GCSE Physics

Forces and Motion

Mark Scheme

Time available: 70 minutes
Marks available: 67 marks

Mark schemes

1.   (a)   equal to

1

      (b)   deceleration / decelerate

                       braking is insufficient

1

      (c) $\dfrac{18}{6}$

1

            3 (m/s^2)

                       *an answer of 3 (m/s^2) scores **2** marks*

                       *allow other correct pairs of numbers taken from **A** to **B***

1

      (d)   the stopping distance increases

1

            by more than double

1

[6]

2.   (a)   double

1

      (b)   the hypothesis does not say how increasing / decreasing the force increases / decreases the acceleration

1

      (c)   appropriate equipment to apply and measure force

                       *eg newtonmeter **or** slotted masses + string + pulley*

1

            appropriate equipment to measure change in velocity and time

                       *eg ticker timer + tape **or** light gates + datalogger*

1

      (d)   to reduce the effect of friction on the trolley

1

(e)

Level 3: The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5-6
Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3-4
Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1-2
No relevant content	0
Indicative content • method by which the trolley is to be accelerated • how the accelerating force is varied to give a suitable range of results • how the accelerating force is measured • the use of suitable apparatus to measure the change in velocity of the trolley over a given distance or time • what data is to be collected in order to calculate acceleration • how the data required is to be measured	

6

(f)   so that the mass is constant

   fair test is insufficient

1

as changing mass would change the acceleration (produced by a given force)
or
so there is only one independent variable

1

(f)   hypothesis A because

   A must be identified to gain either mark

1

the results give a straight line that passes through the origin

showing direct proportionality

1

[15]

3.   (a)   It will have a constant speed.

1

(b)   distance travelled = speed × time

1

(c)   a = $\dfrac{18 - 9}{6}$

          1

a = 1.5

       *allow 1.5 with no working shown for **2** marks*

          1

(d)   resultant force = mass × acceleration

          1

(e)   F = (1120+80) × 1.5

          1

F = 1800 (N)

       *allow 1800 with no working shown for **2** marks*

          1

       *accept their 10.3 × 1200 correctly calculated for **2** marks*

(f) $18^2 - 9^2 = 2 \times 1.5 \times s$

          1

s = $18^2 - 9^2$ / 2 × 1.5

          1

s = 81 (m)

          1

       *allow 81 (m) with no working shown for **3** marks*

       *accept answer using their 10.3 (if not 1.5) correctly calculated for **3** marks*

(g)   **Level 2 (3–4 marks):**
A detailed and coherent explanation is provided. The response makes logical links between clearly identified, relevant points that include references to the numerical factor.

Level 1 (1–2 marks):
Simple statements are made. The response may fail to make logical links between the points raised.

0 marks:
No relevant content.

Indicative content
- doubling speed increase the kinetic energy
- kinetic energy increases by a factor of 4
- work done (by brakes) to stop the car increases
- work done increases by a factor of 4
- work done is force × distance and braking force is constant
- so if work done increases by 4 then the braking distance must increase by 4

          4

          [14]

4. (a) (i) 3000 N   **1**

       (ii) air resistance

                                                               1

     (b) (i) the gradient of the sloping line

                                                                1
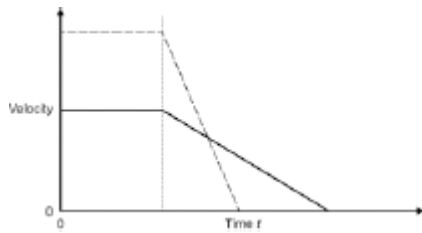
       (ii) the area under the graph

                                                                 1

       (iii) horizontal line above previous one

                                                                   1

          for the same time

                                                                   1

          sloping line cutting time axis before previous line

            eg

                                                                     1

(c)   Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.

0 marks
No relevant content.

Level 1 (1−2 marks)
One factor is given that affects thinking distance
or
one factor is given that affects braking distance

Level 2 (3−4 marks)
One factor and a description of its effect is given for **either** thinking distance **or** braking distance

Level 3 (5−6 marks)
One factor and a description of its effect is given for **both** thinking distance and braking distance
plus
some extra detail

Examples of the points made in the response
stopping distance = thinking distance + braking distance

the faster the car travels the greater the stopping distance

thinking distance is the distance travelled from when the driver sees an obstacle to when the brakes are applied

braking distance is the distance travelled from when the brakes are applied to when the car stops

thinking distance:
*   tiredness increases thinking distance
*   taking drugs increases thinking distance
*   drinking alcohol increases thinking distance
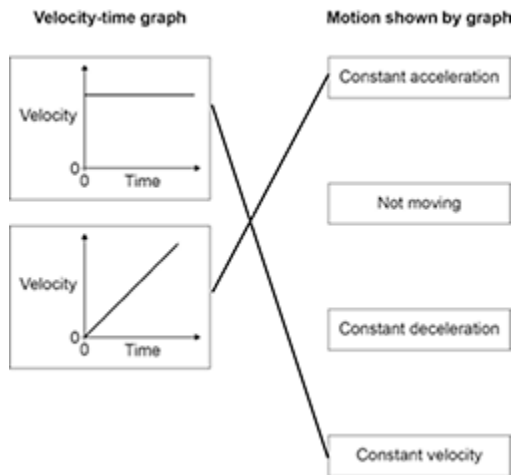*   distractions in the car increase thinking distance.

braking distance:
*   poor condition of brakes increases braking distance
*   poor condition of tyres increases braking distance
*   wet roads increase braking distance
*   icy roads increase braking distance.

6

[13]

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5. (a)

if more than one line is drawn from a graph then all those lines are
wrong allow **1** mark for 1 correct line

2

(b)   speed

1

(c)   (i)   2.25

allow **1** mark for correct substitution i.e.

$$a = \frac{9 - 0}{4} \quad \text{or} \quad a = \frac{9}{4}$$

provided no subsequent step

2

(ii)   the air resistance increases

1

(d)   2000 J

1

mass is half
or
kinetic energy depends on mass

do **not** accept weight for mass

1

[8]

6. (a)   (i)   100 (m)

1

(ii)   stationary

1

(iii)   accelerating

1

(iv)   tangent drawn at $t = 45$ s

1

attempt to determine slope   **1**

speed in the range 3.2 – 4.2 (m / s)
    dependent on 1st marking point

                                                               1

(b)   (i)   500 000 (J)
            ignore negative sign

                                                               1

     (ii)   20 000 (N)
            ignore negative sign
            *allow **1** mark for correct substitution, ie*
            500 000 = F × 25
            ***or** their part (b)(i) = F × 25*
            provided no subsequent step

                                                                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]