

# Stopping Distance and Reaction time 1 Mark schemes

## QUESTION 1

| QUESTION | ANSWER   | EXTRA INFORMATION   | MARKS |
|----------|--|---|-------|
| a)i)     | as one goes up so does the other<br>or<br>(directly) proportional  | accept change by the same ratio   | 1     |
| a)ii)    | steeper straight line through the origin   | judge by eye  | 1     |
| a)iii)   | Yes with reason<br>e.g data would have been checked /repeated<br>or<br>No with reason<br>eg does not apply to all conditions / cars / drivers<br>or<br>are only average values<br>or<br>Maybe with a suitable reason<br>eg cannot tell due to insufficient information | accept produced by a reliable/<br>official/ government source<br><br>do not accept it needs to be reliable  | 1     |
| b)i)     | stopping distance = thinking distance+ braking distance  |   |       |
| b)ii)    | any two from:<br>smooth road / loose surface<br><br>rain / snow / ice<br><br>badly maintained brakes   | factors must be to do with increasing braking distance<br><br>accept wet road/ petrol spills<br>do not accept condition of road unless suitably qualified<br>accept worn brakes | 2     |

|             |   |  |   |
|-------------|---|--|---|
|             | worn tyres<br>downhill slope/gradient<br>heavily loaded car | accept bad/ worn/ rusty brakes<br>do not accept old brakes<br>accept bald tyres<br>accept lack of grip on tyres<br>do not accept old tyres |   |
| Total marks |   |  | 6 |

### QUESTION 2

| QUESTION    | ANSWER                 | EXTRA INFORMATION   | MARKS |
|-------------|------------------------|---|-------|
| a)i)        | constant               |   | 1     |
| a)ii)       | heat                   |   | 1     |
| b)i)        | <p>3 links correct</p> | allow 1 mark for 1 correct link<br>if more than one line is drawn from a condition mark all lines from that condition incorrect | 2     |
| b)ii)       | increased              |   | 1     |
| Total marks |                        |   | 5     |

### QUESTION 3

| QUESTION | ANSWER  | EXTRA INFORMATION   | MARKS |
|----------|---|---|-------|
| a)       | distance travelled under the braking force                  | accept braking (distance)   | 1     |
| b)i)     | (directly) proportional<br>or<br>increase in the same ratio | accept a correct description using figures<br>eg if speed doubles then thinking distance doubles<br><br>accept for 1 mark positive correlation<br>accept for 1 mark as speed increases so does thinking distance<br><br>accept as one increases the | 2     |

|             |   |   |            |
|-------------|---|---|------------|
|             |   | other increases<br>accept as thinking distance<br>increases speed increases   |            |
| b)ii)       | control variable  |   | 1          |
| c)          | experiment done, student listens<br>to music / ipod (etc)<br>experiment (repeated), student not<br>listening to music | for both marks to be awarded<br><br>there must be a comparison  | 1<br><br>1 |
| d)          | increase it   | accept an answer which implies<br>reactions are slower<br>do not accept answers in terms<br>of thinking distance only | 1          |
| e)          | Y   |   | 1          |
| Total marks |   |   | 8          |

#### QUESTION 4

| QUESTION | ANSWER  | EXTRA INFORMATION   | MARKS       |
|----------|---|---|-------------|
| a)       | gravitational / gravity / weight  | do not accept gravitational<br>potential  | 1           |
| b)       | accelerating<br>the distance between the drops<br>increases<br>but the time between the drops is<br>the same  | accept speed / velocity increases<br><br>accept the time between drops is<br>(always) 5 seconds<br>accept the drops fall at the same<br>rate  | 1<br>1<br>1 |
| c)i)     | any one from:<br><ul style="list-style-type: none"> <li>• speed / velocity</li> <li>• (condition of) brakes / road<br/>surface / tyres</li> <li>• weather (conditions)</li> </ul> | accept specific examples,<br><br>eg wet / icy roads<br>accept mass / weight of car<br>friction is insufficient<br>reference to any factor affecting<br>thinking distance negates this<br>answer | 1           |
| c)ii)    | 75 000  | allow 1 mark for correct<br><br>substitution, ie $3000 \times 25$<br>provided no subsequent step  | 2           |

|             |            |  |   |
|-------------|------------|--|---|
|             | joules / J | shown<br>or allow 1 mark for an answer 75<br>or allow 2 marks for<br>75 k(+ incorrect unit), eg 75 kN<br>do not accept j<br>an answer 75 kJ gains 3 marks<br>for full marks the unit and<br>numerical answer must be<br>consistent | 1 |
| Total marks |            |  | 9 |

### QUESTION 5

| QUESTION | ANSWER  | EXTRA INFORMATION  | MARKS |
|----------|---|--|-------|
| a)i)     | distance vehicle travels during driver's reaction time  | accept distance vehicle travels while driver reacts  | 1     |
| a)ii)    | any two from: <ul style="list-style-type: none"> <li>• tiredness</li> <li>• (drinking) alcohol</li> <li>• (taking) drugs</li> <li>• speed</li> <li>• age</li> </ul> | accept as an alternative factor distractions, eg using a mobile phone  | 2     |
| b)i)     | 320,000   | allow 1 mark for correct<br><br>substitution, ie $\frac{1}{2} \times 1600 \times 20^2$<br>provided no subsequent step shown  | 2     |
| b)ii)    | 320,000 or their (b)(i)   |  | 1     |
| b)iii)   | 40<br>or<br>their (b)(ii)/8000 correctly calculated   | allow 1 mark for statement work done = KE lost<br><br>or<br>allow 1 mark for correct substitution, ie<br>$8000 \times \text{distance} = 320\,000$ or their (b)(ii) |       |
| b)iv)    | any one from: <ul style="list-style-type: none"> <li>• icy / wet roads</li> <li>• (worn) tyres</li> <li>• road surface</li> </ul>                                   | accept weather conditions<br><br>accept number of passengers   | 1     |

|             |  |   |                 |
|-------------|--|---|-----------------|
|             | <ul style="list-style-type: none"> <li>mass (of car and passengers)</li> <li>(efficiency / condition of the) brakes</li> </ul>   |   |                 |
| b)v)        | (work done by) friction (between brakes and wheel) (causes) decrease in KE and increase in thermal energy  | do not accept friction between road and tyres / wheels<br>accept heat for thermal energy<br>accept KE transferred to thermal energy   | 1<br>1          |
| c)          | the battery needs recharging less often<br>or<br>increases the range of the car as the efficiency of the car is increased<br>the decrease in (kinetic) energy / work done charges the battery (up) | accept car for battery<br><br>accept less demand for other fuels or lower emissions or lower fuel costs<br>environmentally friendly is insufficient<br>accept it is energy efficient<br><br>accept because not all work done / (kinetic) energy is wasted | 1<br><br>1<br>1 |
| Total marks |  |   | 12              |

### QUESTION 6

| QUESTION | ANSWER  | EXTRA INFORMATION   | MARKS      |
|----------|---|---|------------|
| a)       | Time<br>force   | correct order only  | 1<br>1     |
| b)       | The car tyres being badly worn  |   | 1          |
| c)i)     | braking distance increases with speed<br><br>relevant further details, eg <ul style="list-style-type: none"> <li>but not in direct proportion</li> <li>and increases more rapidly after 15 m/s</li> <li>double the speed, braking distance increases <math>\times 4</math></li> </ul> | accept positive correlation<br>do not accept stopping distance for braking distance<br><br>accept any speed between 10 and 20<br>accept numerical example | 1<br><br>1 |
| c)ii)    | line drawn above existing line starting at the origin   | as speed increases braking distance must increase<br>each speed must have a single braking distance   | 1          |

|             |   |   |            |
|-------------|---|---|------------|
|             |   |   |            |
| d)i)        | reaction time / reaction (of driver)<br>does not depend on speed (of car)   |   | 1          |
| d)ii)       | (on the reduced speed limit roads) over the same period of time<br>monitor number of accidents before and after (speed limit reduced) | accept a specific time, eg 1 year<br>allow 1 mark only for record<br><br>number of vehicles / cars using the (20 mph) roads or collect data on accidents on the (20 mph) roads<br><br>to score both marks the answer must refer to the roads with the reduced speed limit | 1<br><br>1 |
| Total marks |   |   | 9          |