



Forces and Motion

FREE Online Physics GCSE Course

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Name _____ Date _____

TIME ALLOWED

35 minutes

TOTAL MARKS

40

YOU WILL NEED

a ruler, a protractor, a pencil, a black or blue pen and a calculator

Instructions

- Answer **all** questions.
- Write your answers in the spaces provided.
- Use black or blue ink. Draw diagrams in pencil.
- In calculations, show clearly how you work out your answer. Use $g = 10 \text{ N/kg}$.

Information

- The marks for each question are shown in brackets.
- The maximum mark for this test is 40.
- Question 4 (moments) is **Physics only**.

Your score

Question	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Total	%
Out of	6	5	8	4	5	6	6	40	100
Your mark									

Marking your test

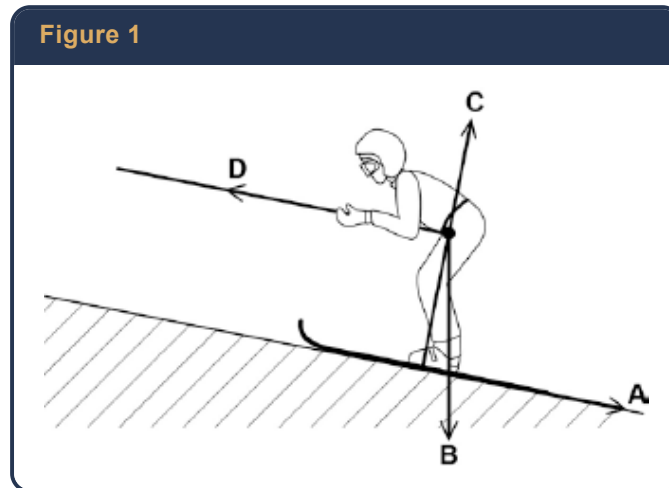
The full mark scheme is at the back of this booklet. Try every question first, then mark your answers in a different colour.

1 Question 1

6 marks

Figure 1 shows a skier using a drag lift. The drag lift pulls the skier from the bottom to the top of a ski slope.

The arrows, **A**, **B**, **C** and **D**, represent the forces acting on the skier and her skis.



(a) Which arrow represents the force pulling the skier up the slope?

Tick (✓) **one** box.

A

☐

B

☐

C

☐

D

☐

(1)

(b) Which arrow represents the normal contact force?

Tick (✓) **one** box.

A

☐

B

☐

C

☐

D

☐

(1)

(c) What is the unit for momentum?

Tick (✓) **one** box.

A p

☐

B kg m/s

☐

C m/s²

☐

D J

☐

(1)

(d) In the formula $F = m a$, what is the best description of F ?

Tick (✓) **one** box.

A The force acting on an object

☐

B The resultant force acting on an object

☐

C The weight of an object

☐

D The force responsible for moving an object

☐

(1)

(e) Near the surface of the Earth, any object falling freely under gravity (when the only force acting is the object's weight) has an acceleration of:

Tick (✓) **one** box.

A 10 m/s^2

☐

B 10 m/s^2 then it reduces to zero as the object reaches terminal velocity

☐

C It is dependent on the weight of the object

☐

D 0 m/s^2 as the object is in free space

☐

(1)

(f) A child drops a small ball which hits the ground at 10 m/s . The air resistance is negligible.

What height was the ball dropped from, to 1 significant figure? ($u = 0 \text{ m/s}$, $v = 10 \text{ m/s}$, $g = 10 \text{ m/s}^2$)

Tick (✓) **one** box.

A Roughly 5 m

☐

B Roughly 0.5 m

☐

C Roughly 1 m

☐

D None of the above

☐

(1)

Total for this question: 6 marks

2 Question 2

5 marks

The figure below shows a child who is balancing on a pogo stick. The child and pogo stick are not moving. The child weighs 350 N.

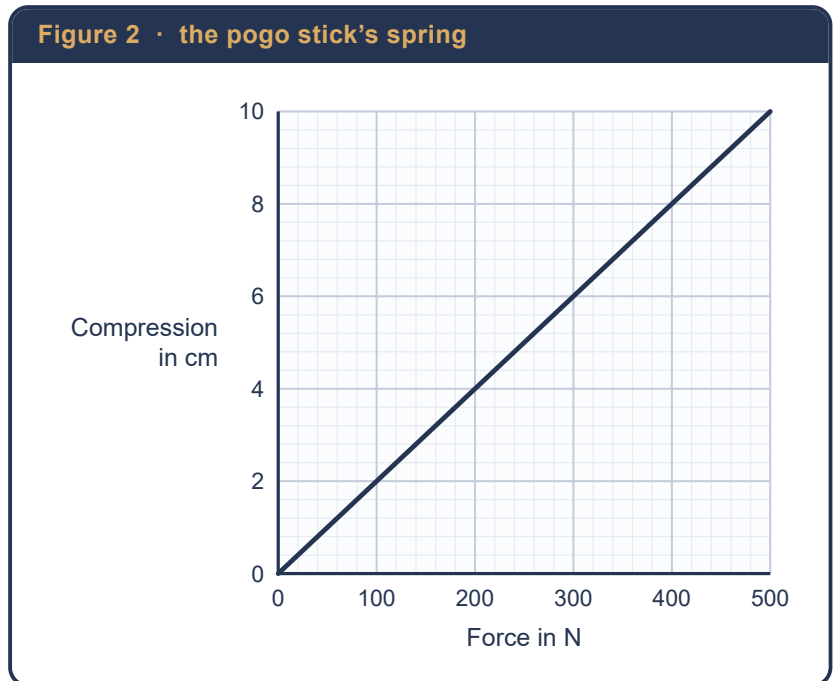
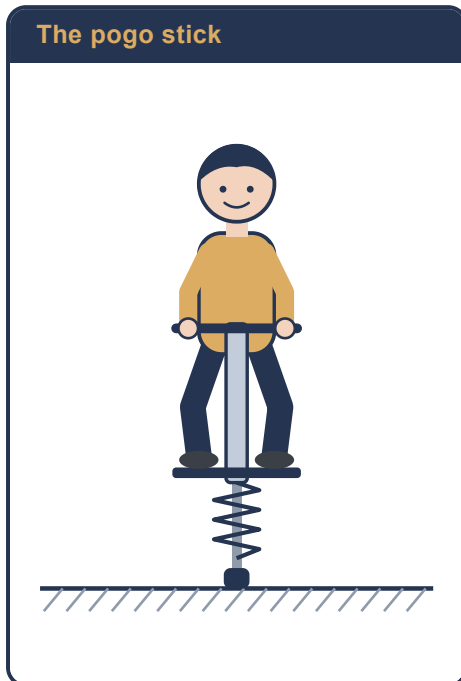


Figure 2 shows how the compression of the spring changes with the force on it.

(a) State Hooke's law.

(1)

(b) Explain how **Figure 2** shows that the spring obeys Hooke's law.

(2)

(c) Use **Figure 2** to find the compression of the spring when the child stands on the pogo stick.

Compression = _____ cm
(1)

- (d) When no force acts on it, the spring is 30 cm long. Calculate its length when the child stands on the pogo stick.

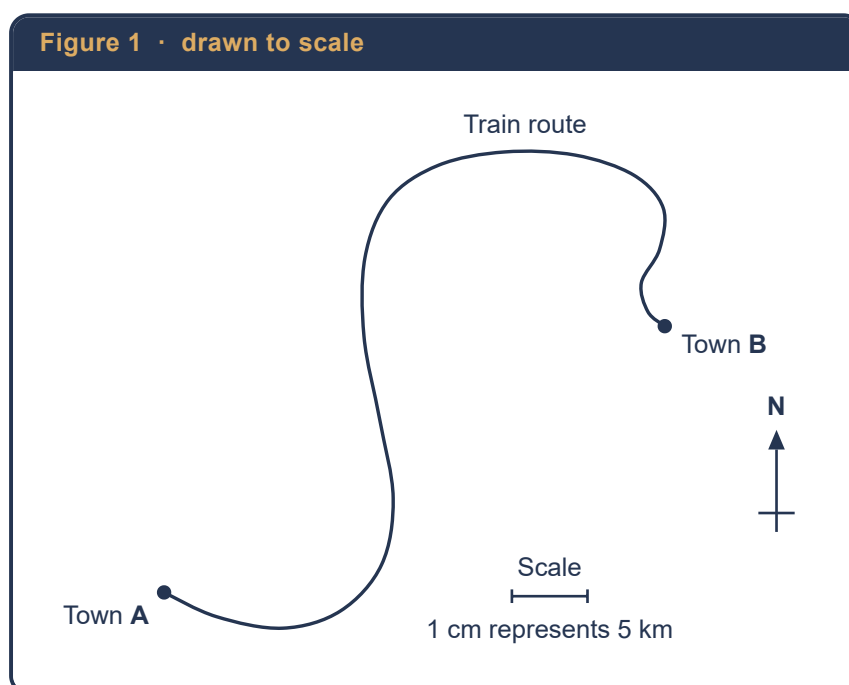
Length = _____ cm
 (1)

Total for this question: 5 marks

3 Question 3

8 marks

A train travels from town **A** to town **B**. **Figure 1** shows the route taken by the train. **Figure 1** has been drawn to scale.



- (a) The distance the train travels between **A** and **B** is not the same as the displacement of the train. What is the difference between distance and displacement?

(1)

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- (b) Use **Figure 1** to determine the displacement of the train in travelling from **A** to **B**.

Show how you obtain your answer.

Displacement = _____ km

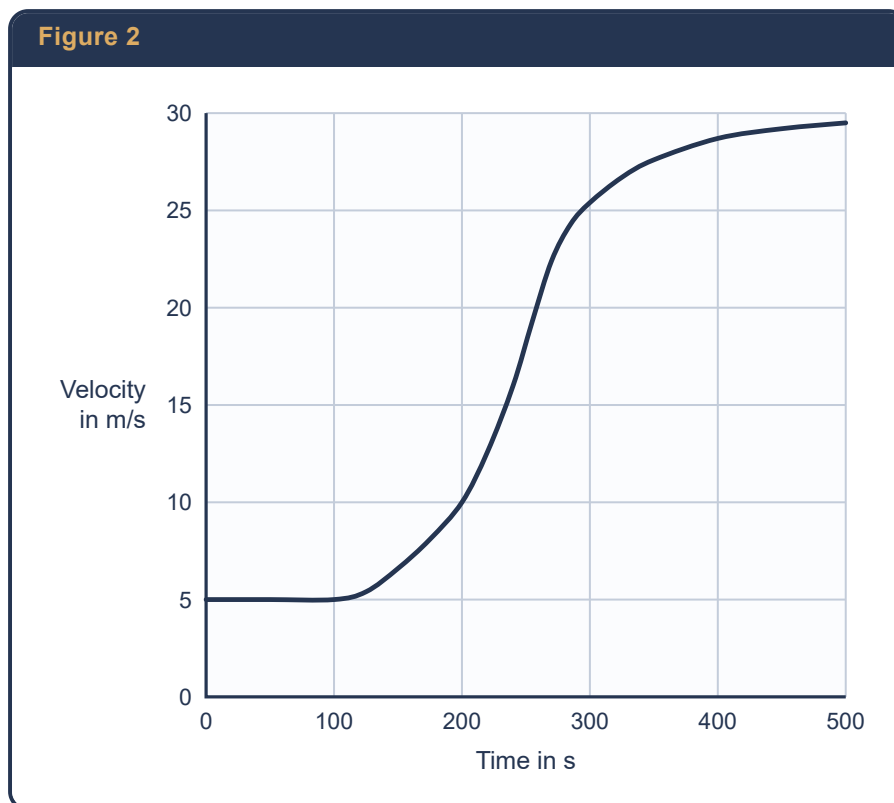
Direction = _____
(2)

- (c) There are places on the journey where the train accelerates without changing speed.

Explain how this can happen.

(2)

- (d) **Figure 2** shows how the velocity of the train changes with time as the train travels along a straight section of the journey.



Estimate the distance travelled by the train along the section of the journey shown in **Figure 2**.
 To gain full marks you must show how you worked out your answer.

Distance = _____ m
 (3)

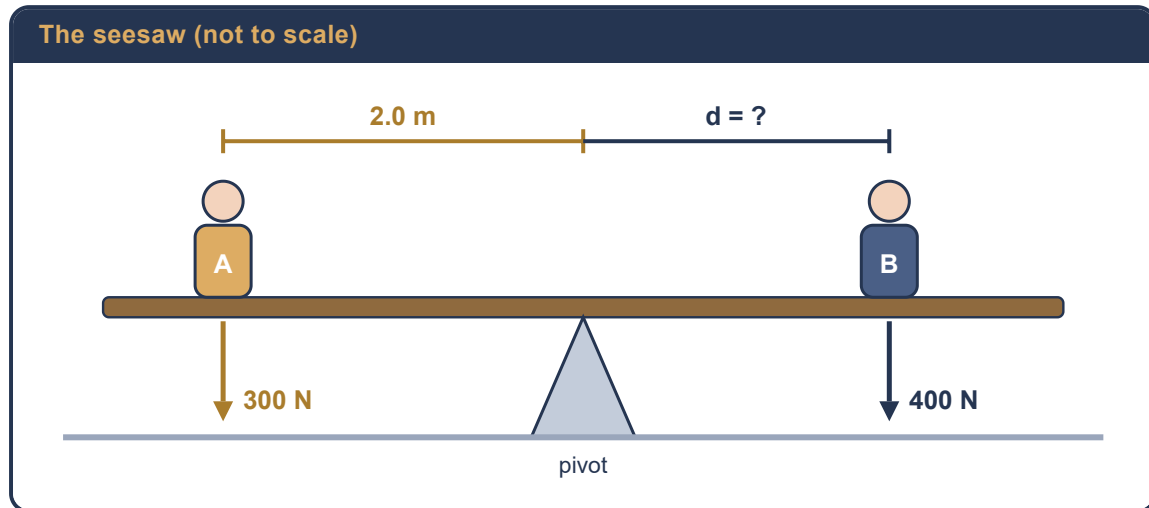
Total for this question: 8 marks

4 Question 4

Physics only

4 marks

Two children, **A** and **B**, sit on a seesaw. Child **A** weighs 300 N and sits 2.0 m from the pivot.



- (a) State the condition for there to be no turning effect on the seesaw, so that it balances.

(1)

- (b) Child **B** weighs 400 N. Calculate how far from the pivot child **B** must sit for the seesaw to balance.

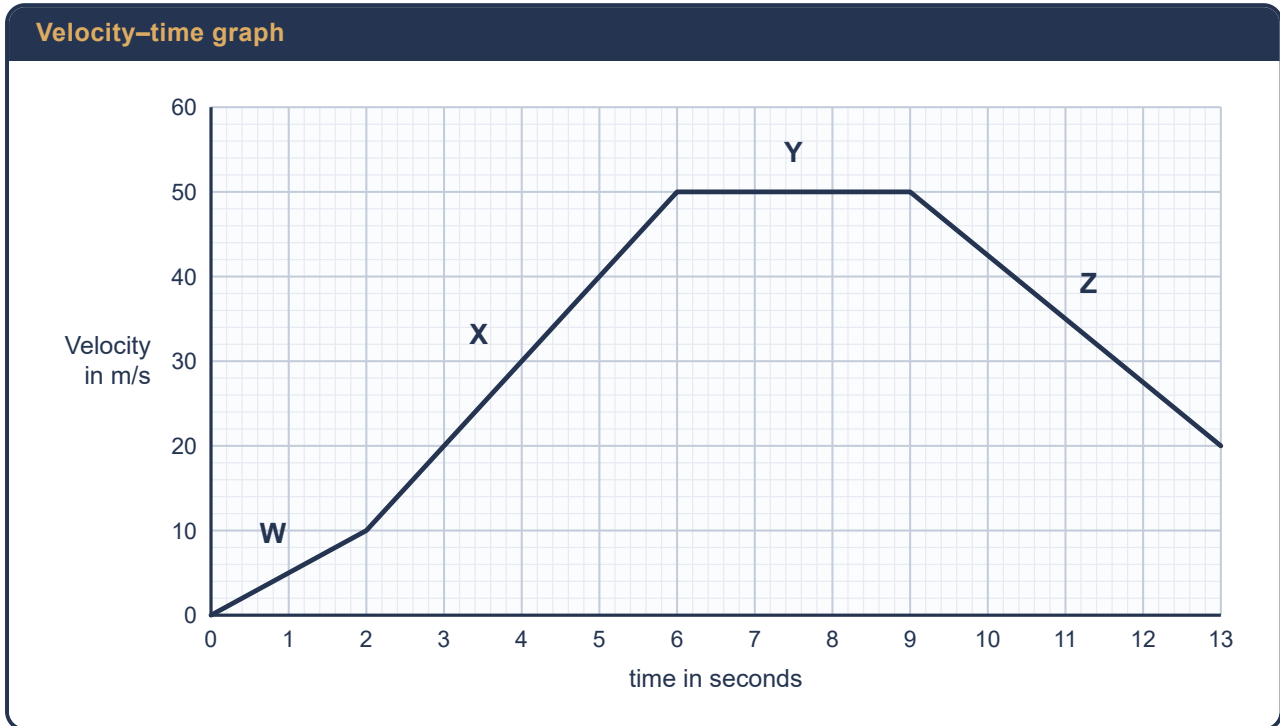
Distance = _____ m
 (3)

Total for this question: 4 marks

5 Question 5

5 marks

The graph shows changes in the velocity of a racing car.



- (a) Describe the motion of the racing car during the period labelled **W**.

(1)

- (b) Calculate the acceleration of the racing car during the period labelled **X**.

Show clearly how you work out your answer and give the unit.

Acceleration = _____
 (4)

Total for this question: 5 marks

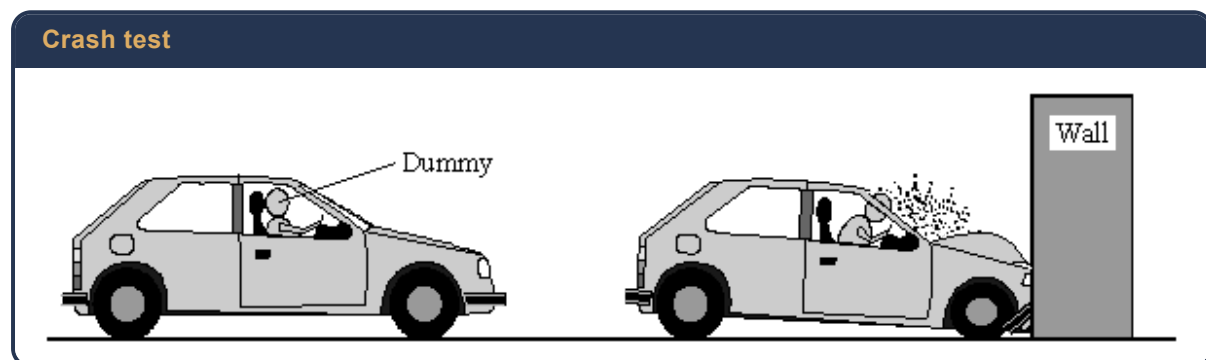
6 Question 6

6 marks

- (a) State **one** factor, apart from speed, which would increase a car's braking distance.

(1)

- (b) The diagram shows a 1000 kg car before and during a crash test. The car hits the wall at 14 metres per second (m/s) and takes 0.25 seconds (s) to stop.



In an accident the crumple zone at the front of a car collapses progressively. This increases the time it takes the car to stop.

In a front-end collision the injury to the car passengers should be reduced. Explain why.

The answer has been started for you.

By increasing the time it takes for the car to stop, the ...

(2)

- (c) Calculate the impact force on the car.

Impact force = _____ N
 (3)

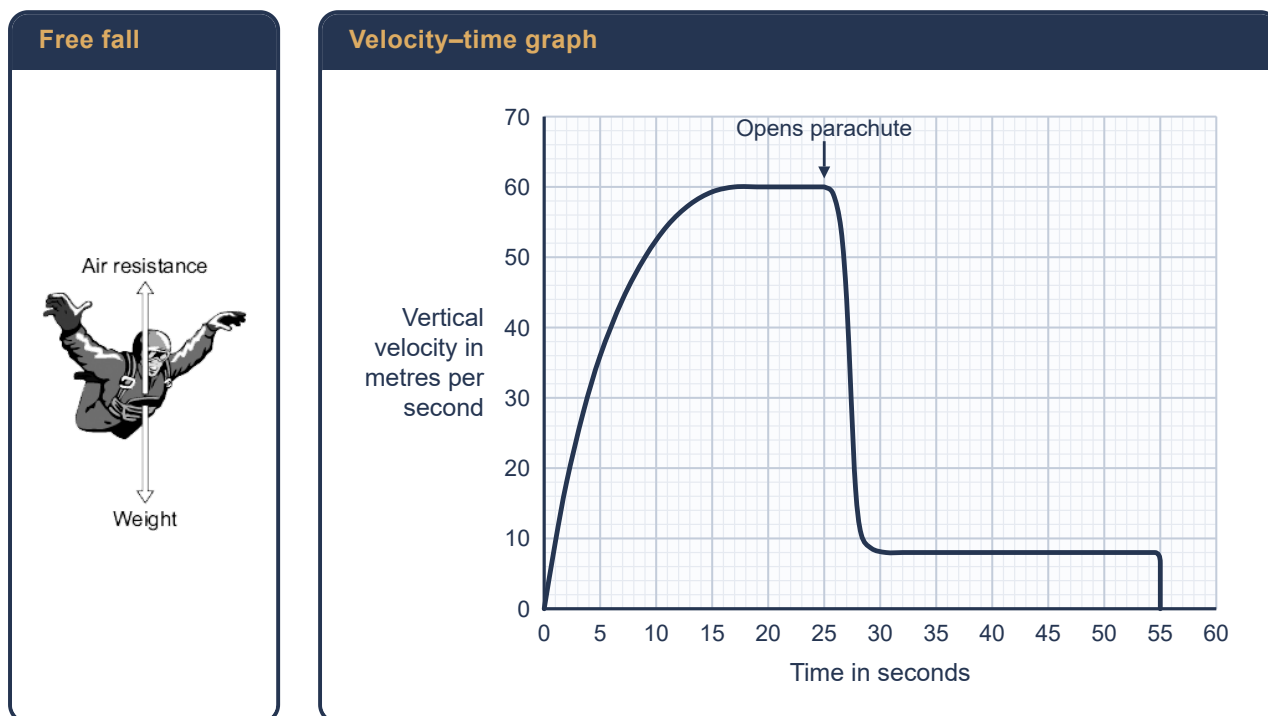
Total for this question: 6 marks

7 Question 7

6 marks

The diagram shows the forces acting on a parachutist in free fall.

The graph shows how the vertical velocity of a parachutist changes from the moment the parachutist jumps from the aircraft until landing on the ground.



In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Using the idea of forces, explain why the parachutist reaches a terminal velocity and why opening the parachute reduces the terminal velocity.



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(6)

Total for this question: 6 marks

END OF TEST

Now mark your answers using the mark scheme that follows.

MARK SCHEME

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[1] in the Mark column means one mark for that line.

accept / allow notes (gold) are other answers that also score.

reject / do not accept notes (red) are answers that do not.

1 Question 1 — mark scheme

6 marks

PART	ANSWER	MARK
(a)	D	1
(b)	C	1
(c)	B kg m/s	1
(d)	B The resultant force acting on an object	1
(e)	A 10 m/s ²	1
(f)	A Roughly 5 m $v^2 = u^2 + 2gh$: $100 = 0 + 2 \times 10 \times h$, so $h = 5$ m	1

Total: 6 marks

2 Question 2 — mark scheme

5 marks

PART	ANSWER	MARK
(a)	the extension (compression) of a spring is directly proportional to the force (load) applied accept: as long as the limit of proportionality is not exceeded do not accept "the extension increases as the force increases" on its own	1
(b)	the graph is a straight line	1
	that goes through the origin accept: doubling the force doubles the compression, for 1 mark	1
(c)	7.0 cm accept 6.8 – 7.2 cm	1
(d)	30 – 7.0 = 23 cm allow error carried forward from (c)	1

Total: 5 marks

3 Question 3 — mark scheme

8 marks

PART	ANSWER	MARK
(a)	distance is a scalar and displacement is a vector or distance has magnitude only, displacement has magnitude and direction	1
(b)	37.5 km accept any value between 36.0 and 38.0 inclusive	1
	062° or N62°E accept 62° to the right of the vertical accept an angle in the range 60° – 64° accept the angle correctly measured and marked on the diagram	1
(c)	the train changes direction, so its velocity changes	1
	acceleration is the rate of change of velocity	1
(d)	number of squares below the line = 17 accept any number between 16 and 18 inclusive	1
	each square represents 500 m	1
	distance = number of squares × value of each square, correctly calculated, e.g. 17 × 500 = 8500 m	1

Total: 8 marks

4 Question 4 — mark scheme

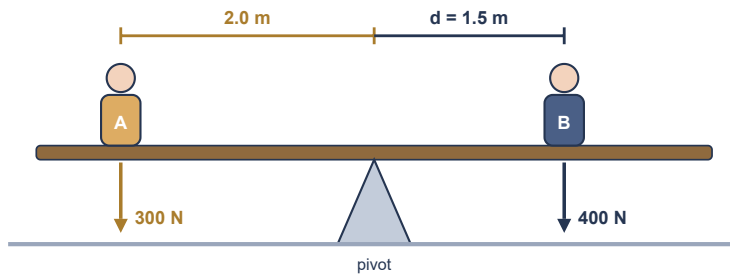
Physics only

4 marks

PART	ANSWER	MARK
(a)	the total clockwise moment (about the pivot) equals the total anticlockwise moment (about the pivot) accept: the moments are balanced / the principle of moments accept: the resultant moment is zero	1
(b)	anticlockwise moment of A = $300 \times 2.0 = 600 \text{ N m}$ moment = force × perpendicular distance from the pivot	1
	$400 \times d = 600$	1

$d = 1.5 \text{ m}$

1



Total: 4 marks

5 Question 5 — mark scheme

5 marks

PART	ANSWER	MARK
(a)	accelerating / speeding up do not accept "acceleration increases"	1
(b)	10 if the answer is not correct, allow 1 mark for acceleration = $\frac{\text{change in velocity}}{\text{time taken for change}}$ and allow 1 mark for $\frac{40 \text{ (m/s)}}{4 \text{ (s)}}$	3
	m/s^2 or m s^{-2} reject m s^2	1

Total: 5 marks

6 Question 6 — mark scheme

6 marks

PART	ANSWER	MARK
(a)	any one from: - wet or icy or worn or smooth road - brakes worn - car heavily loaded - worn tyres - downhill slope accept slippery slope accept faulty brakes do not accept anything to do with thinking distance, e.g. driver tired or drunk	1
(b)	deceleration is reduced accept deceleration is slower accept "acceleration" for deceleration	1

force on the car and / or passengers is reduced

1

accept an answer in terms of change in momentum for full credit

(c) change in momentum = $1000 \times 14 = 14\,000 \text{ kg m/s}$

1

$F = \text{change in momentum} \div \text{time} = 14\,000 \div 0.25$

1

$F = 56\,000 \text{ N}$

1

allow $a = 14 \div 0.25 = 56 \text{ m/s}^2$, then $F = m a = 1000 \times 56 = 56\,000 \text{ N}$

Total: 6 marks

7 Question 7 — mark scheme

6 marks

PART	ANSWER	MARK
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Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Apply a 'best-fit' approach to the marking.

0 No relevant content.

0

L1 There is a brief attempt to explain why the velocity / speed of the parachutist changes

1–2

or

the effect of opening the parachute on velocity / speed is given.

L2 The change in velocity / speed is clearly explained in terms of force(s)

3–4

or

there is a reasoned argument for the open parachute producing a lower speed.

L3 There is a clear and detailed explanation as to why the parachutist reaches terminal velocity **and** a reasoned argument for the open parachute producing a lower speed.

5–6

Examples of the physics points made in the response — to explain the first terminal velocity

- on leaving the plane the only force acting is weight (downwards) — *accept gravity for weight throughout*
- as the parachutist falls, air resistance acts (upwards) — *accept drag / friction for air resistance*
- weight is greater than air resistance **or** the resultant force is downwards
- (resultant force downwards) so the parachutist accelerates
- as velocity / speed increases, so does air resistance
- terminal velocity is reached when air resistance = weight — *accept terminal velocity is reached when the forces are balanced*

To explain the second, lower terminal velocity

- opening the parachute increases the surface area
- opening the parachute increases air resistance
- air resistance is greater than weight
- the resultant force acts upwards / in the opposite direction to the motion
- the parachutist decelerates / slows down
- the lower velocity means a reduced air resistance
- air resistance and weight become equal, but at a lower (terminal) velocity

Total: 6 marks

END OF MARK SCHEME
