

M1. (a) increases 1

increases 1

(b) 23 (m) 2
accept 43 circled for 1 mark
accept 9 + 14 for 1 mark

(c) (i) all points correctly plotted 2
all to $\pm \frac{1}{2}$ small square
one error = 1 mark
two or more errors = 0 marks

line of best fit 1

(ii) correct value from their graph ($\pm \frac{1}{2}$ small square) 1

(d) (i) 70 3
 $\frac{1}{2} \times 35 \times 4$ gains 2 marks
attempt to estimate area under the graph for 1 mark

(ii) line from (0.6,35) 1

sloping downwards with a less steep line than the first line

1

cutting time axis at time > 4.6 s
accept cutting x-axis at 6

1

(e) (i) 42 000
1200 \times 35 gains 1 mark

2

kgm / s
Ns

1

(ii) 10 500 (N)
42 000 / 4 gains 1 mark
alternatively:
 $a = 35 / 4 = 8.75 \text{ m / s}^2$
 $F = 1200 \times 8.75$

2

[19]

- M2. (a)** (i) zero
accept nothing 1
- speed is zero
accept not moving 1
- (ii) A 1
- largest mass **or** weight
accept heaviest luggage
*do **not** accept largest luggage* 1
- (iii) momentum does change
accept yes 1
- direction is changing
accept velocity is changing
*do **not** accept answers in terms of speed changing* 1
- (iv) kg m/s 1

[7]

- M3. (a) (i)** 4.5
allow 1 mark for correct substitution i.e. $9 \div 2$ 2
- (ii) m/s^2
accept answer given in (a)(i) if not contradicted here 1
- (iii) speed 1
- (iv) straight line from the origin passing through (2s, 9m/s)
allow 1 mark for straight line from the origin passing through to $t = 2$ seconds
allow 1 mark for an attempt to draw a straight line from the origin passing through (2,9)
allow 1 mark for a minimum of 3 points plotted with no line provided if joined up would give correct answer. Points must include (0,0) and (2,9) 2
- (b) (i) **B**
if A or C given scores 0 marks in total 1
- smallest (impact) force 1
- on all/ every/ any surfaces
these marks are awarded for comparative answers 1
- (ii) (conditions) can be repeated
- or**
- difficult to measure forces with human athletes
accept answers in terms of variations in human athletes e.g. athletes may have different weights area / size of feet may be different difficult to measure forces athletes run at different speeds
accept any answer that states or implies that with humans the conditions needed to repeat tests may not be constant

e.g.
*athletes unable to maintain constant speed during tests (or
during repeat tests)*
do **not** accept the robots are more accurate
removes human error is insufficient
fair test is insufficient

1

[10]

- M4.** (a) (i) 10800
allow 1 mark for correct substitution i.e. 900×12 2
- (ii) arrow pointing towards the left
allow anywhere on the diagram or at bottom of the page 1
- (b) zero
accept 0 / none / nothing 1
- velocity is zero
accept speed for velocity
accept stopped / not moving
accept a calculation i.e. $900 \times 0 = 0$ 1

[5]

M5. (a)	(i)	16 000	
		<i>allow 1 mark for correct substitution ie 3200 × 5</i>	2
	(ii)	16 000 or their (a)(i)	1
	(iii)	less than	1
(b)		increases	1
		decreases	
		<i>correct order only</i>	1

[6]

M6. (a) (i) lorry
reason only scores if lorry chosen 1

greatest mass
accept weight for mass
accept heaviest
accept correct calculations for all 3 vehicles
the biggest is insufficient 1

(ii) 2450
allow 1 mark for correct substitution
ie 175×14 2

(b) (i) increases
accept any clear indication of the correct answer 1

(ii) speed increases
accept velocity for speed
accept gets faster
*do **not** accept it accelerates on its own*
moves more is insufficient 1

(iii) straight line going to 6, 20
allow 1 mark for a curve going to 6,20
***or** a straight line diagonally upwards but missing 6,20* 2

horizontal line from 6,20 to 8,20
*allow a horizontal line from where their **diagonal** meets*
20m/s to 8,20 1