

Linear Motion and Concavity

Date _____ Period _____

A particle moves along a horizontal line. Its position function is $s(t)$ for $t \geq 0$. For each problem, find the intervals of time when the particle is moving left and moving right and the intervals of time when the particle is slowing down and speeding up.

1) $s(t) = t^2 - 5t - 24$

2) $s(t) = -t^2 + 21t - 110$

3) $s(t) = t^2 - 10t + 16$

4) $s(t) = -t^3 + 11t^2 - 24t$

5) $s(t) = t^4 - 8t^3$

6) $s(t) = -t^4 + 9t^3$

7) $s(t) = -t^3 + 11t^2$

8) $s(t) = t^2 - 10t - 75$

9) $s(t) = -t^4 + 10t^3$

10) $s(t) = t^4 - 11t^3$

For each problem, find the open intervals where the function is concave up and concave down.

11) $y = x^3 - 2x^2 - 1$

12) $y = -x^3 + 2x^2 + 4$

13) $y = 2x^2 + 12x + 19$

14) $y = x^3 - 2x^2 + 3$

15) $y = x^3 - x^2$

$$16) y = x^3 - x^2 - 1$$

$$17) y = -\frac{x^2}{2} - 4x - 3$$

$$18) y = -2x^2 - 16x - 28$$

$$19) y = -2x^2 + 16x - 31$$

$$20) y = -x^3 + 3x^2 + 2$$

Answers to Linear Motion and Concavity (ID: 1)

- 1) Moving left: $0 \leq t < \frac{5}{2}$, Moving right: $t > \frac{5}{2}$ 2) Moving left: $t > \frac{21}{2}$, Moving right: $0 \leq t < \frac{21}{2}$
 Slowing down: $0 \leq t < \frac{5}{2}$, Speeding up: $t > \frac{5}{2}$ Slowing down: $0 \leq t < \frac{21}{2}$, Speeding up: $t > \frac{21}{2}$
- 3) Moving left: $0 \leq t < 5$, Moving right: $t > 5$
 Slowing down: $0 \leq t < 5$, Speeding up: $t > 5$
- 4) Moving left: $0 \leq t < \frac{4}{3}$, $t > 6$, Moving right: $\frac{4}{3} < t < 6$
 Slowing down: $0 \leq t < \frac{4}{3}$, $\frac{11}{3} < t < 6$, Speeding up: $\frac{4}{3} < t < \frac{11}{3}$, $t > 6$
- 5) Moving left: $0 < t < 6$, Moving right: $t > 6$
 Slowing down: $4 < t < 6$, Speeding up: $0 < t < 4$, $t > 6$
- 6) Moving left: $t > \frac{27}{4}$, Moving right: $0 < t < \frac{27}{4}$
 Slowing down: $\frac{9}{2} < t < \frac{27}{4}$, Speeding up: $0 < t < \frac{9}{2}$, $t > \frac{27}{4}$
- 7) Moving left: $t > \frac{22}{3}$, Moving right: $0 < t < \frac{22}{3}$
 Slowing down: $\frac{11}{3} < t < \frac{22}{3}$, Speeding up: $0 < t < \frac{11}{3}$, $t > \frac{22}{3}$
- 8) Moving left: $0 \leq t < 5$, Moving right: $t > 5$
 Slowing down: $0 \leq t < 5$, Speeding up: $t > 5$
- 9) Moving left: $t > \frac{15}{2}$, Moving right: $0 < t < \frac{15}{2}$
 Slowing down: $5 < t < \frac{15}{2}$, Speeding up: $0 < t < 5$, $t > \frac{15}{2}$
- 10) Moving left: $0 < t < \frac{33}{4}$, Moving right: $t > \frac{33}{4}$
 Slowing down: $\frac{11}{2} < t < \frac{33}{4}$, Speeding up: $0 < t < \frac{11}{2}$, $t > \frac{33}{4}$
- 11) Concave up: $\left(\frac{2}{3}, \infty\right)$ Concave down: $\left(-\infty, \frac{2}{3}\right)$ 12) Concave up: $\left(-\infty, \frac{2}{3}\right)$ Concave down: $\left(\frac{2}{3}, \infty\right)$
- 13) Concave up: $(-\infty, \infty)$ Concave down: No intervals exist.
- 14) Concave up: $\left(\frac{2}{3}, \infty\right)$ Concave down: $\left(-\infty, \frac{2}{3}\right)$ 15) Concave up: $\left(\frac{1}{3}, \infty\right)$ Concave down: $\left(-\infty, \frac{1}{3}\right)$
- 16) Concave up: $\left(\frac{1}{3}, \infty\right)$ Concave down: $\left(-\infty, \frac{1}{3}\right)$
- 17) Concave up: No intervals exist. Concave down: $(-\infty, \infty)$
- 18) Concave up: No intervals exist. Concave down: $(-\infty, \infty)$
- 19) Concave up: No intervals exist. Concave down: $(-\infty, \infty)$
- 20) Concave up: $(-\infty, 1)$ Concave down: $(1, \infty)$