

- M1.** (a) distance is a scalar and displacement is a vector
or
distance has magnitude only, displacement has magnitude and direction 1
- (b) 37.5 km
accept any value between 37.0 and 38.0 inclusive 1
- 062° or N62°E
accept 62° to the right of the vertical 1
- accept an angle in the range 60° – 64°*
accept the angle correctly measured and marked on the diagram
- (c) train changes direction so velocity changes 1
- acceleration is the rate of change of velocity 1
- (d) number of squares below line = 17
accept any number between 16 and 18 inclusive 1
- each square represents 500 m 1
- distance = number of squares × value of each square correctly calculated – 8500 m 1

[8]

M2. (a) (i) gravity/weight

1

(ii) 2193750000000 or 2.19×10^{12}

not 2.19^{12}

allow 1 mark for the correct conversion to 7500 (m/s)

allow one mark for answer 2193750(J)

2

transferred to heat

ignore extras of sound and light

accept changed to heat

accept lost due to friction

1

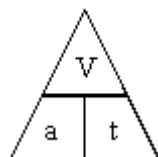
(b) (i) acceleration = $\frac{\text{change in velocity}}{\text{time (taken)}}$

accept word speed instead of velocity

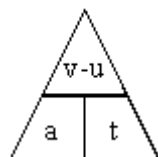
accept $a = \frac{v - u}{t}$

or *correct rearrangement*

do not accept



even if subsequent calculation correct



can gain credit if subsequent calculation correct

1

(ii) 2

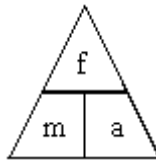
ignore + or – signs

m/s² 1

accept m/s/s or ms⁻²

2

- (c) (i) force = mass × acceleration
accept correct rearrangement
accept $F = m \times a$
do not accept



unless subsequent calculation correct

1

(ii) 156 000

accept 78 000 × their (b)(ii)(only if (b)(i) correct)

1

[9]

M3. (a) Each scale optimum
 Else both half size
 Straight line joining 30,0 to 30,0.67 to 0, 5.67
any 5 for 1 mark each 5

(b) 6
 Else $a = 30/5$
gets 2 marks

 Else $a = v/t$
gets 1 mark 3

(c) 9000
 Else $F = 6 \times 1500$
gets 2 marks

 Else $F = ma$
gets 1 mark 3

(d) (i) Driver has forward momentum
 Which is conserved
 Giving driver relative forward speed to car
for one mark each 3

(ii) Car stops in 75m
gets 1 mark

 $W = F.d$ or 9000×75
gets 1 mark

 $W = 675\,000\text{ J}$
OR $ke = 1/2 mv^2$
gets 1 mark

 $ke = 1/2 \cdot 1500 \cdot 302$
 $ke = 675\,000\text{ J}$ 3

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 0.8×15 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]