



CAMI Mathematics: Grade 12

12.5 Calculus

12.5 Rate of change and calculus of motion

Rate of change

1. The temperature inside a jet engine in degrees Celsius after t seconds is:

$$T = 4t^3 - 72t^2 + 500t + 50$$

- (a) Determine the rate of increase after 7 seconds.
(b) Determine t where the rate of increase is at a maximum.

2. The temperature inside a jet engine in degree Celsius after t seconds is:

$$T = 3t^3 - 27t^2 + 400t + 22$$

- (a) Determine the rate of increase after 3 seconds.
(b) Determine t where the rate of increase is at a maximum.

3. The distance covered by an object after t seconds is:

$$s = 3t^3 + t^2 - 5t + 4$$

- (a) Determine the distance covered in 7 seconds.
(b) Determine the velocity after 7 seconds.
(c) Determine the acceleration after 7 seconds.

Calculus of movement

1. The displacement of a particle (in meters) after t seconds is:

$$s = 4t + 4$$

- (a) Determine the displacement after 4 seconds.
(b) Determine the distance covered.

2. If the displacement of a particle (in meters) after t seconds is

$$s = -5t^2 + 4t + 6, \text{ determine the velocity after 4 seconds.}$$

3. If the displacement of a particle (in meter) after t seconds is

$$s = -3t^2 - 2t - 3, \text{ determine the acceleration after 6 seconds.}$$

4. If the displacement of a particle (in meter) after t seconds is

$$s = t^3 - 4t + 6, \text{ determine the velocity after 8 seconds.}$$

5. If the displacement of a particle (in meter) after t seconds is

$$s = t^3 - t^2 - 2t - 1, \text{ determine the acceleration after 2 seconds.}$$



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MEMO

Rate of change [5.7.5.2]

1. $T = 4t^3 - 72t^2 + 500t + 50$

(a)

$$T' = 12t^2 - 144t + 500$$

$$T'(7) = 12(7)^2 - 144(7) + 500$$

$$T'(7) = 80$$

Rate of increase = 80°C/s

(b)

$$T'' = 24t - 144$$

$$0 = 24t - 144$$

$$24t = 144$$

$$t = 6 \text{ sec}$$

2. $T = 3t^3 - 27t^2 + 400t + 22$

(a)

$$T' = 9t^2 - 54t + 400$$

$$T'(3) = 9(3)^2 - 54(3) + 400$$

$$T'(3) = 319$$

Rate of increase = 319°C/s

(b)

$$T' = 9t^2 - 54t + 400$$

$$T'' = 18t - 54$$

$$0 = 18t - 54$$

$$t = 3 \text{ sec}$$

3. $s = 3t^3 + t^2 - 5t + 4$

(a)

$$s = 3t^3 + t^2 - 5t + 4$$

$$s = 3(7)^3 + (7)^2 - 5(7) + 4$$

$$s = 1047 \text{ m}$$



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(b)

$$s = 3t^3 + t^2 - 5t + 4$$

$$s' = 9t^2 + 2t - 5$$

$$s' = 9(7)^2 + 2(7) - 5$$

$$s' = 450m/s$$

(c)

$$s' = 9t^2 + 2t - 5$$

$$s'' = 18t + 2$$

$$s'' = 18(7) + 2$$

$$s'' = 128m/s^2$$

Calculus of movement [5.7.6.1; 5.7.6.2; 5.7.6.3]

1. $s = 4t + 4$

(a)

$$s = 4t + 4$$

$$s = 4(4) + 4$$

$$s = 20m$$

(b)

$$s = 4t + 4$$

$$\text{Start point: } 4(0) + 4 = 4m$$

Distance:

$$|\text{Distance} - \text{Start}|$$

$$= |20 - 4|$$

$$= 16m$$

2. $s = -5t^2 + 4t + 6$

$$s' = -10t + 4$$

$$s' = -10(4) + 4$$

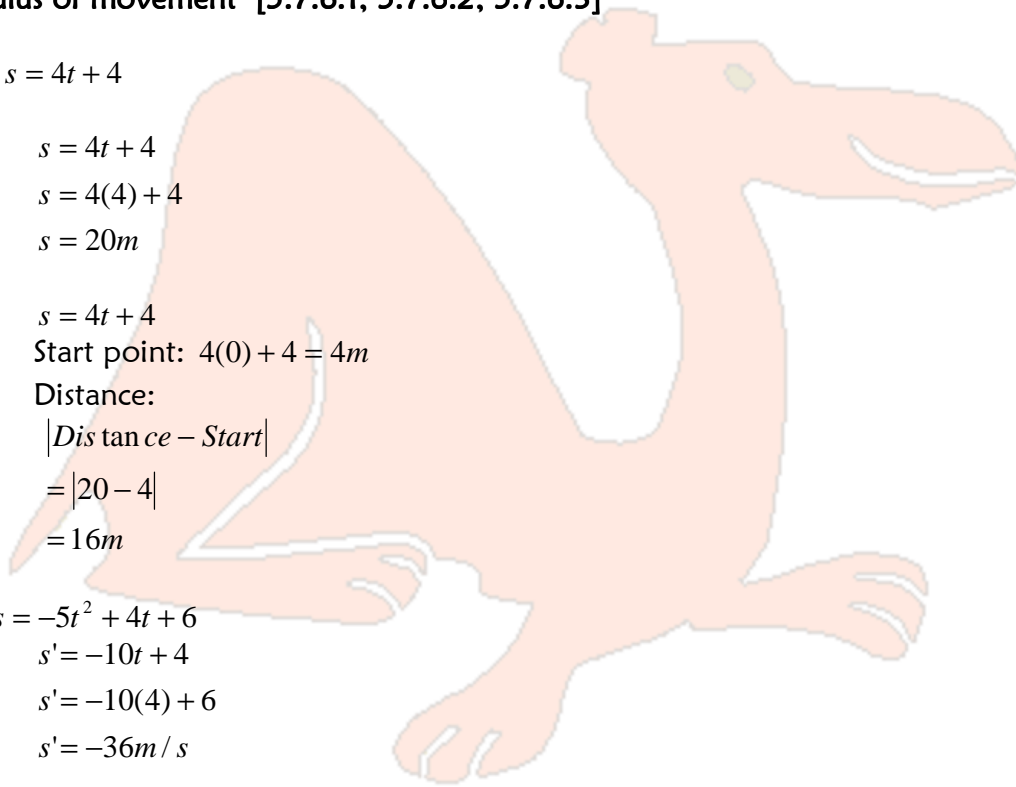
$$s' = -36m/s$$

3. $s = -3t^2 - 2t - 3$

$$s = -3t^2 - 2t - 3$$

$$s' = -6t - 2$$

$$s'' = -6m/s^2$$





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4. $s = t^3 - 4t + 6$
 $s = t^3 - 4t + 6$
 $s' = 3t^2 - 4$
 $s'(8) = 3(8)^2 - 4$
 $s'(8) = 188m/s$

5. $s = t^3 - t^2 - 2t - 1$
 $s' = 3t^2 - 2t - 2$
 $s'' = 6t - 2$
 $s''(2) = 6(2) - 2$
 $s''(2) = 10m/s^2$

