

# The Distance-Time Relationship

## Mark Scheme 1

<b>Level</b>	GCSE (9-1)
<b>Subject</b>	Combined Science: Trilogy - Physics
<b>Exam Board</b>	AQA
<b>Topic</b>	6.5 Forces
<b>Sub-Topic</b>	The Distance-Time Relationship
<b>Difficulty Level</b>	Gold Level
<b>Booklet</b>	Mark Scheme 1

**Time Allowed:** 59 minutes

**Score:** /59

**Percentage:** /100

**Grade Boundaries:**

M1.(a)	(i)	100 (m)	1
	(ii)	stationary	1
	(iii)	accelerating	1
	(iv)	tangent drawn at $t = 45$ s	1
		<i>attempt to determine slope</i>	1
		speed in the range $3.2 - 4.2$ (m / s) <i>dependent on 1st marking point</i>	1
(b)	(i)	500 000 (J) <i>ignore negative sign</i>	1
	(ii)	20 000 (N) <i>ignore negative sign</i> <i>allow 1 mark for correct substitution, ie</i> $500\,000 = F \times 25$ <i>or their part (b)(i) = <math>F \times 25</math></i> <i>provided no subsequent step</i>	2

(iii) (kinetic) energy transferred by heating

1

to the brakes

*ignore references to sound energy*

*if no other marks scored allow k.e. decreases for 1 mark*

1

[11]

**M2.(a)** more streamlined

*accept decrease surface area*

1

air resistance is smaller (for same speed)

*accept drag for air resistance*

*friction is insufficient*

1

so reaches a higher speed (before resultant force is 0)

*ignore reference to mass*

1

(b) (i) 1.7

*allow 1 mark for correct method, ie  $\frac{5}{3}$*

*or allow 1 mark for an answer with more than 2 sig figs that rounds to 1.7*

*or allow 1 mark for an answer of 17*

2

(ii) 7.5

*allow 1 mark for correct use of graph, eg  $\frac{1}{2} \times 5 \times 3$*

2

- (iii) air (resistance)  
*accept wind (resistance)*  
*drag is insufficient*  
*friction is insufficient*

1  
**[8]**

**M3.(a) D – E**

*reason only scores if D – E chosen*

1

shallowest slope / gradient  
*accept smallest distance in biggest time*  
*accept longest time to travel the same distance*  
*accept the line is not as steep accept it is a less steep line*  
*do **not** accept the line is not steep*

1

(b) 80 000

*allow 1 mark for correct substitution, ie  $16\,000 \times 5$  provided  
no subsequent step shown*

2

(c) (i) straight line starting at origin  
*accept within one small square of the origin*

1

passing through  $t = 220$  and  $d = 500$

1

(i) 186  
*accept any value between 180 and 188*  
*accept where their line intersects given graph line correctly*  
*read  $\pm 4$  s*

1  
**[7]**

**M4.(a)** (i) longer reaction time

*accept slower reactions*

*do **not** accept slower reaction time unless qualified*

**or** greater thinking distance

*accept greater thinking time*

**or** greater stopping distance

*accept greater stopping time*

*greater braking distance negates answer*

1

(ii) lines / slopes have the same gradient

*accept slopes are the same*

**or** velocity decreases to zero in same time / in 2.6 seconds

*accept any time between 2.4 and 2.8*

*accept braking distances are the same*

1

(iii) 12

*accept extracting both reaction times correctly for **1** mark (0.6 and 1.4)*

**or**

*time = 0.8 (s) for **1** mark*

*accept  $0.8 \times 15$  for **2** marks*

*accept calculating the distance travelled by car **A** as 28.5 m*

**or**

*the distance travelled by car **B** as 40.5 m for **2** marks*

3

(b) **Z**

1

different force values give a unique / different resistance

*only scores if **Z** chosen*

*do **not** accept force and resistance are (directly) proportional*

*accept answers in terms of why either X or Y would not be best eg*

*X – same resistance value is obtained for 2 different force values*

*Y – all force values give the same resistance*

1

[7]

**M5.(a)** any **two** from:

- (acceleration occurs when) the direction (of each capsule) changes
- velocity has direction
- acceleration is (rate of) change of velocity

2

(b) to(wards) the centre (of the wheel)

1

(c) the greater the radius / diameter / circumference (of the wheel) the smaller the (resultant) force (required)

*accept 'the size' for radius both parts required for the mark*

1

[4]

**M6.** (a) 48

*allow for 1 mark correct method shown, ie  $6 \times 8$*

*or correct area indicated on the graph*

2

(b) diagonal line from (0,0) to (6,48) / (6, their (a))

*if answer to (a) is greater than 50, scale must be changed to gain this mark*

1

horizontal line at 48m between 6 and 10 seconds

*accept horizontal line drawn at their (a) between 6 and 10 seconds*

1

[4]

M7. (a) (i) longer reaction time

*accept slower reactions*

*do **not** accept slower reaction time unless qualified*

**or**

greater thinking distance

*accept greater thinking time*

**or**

greater stopping distance

*accept greater stopping time*

*greater braking distance negates answer*

1

(ii) lines / slopes have the same gradient

*accept slopes are the same*

**or**

velocity decreases to zero in same time / in 2.6 seconds

*accept any time between 2.3 and 2.8*

*accept braking distances are the same*

1

(iii) 12

*accept extracting both reaction times correctly for 1 mark*

*(0.6 and 1.4 ) **or** time = 0.8(s) for 1 mark*

*accept  $0.8 \times 15$  for 2 marks*

*accept calculating the distance*

*travelled by car **A** as 28.5 m **or** the distance travelled by car **B** as 40.5 m for 2 marks*

3

(b) Z

1

different force values give a unique / different resistance

*only scores if Z chosen*

*do **not** accept force and resistance are (directly) proportional*

*accept answers in terms of why*

*either X or Y would not be the best eg*

*X – same resistance value is obtained for 2 different force values*

*Y – all force values give the same resistance*

1

[7]

**M8.** (a) (i) a single force that has the same effect as all the forces combined  
*accept all the forces added / the sum of the forces / overall force*

1

(ii) constant speed (in a straight line)  
*do **not** accept stationary*

**or** constant velocity

1

(b) 3

*allow 1 mark for correct substitution into transformed equation*

*accept answer 0.003 gains 1 mark*

*answer = 0.75 gains 1 mark*

2

m/s<sup>2</sup>

1

(c) as speed increases air resistance increases  
*accept drag / friction for air resistance*

1

reducing the resultant force

1

[7]



**M9.** (a) 4

*allow 1 mark for extracting correct information 12*

2

m/s<sup>2</sup>

*ignore negative sign*

1

(b) 9 (s)

1

**[4]**