Kinematics: exam questions

10 questions · 31 marks · mark schemes at the end

Name _____ Date _____ Score / 31

- Calculators are allowed on both 4MA1 Higher papers (1H and 2H). Show your working: most marks are for method.
- Mark schemes start after the questions. M marks are for a correct method, A marks for an accurate answer that follows a correct method, and B marks for a correct result on its own.
- Online, with more practice: igcsemathrevision.com/igcse-frontend/4ma1/exam-questions/kinematics

1. **4 marks**

A particle moves along a straight line. Its displacement, s metres, from a fixed point O at time t seconds is $s = t^3 - 6t^2 + 9t$.

(a) Find an expression for the velocity of the particle at time t. **(2)**

(b) Find the times when the particle is at rest. **(2)**

2. **3 marks**

A particle moves so that its displacement, s metres, at time t seconds is $s = 4t^2 - t^3$.

Work out the acceleration of the particle when $t = 2$.

3. **2 marks**

The velocity, v m/s, of a particle at time t seconds is $v = 2t^2 - 8t + 6$.

Work out the acceleration of the particle when $t = 3$.

4. **5 marks**

A particle moves so that its displacement, s metres, at time t seconds is $s = 2t^3 - 15t^2 + 36t$.

(a) Find the times when the velocity of the particle is zero. **(3)**

(b) Work out the acceleration of the particle when $t = 2$. **(2)**

5. **2 marks**

The displacement, s metres, of a particle at time t seconds is $s = t^2 + 3t + 2$.

Work out the distance travelled by the particle during the third second (from $t = 2$ to $t = 3$). The particle does not change direction.

6. **3 marks**

A ball is thrown upwards. Its height, s metres, after t seconds is $s = 20t - 5t^2$.

Work out the greatest height of the ball.

7. **3 marks**

The velocity, v m/s, of a particle at time t seconds is $v = 3t^2 - 2t$.

(a) Work out the velocity when $t = 4$. **(1)**

(b) Work out the acceleration when $t = 4$. **(2)**

8. **3 marks**

A particle moves so that its displacement, s metres, at time t seconds is $s = t^3 - 3t^2 + 4$, for $t \geqslant 0$.

Work out the least velocity of the particle.

9. **3 marks**

A particle starts at O. Its displacement from O, s metres, at time t seconds is $s = 5t - \frac{1}{2}t^2$.

(a) Find the time when the particle returns to O. **(2)**

(b) Find its velocity at that time. **(1)**

10. **3 marks**

The velocity, v m/s, of a particle at time t seconds is $v = 12 - 3t^2$, for $t \geqslant 0$.

Work out the acceleration of the particle when it is momentarily at rest.

Answers and worked solutions

Question 1 — 4 marks

(a)

M1 differentiating, at least two terms correct

A1 $v = 3t^2 - 12t + 9$

(b)

M1 $3(t-1)(t-3) = 0$

A1 $t = 1$ and $t = 3$

Answer: (a) $v = 3t^2 - 12t + 9$; (b) 1 second and 3 seconds

Question 2 — 3 marks

M1 $v = 8t - 3t^2$

M1 $a = 8 - 6t$

A1 $-4\ \text{m/s}^2$

Answer: $-4\ \text{m/s}^2$

Question 3 — 2 marks

M1 $a = 4t - 8$

A1 $4\ \text{m/s}^2$

Answer: $4\ \text{m/s}^2$

Question 4 — 5 marks

(a)

M1 $v = 6t^2 - 30t + 36$

M1 $6(t-2)(t-3) = 0$

A1 $t = 2$ and $t = 3$

(b)

M1 $a = 12t - 30$

A1 $-6\ \text{m/s}^2$

Answer: (a) 2 seconds and 3 seconds; (b) $-6\ \text{m/s}^2$

Question 5 — 2 marks

M1 $s(3) = 20$ and $s(2) = 12$

A1 8 m

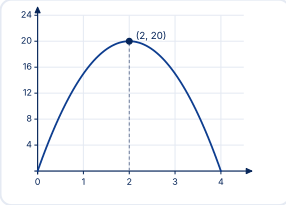
Answer: 8 m

Question 6 — 3 marks

M1 $v = 20 - 10t$

M1 $20 - 10t = 0$, $t = 2$

A1 20 m



Answer: 20 m

Question 7 — 3 marks

(a)

B1 $40\ \text{m/s}$

(b)

M1 $a = 6t - 2$

A1 $22\ \text{m/s}^2$

Answer: (a) $40\ \text{m/s}$; (b) $22\ \text{m/s}^2$

Question 8 — 3 marks

M1 $v = 3t^2 - 6t$

M1 $a = 6t - 6 = 0$, so $t = 1$

A1 $-3\ \text{m/s}$

Answer: $-3\ \text{m/s}$

Question 9 — 3 marks

(a)

M1 $t\left(5 - \frac{1}{2}t\right) = 0$

A1 $t = 10$ seconds

(b)

B1 $-5\ \text{m/s}$

Answer: (a) 10 seconds; (b) $-5\ \text{m/s}$

Question 10 — 3 marks

M1 $12 - 3t^2 = 0$, $t = 2$

M1 $a = -6t$

A1 $-12\ \text{m/s}^2$

Answer: $-12\ \text{m/s}^2$

Online, with every solution: igcsemathrevision.com/igcse-frontend/4ma1/exam-questions/kinematics

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