M1·2

Kinematics of motion in a straight line

CHAPTER ASSIGNMENT

Name _____ Class _____ No. _____ Date _____

Answer every question in the space provided, showing clear mathematical working and units. Use g = 10 ms^{-2} for acceleration due to gravity unless stated otherwise. Fractions may be written as a/b.

Practice questions adapted from *Cambridge International AS & A Level Mathematics: Mechanics Student's Book* (Collins, Tom Andrews and Michael Kent), Chapter 2 (Kinematics of motion in a straight line), Exercises 2.1A to 2.5A and Exam-style questions, for classroom use. Diagrams are described in words and tables. The Check yourself and Chapter quiz questions are Guru Jazzy's own.

Exercise 2.1A · The language of kinematics

2.1.1 A particle travels 30 m in the negative direction along a straight line, then turns and moves 20 m in the positive direction. Determine: (a) the total distance travelled (b) the displacement from the starting point.

2.1.2 A model rocket is launched vertically upwards from ground level. It attains a peak altitude of 73 m before falling straight back to the launch pad.

(a) Find the total distance travelled by the rocket.

(b) Find the net displacement of the rocket upon landing.

2.1.3 A ball is projected vertically upwards from the roof of a 15 m tall building, reaching a maximum height of 40 m above the roof before falling all the way to ground level. Choosing upwards as the positive direction:

(a) Calculate the total distance covered by the ball.

(b) Determine the final displacement of the ball relative to its release position.

2.1.4 A snail crawls around the entire perimeter of a rectangular garden plot measuring 7 m by 4 m.

(a) Find the total distance crawled by the snail.

(b) State the snail's displacement when it returns to its initial corner.

2.1.5 A cyclist rides from her home to her grandparents' house by travelling 16 km due East followed by 16 km due South.

(a) Determine the bearing of the grandparents' house from her home.

(b) Find her overall displacement in magnitude and direction.

(c) How much further did she cycle compared to the straight-line displacement?

2.1.6 A walker travels 32 m due West and then 24 m due South in a total time of 28 seconds.

(a) Calculate the total distance covered.

(b) Find the magnitude and direction of the displacement from the starting point.

(c) Find the average speed of the walker.

2.1.7 A sailing yacht maintains a steady speed for 20 minutes on a bearing of 120°, and then for another 20 minutes on a bearing of 240°. At the end of the 40-minute journey, the yacht is 10 km from its initial position.

(a) Find the total distance sailed.

(b) Calculate the sailing speed in km h^{-1} or m s^{-1}.

2.1.8 An ant moves along grid lines from point (38, −4) to point (−2, 5) taking the shortest path along the grid axes.

(a) Calculate the total grid distance travelled by the ant.

(b) Find the straight-line displacement vector and its bearing to the nearest degree.

(c) If the ant travels at 1 grid unit per second, how much longer does the grid journey take compared to direct travel along the displacement vector?

2.1.9 A bus drives 15 km on a bearing of 060°, and then 36 km on a bearing of 150°.

(a) Find the difference between the distance driven and the direct displacement.

(b) Find the overall displacement vector and state its bearing to the nearest integer degree.

Exercise 2.2A · Equations of uniformly accelerated motion

2.2.1 Evaluate the unknown SUVAT variable in each case:

(a) Find s when u = 70 ms^{-1}, a = -3 ms^{-2}, and t = 10 s.

(b) Find s when u = 15 ms^{-1}, v = 29 ms^{-1}, and t = 9 s.

(c) Find a when u = 3 ms^{-1}, v = 38 ms^{-1}, and t = 7 s.

(d) Find s when u = 22 ms^{-1}, a = 6 ms^{-2}, and v = 28 ms^{-1}.

(e) Find t when v = -28 ms^{-1}, a = -7 ms^{-2}, and s = 0 m.

2.2.2 A particle moves along a straight line with an initial velocity of 24 ms^{-1} and uniform acceleration of 5 ms^{-2}.

(a) Calculate its speed after travelling 10 m.

(b) Find the time required to cover this 10 m distance.

2.2.3 A particle has an initial velocity of 60 ms^{-1} and experiences a constant deceleration of 8 ms^{-2}.

(a) Determine its velocity after 10 seconds.

(b) At what time does the particle momentarily come to rest?

2.2.4 Starting from rest, a sprinter accelerates uniformly at 0.5 ms^{-2} for 40 seconds to cross the finish line.

(a) What is her speed as she finishes?

(b) What is the total length of the sprint track?

2.2.5 A bullet strikes a target at 50 ms^{-1} and penetrates 1500 m through a resistant medium before stopping under uniform deceleration.

(a) Find the magnitude of the deceleration and the duration of penetration.

(b) State two modelling assumptions required for this calculation.

2.2.6 Solve the following constant-acceleration problems:

(a) A particle accelerating from rest at 4 ms^{-2} travels 128 m. Find the elapsed time.

(b) A particle launched at 180 ms^{-1} undergoes constant retardation of 3 ms^{-2}. In how many minutes does it return to its launch point?

(c) A particle with u = 5 ms^{-1} and a = 3 ms^{-2} travels 84 m in T seconds. Show that $3T^2 + 10T - 168 = 0$ and solve for T.

2.2.7 A coin rolling down an incline has constant acceleration 0.25 ms^{-2} and covers 930 m in 60 seconds. Calculate its initial speed and its speed at the end of the minute.

2.2.8 A car accelerates uniformly from rest to 60 km h^{-1} in 8 seconds, then continues at this steady speed.

(a) How long does it take to travel the first 200 m?

(b) What is the total time taken to travel 1 km from rest?

2.2.9 A particle moves with constant acceleration along line PQRS, taking 5 s to travel PQ = 100 m and 15 s to travel QR = 720 m.

(a) Calculate the acceleration of the particle.

(b) Find the velocity of the particle as it passes Q.

(c) If segment RS = 830 m, find the time taken to travel from Q to S.

2.2.10 A driver travelling at 20 ms^{-1} with constant acceleration 2 ms^{-2} sees an obstruction 80 m ahead. Under braking, the car decelerates at 4 ms^{-2}.

(a) If the driver brakes with zero reaction time, how far from the obstacle does the vehicle stop?

(b) If reaction time is 2.0 seconds before braking starts, calculate the impact speed.

2.2.11 Two bodies A and B, initially at rest at opposite ends of a 100 m straight track, accelerate towards each other at 6 ms^{-2} and 2 ms^{-2} respectively.

(a) Where along the track do they meet?

(b) At what time do they collide?

(c) Find the speed of each body at the instant of impact.

2.2.12 A particle moves along a straight line with u = 13 ms^{-1} and constant acceleration a = -2 ms^{-2}. Find the two times at which its displacement from the origin is 30 m.

2.2.13 Particle J passes point O with speed 2 ms^{-1} and acceleration 1 ms^{-2}. When J is 30 m from O, particle K starts from rest at O with acceleration 0.8 ms^{-2}. When K reaches 4 ms^{-1}, particle L passes O at 3 ms^{-1} with acceleration 0.5 ms^{-2}. Find the distance between J and K at the instant L reaches a speed of 7 ms^{-1}.

2.2.14 A body travels along straight line EFGH with constant deceleration. It takes 7 s to cover EF, 3 s to cover FG = 66 m, and 4 s to cover GH, where it comes to rest at H.

(a) Find the deceleration of the body.

(b) Find its velocity at point E.

2.2.15 A cyclist passes a garage, a café, and a library in sequence along a straight road with steady acceleration 0.15 ms^{-2}, passing the library at 9 ms^{-1}. The café-to-library distance is 240 m, and the time taken from café to library is twice that from garage to café. Find the total distance from the garage to the library.

Exercise 2.3A · Vertical motion

2.3.1 A pebble is dropped from rest into a deep well and strikes the water after 1.8 s. Taking g = 10 ms^{-2}, calculate the depth to the water surface.

2.3.2 A small object slips from the edge of a table 1.2 m above a floor. Find the time taken to hit the floor.

2.3.3 A ball is thrown vertically downwards from an elevated platform at 7 ms^{-1} and hits the ground at 15 ms^{-1}. Find the height of the platform.

2.3.4 A stone is dropped from rest from the top of a 48 m vertical cliff. Calculate, to 3 significant figures:

(a) the speed with which it strikes the sea

(b) the time taken to reach the sea.

2.3.5 A flare is projected vertically upwards from a cliff edge at 40 ms^{-1} and falls into the sea 10 seconds later.

(a) Determine the height of the cliff above sea level.

(b) Calculate the maximum height above sea level reached by the flare.

(c) Find the time taken to attain maximum height.

(d) Find the impact speed at the sea surface.

(e) How long after launch does the flare pass its launch level on the way down?

2.3.6 A ball is projected vertically upwards from ground level at 25 ms^{-1}.

(a) Find the total time of flight until it lands.

(b) Calculate the maximum height reached.

(c) Find the time taken to reach three-quarters of its maximum height for the first time.

(d) Explain whether air resistance makes the theoretical maximum height an over- or under-estimate.

(e) How would the flight duration differ if the ball had double the mass, ignoring air resistance?

2.3.7 (a) An object is dropped from height h under uniform gravity g. Prove that the time taken to hit the ground is $t = \sqrt{(2h/g)}$.

(b) If released from 12 times that height on a planet where gravity is 3 times as large, by what factor does the fall time change?

2.3.8 Stone A is dropped from rest from the battlements of a castle. Exactly 1.0 s later, stone B is thrown downwards from the same position at 14 ms^{-1}. If both stones hit the moat simultaneously, find the height of the castle.

2.3.9 A ball is thrown upwards at 15 ms^{-1} from a height of 20 m above the ground. Two students calculate the final impact velocity:

Student A solves $-20 = 15t - 5t^2$ to find $t = 4$ s, then uses $v = u + at = 15 - 10(4) = -25$ ms^{-1}.

Student B uses $v^2 = 15^2 + 2(-10)(-20) = 625$ to obtain $v = 25$ ms^{-1}.

Critique both methods and clarify why direction matters for velocity.

2.3.10 A projectile is launched upwards from ground level with speed 70 ms^{-1}.

(a) Show that the projectile is at least 165 m above ground when $T^2 - 14T + 33 < 0$.

(b) Find the total time interval during which the projectile remains above 165 m.

2.3.11 A ball is thrown vertically upwards from a balcony 11.4 m high. It reaches its maximum height at time T seconds and strikes the ground 4.3 seconds after launch. Find the value of T.

2.3.12 A ball is projected vertically upwards from ground level at 43 ms^{-1}. Calculate the total duration for which the ball is more than 90 m above the ground.

2.3.13 A load is lifted vertically from rest on a table by a cable with upward acceleration 0.8 ms^{-2}. After 4 seconds the cable snaps. How long after the break does the load return to the table?

2.3.14 Stone 1 is dropped from the top of a 37 m tall structure. When it has fallen halfway, stone 2 is thrown downwards from the top. Find the initial downward velocity of stone 2 so that both strike the ground simultaneously.

2.3.15 A person on a 45 m high roof can catch a ball only if its speed is 5 ms^{-1} or less. A ball is launched upwards from the ground at U ms^{-1}.

(a) Determine the range of launch speeds U that allow a catch on the way up.

(b) If the ball is missed on the ascent, find the maximum time before it returns to roof level on the descent.

2.3.16 A particle dropped from a tower of height H m takes T seconds to reach the ground. If thrown upwards at U ms^{-1} from the same spot, it takes (T + X) seconds. Prove that $H = 5X^2((U - 5X)/(10X - U))^2$.

Exercise 2.4A · Displacement-time and velocity-time graphs

2.4.1 A cyclist travels at a constant 12 ms^{-1} for 10 s, decelerates uniformly over 20 s to 5 ms^{-1}, and maintains 5 ms^{-1} for a final 10 s.

(a) Find the deceleration during the middle phase.

(b) Calculate the total distance covered using the area under the v-t graph.

2.4.2 A bus departs at 11:20 a.m., travels at 45 km h^{-1} for 40 minutes, waits for 60 minutes, and returns along the same route at 50 km h^{-1}.

(a) Sketch the displacement-time graph for the journey.

(b) At what time does the bus return to its origin?

2.4.3 Particle 1 moves at 3 ms^{-1} for 12 s, then immediately reverses to -2 ms^{-1} for 15 s. Particle 2 sets out from the same origin 3 s after Particle 1 at a constant speed of 1.6 ms^{-1}.

(a) Sketch both displacement-time graphs on the same axes.

(b) Determine the time and location at which they meet.

2.4.4 Cars A and B leave opposite ends of a 42 km road at 4:45 p.m. Car A drives at 75 km h^{-1} for 20 min, halts for 10 min, and resumes at 51 km h^{-1}. Car B drives at 72 km h^{-1} for 10 min, halts for 20 min, and resumes at 72 km h^{-1}. Find when and where they pass.

2.4.5 A car accelerates uniformly from rest for 30 s to V ms^{-1}, cruises at V for X seconds, and decelerates uniformly to rest at t = 100 s. One-quarter of the total distance is covered during the first 30 s.

(a) Find the cruise duration X.

(b) If the deceleration is 0.9 ms^{-2}, calculate the top speed V.

2.4.6 A motorbike cruising at 18 ms^{-1} passes a stationary patrol car. After 10 s, the patrol car accelerates at constant rate for 10 s to 24 ms^{-1} and maintains this speed.

(a) Sketch the velocity-time graphs for both vehicles on one diagram.

(b) Find the time elapsed after the motorbike passes until the patrol car overtakes it.

(c) How far has the patrol car travelled when it catches the bike?

2.4.7 Particle P starts from O with acceleration 1.25 ms^{-2} for T seconds, reaching displacement D. Particle Q starts at D with acceleration -0.5 ms^{-2} for T seconds, reaching displacement 30 m. Find T and D.

2.4.8 Athlete 1 accelerates from rest at 0.8 ms^{-2} for 10 s, then maintains top speed to finish in 105 s. Athlete 2 accelerates at 0.225 ms^{-2} for 40 s, then continues at a reduced acceleration, finishing 3 s ahead of Athlete 1.

(a) Find the total race distance.

(b) Calculate the finishing speed of Athlete 2.

2.4.9 A vehicle accelerates from rest to V ms^{-1} in T_1 s, cruises at V for T_2 s, and decelerates to rest in T_3 s. Show that the total displacement is represented by the area of a trapezium with parallel sides ($T_1 + T_2 + T_3$) and T_2, and height V.

2.4.10 Vehicles A and B travel between the same two points, starting and stopping together. A accelerates at 1.5 ms^{-2} for 20 s, cruises for 70 s, and decelerates. B accelerates at 0.8 ms^{-2} for 50 s, cruises for 20 s, and decelerates.

(a) Find the total journey time and total distance.

(b) Calculate the deceleration of each vehicle.

2.4.11 A parachutist free-falls from rest for 45 s under gravity (10 ms^{-2}), then deploys her parachute and descends at a steady 8 ms^{-1} for 3 minutes to land.

(a) Sketch the velocity-time graph.

(b) Calculate the total vertical descent predicted by this simplified model.

(c) Discuss why the true drop distance differs from this model.

2.4.12 A delivery van travels at constant speed V ms^{-1} for 45 s, then decelerates at 1.6 ms^{-2} to rest in T seconds, covering 2.3 km in total.

(a) Prove that $T^2 + 90T - 2875 = 0$.

(b) Find the cruising speed V.

Exercise 2.5A · Solving kinematics problems using differentiation and integration

2.5.1 The position of a particle is given by $s = 13t + 20 - 4t^2$ metres.

(a) Find the velocity at t = 2 s.

(b) Show that the acceleration is constant.

2.5.2 A body moves along a line with displacement $s = 5t^3 - 7t^2$ metres.

(a) Derive expressions for velocity v and acceleration a.

(b) Find v when t = 2 s, and a when t = 3 s.

2.5.3 The velocity of a particle is $v = (t - 2)\ ms^{-1}$. At t = 6 s, s = 11 m.

(a) Find an expression for s in terms of t.

(b) Calculate the displacement at t = 8 s.

(c) Find the velocity when the displacement is 53 m.

2.5.4 A particle moves along a line such that $s = t^3 - 8t^2 + 5t + 10$.

(a) Find the times when the particle is instantaneously at rest.

(b) For what range of times is the acceleration positive?

(c) Find v and s when the acceleration is 2 ms^{-2}.

2.5.5 The velocity of a particle is $v = 18t - t^2$ ms^{-1}. Calculate its acceleration at each instant when $v = 65$ ms^{-1}.

2.5.6 A particle's displacement is given by $s = 8\sqrt{t} - 64/t$.

(a) Verify that $s = 0$ when $t = 4$ s.

(b) Calculate the velocity and acceleration at $t = 4$ s.

2.5.7 A particle accelerates according to $a = 6t - 20$ ms^{-2}. At $t = 12$ s, $v = 223$ ms^{-1}; at $t = 7$ s, $s = 40$ m.

(a) Determine expressions for v(t) and s(t).

(b) Find the times when the particle passes the origin.

(c) Find the times when its speed is 19 ms^{-1}.

2.5.8 The displacement of a particle is $s = t^4 - 8t^3 + 22t^2 - 20t + q$ cm. When $t = 4$ s, $s = 33$ cm.

(a) Find q.

(b) Find the displacement whenever the particle moves at 4 cm s^{-1}.

(c) Find the displacement when the acceleration is 188 cm s^{-2}.

2.5.9 The acceleration of a particle is $a = 6t - 30$ ms^{-2}. Initially $s = 0$ and $v = 72$ ms^{-1}.

(a) Find the minimum velocity attained.

(b) At what times is the particle instantaneously at rest?

(c) Calculate the total distance covered in the first 10 seconds.

2.5.10 Given $a = 9 - 2t$ ms^{-2} with the particle initially at rest at O:

(a) Find the distance travelled in the first 2 seconds.

(b) Find the distance travelled during the 5th second.

(c) Find the distance travelled during the 9th and 10th seconds combined.

2.5.11 A particle starts from O at 2 ms^{-1} with acceleration defined piecewise: $a = \frac{1}{2}(t + 6)$ for $0 \le t \le 4$, and $a = 320/t^3$ for $4 < t \le 8$.

(a) Find the velocity at $t = 3$ s and $t = 5$ s.

(b) Find the total displacement over the 8-second interval.

2.5.12 The velocity of a particle starting from O is $v = 2t + 4$ for $0 \le t \le 6$, and $v = 20 - (t - 8)^2$ for $6 < t \le 10$.

(a) Sketch the velocity-time profile.

(b) Determine the maximum speed of the particle.

(c) Find the acceleration and displacement at $t = 5$ s and $t = 9$ s.

2.5.13 A particle starts from O and accelerates from 6 ms^{-1} to 33 ms^{-1} in 18 s. Thereafter, its acceleration is $a = \frac{1}{4}(t - 12)$ ms^{-2}. Find the total distance travelled during the first 30 seconds.

Exam-style questions · Kinematics review

R2.1 A car travels along a straight road with constant acceleration. It passes A at 1.5 ms^{-1} and 6 s later passes B, where AB = 90 m.

(a) Find the acceleration of the car.

(b) The car later passes C at 37.5 ms^{-1}. Find distance AC.

R2.2 A ball is thrown vertically upwards from A to a maximum height of 80 m above A.

(a) Calculate the speed of projection.

(b) Find the total time elapsed before returning to A.

R2.3 A particle's position is $s = t^3 - 14t^2 + 48t$ metres.

(a) Find all times at which the particle returns to its initial position.

(b) Find the displacement when it is travelling with minimum velocity.

R2.4 The acceleration of a particle is $a = pt - 10$ ms^{-2}. At $t = 2$ s, $v = 30$ ms^{-1}; at $t = 2.5$ s, $v = 52$ ms^{-1}. Given $s(0) = 0$, find the position at $t = 3$ s.

R2.5 A flare is fired vertically upwards from a 20 m tower at 37.5 ms^{-1}.

(a) Show that impact occurs when $2t^2 - 15t - 8 = 0$.

(b) Find the time of flight until ground impact.

(c) Calculate the total distance traversed by the flare.

R2.6 A vehicle passes roadside markers P, Q, R with constant acceleration. It takes 5 s to travel PQ = 40 m, and 10 s to travel QR = 20 m. Find its speed at P and its acceleration.

R2.7 A ball projected vertically upwards from ground level at u ms^{-1} lands after 6 seconds, reaching a peak height of 45 m.

(a) Sketch the velocity-time graph.

(b) Determine the value of u.

(c) State one physical effect omitted by this mathematical model.

R2.8 A particle moves along the x-axis with $v = 3t^2 - 12t + 11$ ms^{-1}. Starting from the origin, find its displacement when its velocity is a minimum.

R2.9 Cars A and B pass O together at t = 0. A travels at steady 36 ms^{-1}. B starts through O at 18 ms^{-1} with constant acceleration 3 ms^{-2}.

(a) Find B's speed after covering 42 m.

(b) Find A's displacement when B has travelled 42 m.

(c) Find the time when B overtakes A.

R2.10 A car accelerates from rest for 30 s to 24 ms^{-1}, cruises at 24 ms^{-1} for 150 s, and decelerates uniformly to rest at F, covering 4.5 km in total.

(a) Sketch the velocity-time graph.

(b) Find the total trip duration.

(c) A motorcycle departs S 20 s after the car, accelerating uniformly from rest, and catches the car at P, 1920 m from S. Find the motorcycle's travel time and speed at P.

R2.11 A sprinter accelerates from rest at 4 ms^{-2} for 2 s, then at ⅓ ms^{-2} for 3 s, then at 3/13 ms^{-2} for 13 s, and finally decelerates at 2.4 ms^{-2} to rest. Find the average speed for the race to 3 s.f.

R2.12 A particle moves with $v = 8t - t^2$ for $0 \le t \le 6$, and $v = 15 - \frac{1}{2}t$ for $t > 6$. Find:

(a) the acceleration at $t = 5$ s

(b) the total distance covered during the first 40 seconds.

R2.13 A car passes A at 18 ms^{-1}, decelerates uniformly over 180 m to 6 ms^{-1} at sign W, accelerates uniformly for 18 s to V ms^{-1} ($V > 18$), and cruises at V for 33 s to B. Total distance AB is 1.2 km.

(a) Sketch the velocity-time graph.

(b) Find the total time taken and the value of V.

R2.14 A particle on the x-axis has acceleration $a = t - 6$ ms^{-2} with $v(0) = 10$ ms^{-1}.

(a) Express v in terms of t.

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

(c) Calculate the distance between these two stationary points.

R2.15 Ball 1 is projected upwards from a building at 35 ms^{-1}. Exactly 2 s later, ball 2 is thrown upwards from the same height at 24 ms^{-1}. Both hit the ground at the same moment. Find the height of the building.

R2.16 A particle with constant acceleration covers collinear segments AB and BC where BC = 3AB. Times taken are 3 s for AB and 7 s for BC. Velocity at B is 4.5 ms^{-1} greater than at A. Find the total distance AC.

R2.17 A particle has displacement $s = t^2(t + k)$ where $k \neq 0$. If it comes to instantaneous rest at t = 6 s:

(a) Show that the acceleration at t = 13 s is 60 ms^{-2}.

(b) Prove that the total distance travelled in the first 10 s is 316 m.

Check yourself

C2.1 A cyclist travels at 8 ms^{-1} and decelerates uniformly to rest over 32 m. Find the magnitude of the deceleration and the time taken.

C2.2 A stone is thrown vertically upwards from a bridge with speed 15 ms^{-1}. Taking g = 10 ms^{-2}, calculate the time taken to hit the river 20 m below the bridge.

C2.3 A vehicle accelerates from rest to 20 ms^{-1} in 10 s, maintains 20 ms^{-1} for 30 s, and decelerates to rest in 15 s. Find the total distance travelled.

C2.4 The displacement of a particle is given by $s = 2t^3 - 15t^2 + 24t$. Determine the time at which the acceleration is zero and the velocity at that instant.

C2.5 A particle moves along a straight line with acceleration $a = 12 - 6t$ ms^{-2}. At t = 0, the particle is at rest at the origin. Find its maximum velocity and its position when it next comes to rest.

Chapter quiz

Q1 A runner travels 40 m North, then turns and runs 30 m South. What are the distance and displacement?

A	B	C	D
Distance 70 m, displacement 10 m North	Distance 10 m, displacement 70 m North	Distance 70 m, displacement 70 m North	Distance 10 m, displacement 10 m North

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Q2 A car accelerates uniformly from 12 m s^{-1} to 28 m s^{-1} in 4 s. Find its acceleration.

A	B	C	D
2 m s^{-2}	4 m s^{-2}	5 m s^{-2}	16 m s^{-2}

Q3 A train decelerates uniformly from 30 m s^{-1} to rest in 150 m. Find its acceleration.

A	B	C	D
−3 m s^{-2}	−6 m s^{-2}	3 m s^{-2}	−0.2 m s^{-2}

Q4 A particle starts from rest with acceleration 3 m s^{-2}. What distance does it cover in 6 s?

A	B	C	D
18 m	36 m	54 m	108 m

Q5 A stone is projected vertically upwards at 30 m s^{-1}. Taking g = 10 m s^{-2}, find its maximum height.

A	B	C	D
30 m	45 m	90 m	15 m

Q6 A ball is dropped from a 45 m high tower. Taking g = 10 m s^{-2}, how long does it take to hit the ground?

A	B	C	D
3.0 s	4.5 s	2.1 s	9.0 s

Q7 On a velocity-time graph, what do the gradient and the area under the curve represent?

A	B	C	D
Gradient = speed, area = acceleration	Gradient = acceleration, area = displacement	Gradient = displacement, area = acceleration	Gradient = distance, area = velocity

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Q8 A trapezoidal v-t graph has parallel sides of length 20 s and 50 s with height 14 m s^{-1}. Find displacement.

A	B	C	D
490 m	700 m	980 m	350 m

Q9 The displacement of a particle is $s = 2t^3 - 9t^2 + 12t$. At what times is it instantaneously at rest?

A	B	C	D
t = 1 s and t = 2 s	t = 2 s and t = 3 s	t = 0 s and t = 4 s	t = 1.5 s only

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Q10 A particle moves with velocity $v = 6t - 4$ m s^{-1}. If $s = 5$ m at $t = 1$ s, find s when $t = 3$ s.

A	B	C	D
17 m	21 m	23 m	27 m

Q11 The velocity of a particle is $v = 12t - 3t^2$ m s^{-1}. What is its maximum velocity?

A	B	C	D
8 m s^{-1}	12 m s^{-1}	16 m s^{-1}	24 m s^{-1}

End of assignment · Check your answers against the chapter at gurujazzy.com/subjects/as-a-level-mathematics/m1-2-kinematics-of-motion-in-a-straight-line/