# Calculus in kinematics

Grade 9 | Higher | 10 questions, 34 marks

**GCSE Maths topic practice**

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**Name:** _____ **Date:** _____ **Score:** _____ **/ 34**

**1** A particle moves along a straight line. At time $t$ seconds its displacement, $s$ metres, from a fixed point O is given by

$s = 3t^2 + 4t$

a. Find an expression for the velocity, $v$ m/s, of the particle at time $t$ seconds.

b. Find the velocity of the particle when $t = 2$.

(2 marks)

Answer _____

**2** A particle moves along a straight line. At time $t$ seconds its velocity, $v$ m/s, is given by

$v = 12t - 2t^2$

a. Find an expression for the acceleration, $a$ m/s$^2$, of the particle at time $t$ seconds.

b. Find the acceleration of the particle when $t = 5$.

(2 marks)

Answer _____

**3** A particle P moves along a straight line through a fixed point O. At time $t$ seconds the displacement, $s$ metres, of P from O is given by

$s = t^3 - 6t^2 + 9t + 2$

a. Find an expression for the velocity, $v$ m/s, of P at time $t$ seconds.

b. Find an expression for the acceleration, $a$ m/s$^2$, of P at time $t$ seconds.

c. Find the acceleration of P when $t = 4$.

(4 marks)

Answer _____


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**4** A particle moves along a straight line. At time $t$ seconds its displacement, $s$ metres, from a fixed point O is given by

$s = 2t^3 - 15t^2 + 24t$ for $0 \leq t \leq 6$

Find the values of $t$ for which the particle is momentarily at rest.

(3 marks)

Answer _____

**5** A particle P moves along a straight line through a fixed point O. At time $t$ seconds the displacement, $s$ metres, of P from O is given by

$s = t^3 - 9t^2 + 5t$ for $t \geq 0$

a. Find an expression for the acceleration, $a$ m/s$^2$, of P at time $t$ seconds.

b. Find the value of $t$ when the acceleration of P is zero.

(3 marks)

Answer _____

**6** The number of bacteria, $N$, in a dish $t$ hours after the start of an experiment is given by

$N = 400 + 30t^2 - t^3$ for $0 \leq t \leq 20$

a. Find an expression for $\frac{dN}{dt}$.

b. Find the rate at which the number of bacteria is increasing, in bacteria per hour, when $t = 2$.

(3 marks)

Answer _____


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**7** Priya throws a ball straight up into the air. The height, $h$ metres, of the ball above the ground $t$ seconds after it leaves her hand is given by

$h = 30t - 5t^2$

a. Find the value of $t$ when the ball reaches its greatest height.

b. Find the greatest height, in metres, that the ball reaches.

(4 marks)

Answer _____

**8** A train moves along a straight track. At time $t$ seconds its velocity, $v$ m/s, is given by

$v = 24t - 3t^2$ for $0 \leq t \leq 8$

a. Find an expression for the acceleration, $a$ m/s$^2$, of the train at time $t$ seconds.

b. Find the value of $t$ when the velocity of the train is greatest.

c. Find the greatest velocity of the train, in m/s.

(4 marks)

Answer _____

**9** A particle P moves along a straight line. At time $t$ seconds the displacement, $s$ metres, of P from a fixed point O is given by

$s = 6t^2 - t^3$

P starts at O when $t = 0$ and later returns to O.

a. Find the value of $t$ when P returns to O.

b. Find the velocity of P, in m/s, at the instant it returns to O.

(4 marks)

Answer _____


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**10** A particle moves along a straight line through a fixed point O. At time $t$ seconds the displacement, $s$ metres, of the particle from O is given by

$s = 2t^3 - 21t^2 + 60t$ for $0 \leq t \leq 6$

a. Find the values of $t$ for which the velocity of the particle is zero.

b. Find the greatest displacement, in metres, of the particle from O during the 6 seconds. (5 marks)

Answer _____

End of questions | Total 34 marks


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