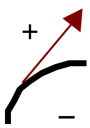
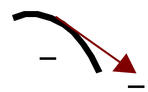
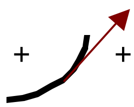
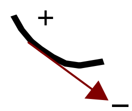
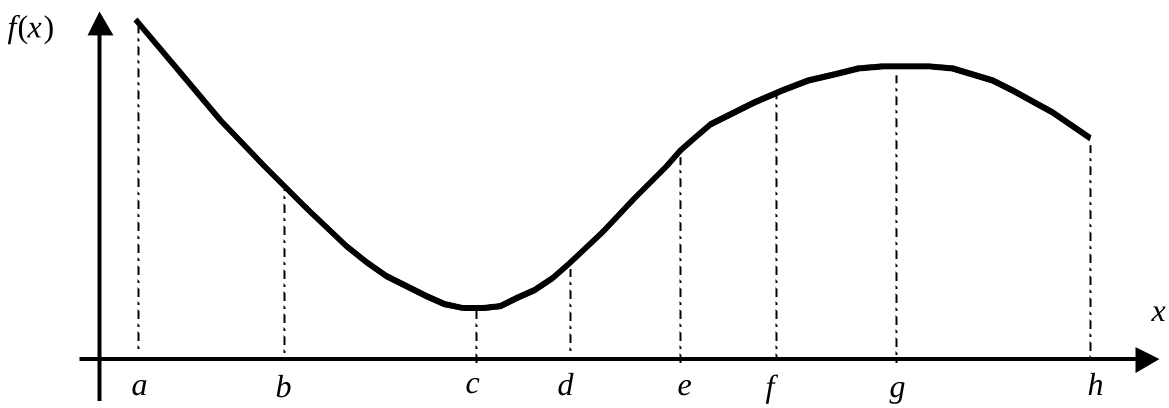
**Math M119** **Section 2.4 Supplement**

- $f'(x)$ indicates if it is Increasing or Decreasing or neither
  - $f'(x) > 0$ : increasing , rising
  - $f'(x) < 0$ : decreasing, falling
  - $f'(x) = 0$ : no changes, horizontal slope for the tangent line
- $f''(x)$ indicates if it is concave up, down or neither
  - $f''(x) > 0$ : concave up
  - $f''(x) < 0$ : concave down
  - $f''(x) = 0$ : inflection point, the point where concavity changes.

| | | | |
|---|---|---|---|
|  | $f'(x) > 0$ increasing, $f''(x) < 0$ concave down |  | $f'(x) < 0$ decreasing, $f''(x) < 0$ concave down |
|  | $f'(x) > 0$ increasing, $f''(x) > 0$ concave up |  | $f'(x) < 0$ decreasing, $f''(x) > 0$ concave up |

Example 1. Referring to this graph, indicate the points or intervals where the following conditions can hold:




| Condition | Answer |
|---|---|
| $f'(x) < 0$ | |
| $f'(x) > 0$ | |
| $f'(x) = 0$ | |
| $f''(x) = 0$ | |

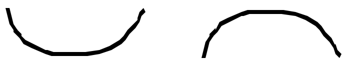
| Condition | Answer |
|---|---|
| $f'(x) = 0$ and $f''(x) < 0$ | |
| $f'(x) = 0$ and $f''(x) > 0$ | |
| $f''(x) > 0$ | |
| $f''(x) < 0$ | |

Example 2: Draw possible graph for $f(x)$ by using the graph information of $f''(x)$ and $f'(x)$:

a) Draw possible shape for:

$f''(x) = 0$ at: $x = b$, $x = d$
$f''(x) < 0$ on : $b < x < d$
$f''(x) > 0$ on : $x > d$ and $x < b$

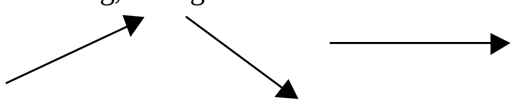
as concave up or concave down or neither.

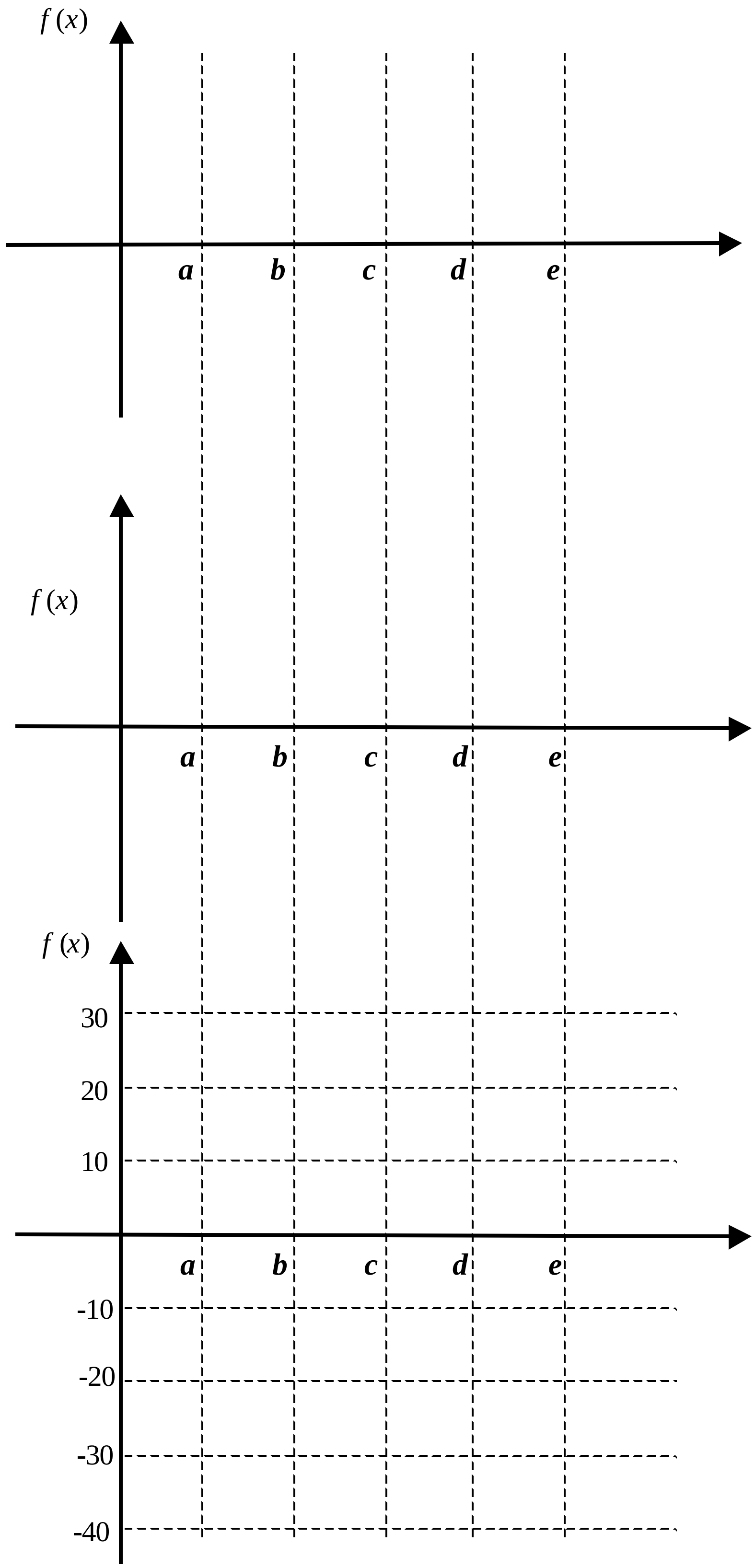


b) Draw possible shape for:

$f'(x) = 0$ at: $x = a$, $x = c$, $x = e$
$f'(x) < 0$ on : $x < a$ and $c < x < e$
$f'(x) > 0$ on : $x > e$ and $a < x < c$

as rising, falling or neither:






c) Use the above information to finalize the graph of $f(x)$ if:

$f(a) = -30$
$f(b) = 5$
$f(c) = 25$
$f(d) = -10$
$f(e) = -40$

d) Fill the following:

$f'(x) = 0$ and $f''(x) > 0$ at : $x =$
$f'(x) = 0$ and $f''(x) < 0$ at : $x =$