

# Forces and Braking

## 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>	Forces and Braking
<b>Difficulty Level</b>	Gold Level
<b>Booklet</b>	Mark Scheme 1

**Time Allowed:** 51 minutes

**Score:** /51

**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)** (i) distance vehicle travels during driver's reaction time

*accept distance vehicle travels while driver reacts*

1

(ii) any **two** from:

- tiredness
- (drinking) alcohol
- (taking) drugs
- speed
- age

*accept as an alternative factor distractions, eg using a mobile phone*

2

(b) (i) 320 000

*allow 1 mark for correct substitution, ie  $\frac{1}{2} \times 1600 \times 20^2$   
provided no subsequent step shown*

2

(ii) 320000 **or** their (b)(i)

1

(iii) 40

or

their (b)(ii)

8000 correctly calculated

allow 1 mark for statement work done = KE lost

or

allow 1 mark for correct substitution, ie

$8000 \times \text{distance} = 320\,000$  or their (b)(ii)

2

(iv) any **one** from:

- icy / wet roads  
*accept weather conditions*
- (worn) tyres
- road surface
- mass (of car and passengers)  
*accept number of passengers*
- (efficiency / condition of the) brakes

1

(v) (work done by) friction  
(between brakes and wheel)

do **not** accept friction between road and tyres / wheels

1

(causes) decrease in KE and increase in thermal energy

*accept heat for thermal energy accept*

*KE transferred to thermal energy*

1

(c) the battery needs recharging less often

*accept car for battery*

1

or increases the range of the car

*accept less demand for other fuels or lower emissions or*

*lower fuel costs*  
*environmentally friendly is insufficient*

as the efficiency of the car is increased  
*accept it is energy efficient*

1

the decrease in (kinetic) energy / work done charges the battery (up)  
*accept because not all work done / (kinetic) energy is wasted*

1

[14]

**M3.(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]

- 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) (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]



