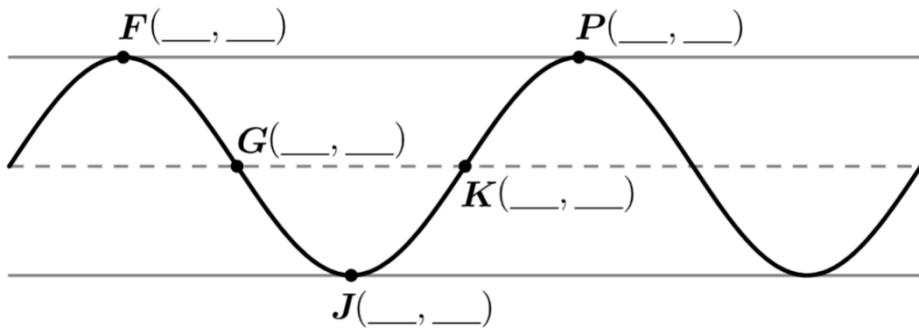


The figure shows a pencil sharpener on a level surface. Point B is located at the end of a handle that is 2 inches from the center of rotation. The handle rotates in a clockwise direction and completes 2 rotations every second. At time $t = 0$ seconds, point B is located directly below the center of rotation. The center of rotation is 3 inches above the level surface on which the pencil sharpener sits. As the handle rotates, the distance between point B and the level surface periodically increases and decreases.

The sinusoidal function h models the distance, in inches, between point B and the level surface as a function of time t in seconds.

- (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 .



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

- (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 .

- (j) 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) Describe how the rate of change of h is changing over the interval (t_1, t_2) .