

Speed, distance, acceleration mark scheme

Higher tier

Duel award – physics 2018 Q4

(a)		Acceleration is constant for 2 s (1) then decreases to zero (1)
(b)		Tangent drawn at a point between 4 s and 6 s(1) Calculation of acceleration from the line drawn ecf (1) [Do not accept $20/5 = 4$] [Expect 1.8 – 2.7] Unit m/s^2 correct (1)
(c)		Area of $\frac{1}{2}$ base \times height attempted (1) Answer of $22 \text{ m} \pm 1 \text{ m}$ obtained (1)
(d)		Steeper line after 3 s [allow steeper from the start] (1) Either: Velocity flattens off at 27 m/s earlier than 11 s (1) Or Terminal velocity shown $> 27 \text{ m/s}$ (1) Or Velocity continues increasing above 27 m/s [may or may not plateau] (1)

Duel award – physics 2022 Q4

(a)

Indicative content:

AB and CD have a gradient of 0 which means the acceleration is 0. The train moves at constant velocity between AB and is stopped from CD. BC has a [constant] gradient which is double the value of DE so has a [constant] acceleration that is double. However, BC has a negative gradient and DE a positive gradient. BC is a deceleration or negative acceleration, whereas DE shows a positive acceleration.

The area under AB is 4 squares, BC 2 squares, CD 0 squares and DE 4 squares. AB and DE have identical areas so the train travels equal distances in both. In comparison BC is $\frac{1}{2}$ the area of AB or DE so $\frac{1}{2}$ the distance is travelled.

5–6 marks

Detailed comparison of distances travelled and accelerations.

There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.

3–4 marks

Limited comparison of distances travelled and accelerations

or detailed comparison of either distances travelled or acceleration.

There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.

(b)	(i)		$F = ma$ or accept in words
	(ii)	I	Total mass of train = $2.3 [\times 10^5] \times 2$ (1) = $[4.6 \times 10^5]$ [kg] = $4.6 \times 10^5 \times 0.7$ = 3.22×10^5 (1) [N] accept 322×10^3 [N] Award maximum of 1 mark for $2.3 \times 10^5 \times 0.7 = 1.61 \times 10^5$ [N] accept 161×10^3 [N] Award 1 mark for answer of 3.22 or 1.61
		II	Substitution: $0.7 = \frac{55.8}{t}$ (1) Rearrangement: time = 79.7 (1) [s] accept 80 [s]
	(iii)		$2.3 [\times 10^5] \times 2 = 4.6 [\times 10^5]$ (1) which is approximately $4.4 [\times 10^5]$ so this part of claim correct (1) Both trains have same emergency deceleration / 1.2 m/s^2 and so will take the same time to stop / this part of the claim is incorrect (1) Alternative: $\frac{4.4 [\times 10^5]}{2.3 [\times 10^5]} = 1.9$ (1) which is approximately 2 so this part of claim correct (1) Both trains have same emergency deceleration / 1.2 m/s^2 and so will take the same time to stop / this part of the claim is incorrect (1)

Duel award – physics 2023 Q1

(a)	(i)		Alcohol / drugs / old age / tiredness Accept <u>longer</u> reaction time or use of mobile phones Don't accept poor visibility
	(ii)		Icy or wet road / worn brakes / worn tyres Accept <u>greater</u> mass Don't accept weather not qualified
(b)			Thinking distance will halve from 12 to 6 m (1) Braking distance {will be $\frac{1}{4}$ / is 6 not 12 [m] / decreases from 24 to 6 [m] which is not a half} (1) Stopping distance {will be $\frac{1}{3}$ / is 12 not 18 [m] / decreases from 36 to 12 [m] which is not a half} (1)

Separate physics 2023 Q7 – part a + bi

(a)	(i) (ii) (iii)	The same (1) Increases (1) Increases (1)				
(b)	(i)	Initial speed (km/h)	Initial speed (m/s)	Thinking distance (m)	Braking distance (m)	Stopping distance (m)
		60	16.8 (1) Accept 17	25 (1)	20 (1)	45 (1)

Separate physics 2022 Q7 – part b

(b)	(i)	$\text{Gradient} = \frac{(54 - 13) (1)}{(9.5 - 0.5) (1)}$ $\text{Gradient} = \frac{41}{9} = 4.6 \text{ [m/s}^2\text{]} (1)$ Accept range $4.6 \pm 0.3 \text{ [m/s}^2\text{]}$
	(ii)	[Acceleration] decreases (1) to zero [at 15 s] (1)
	(iii)	Distance travelled = area under line stated or implied or $x = \frac{1}{2} (u + v) t (1)$ $(\frac{1}{2} \times 5 \times 33) (1)$ $= 82.5 \text{ [m]} (1)$ Accept answers in the range 80-85 [m]