M1. (a)   increases

1

increases

1

(b)   23 (m)

*accept 43 circled for **1** mark*
*accept 9 + 14 for **1** mark*

2

(c)   (i)   all points correctly plotted

all to ± ½ small square
*one error = **1** mark*
*two or more errors = **0** marks*

2

line of best fit

1

(ii)   correct value from their graph (± ½ small square)

1

(d)   (i)   70

*½ × 35 × 4 gains **2** marks*
*attempt to estimate area under the graph for **1** mark*

3

(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 × 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 m / s^2
     F = 1200 × 8.75

2
[19]

M2. (a) (i) as one goes up so does the other

or (directly) proportional
accept change by the same ratio

1

(ii) steeper straight line through the origin
judge by eye

1

(iii) Yes with reason

eg data would have been checked / repeated
accept produced by a reliable/ official/ government source
*do **not** accept it needs to be reliable*

or No with reason

eg does not apply to all conditions / cars / drivers

or are only average values

or Maybe with a suitable reason

eg cannot tell due to insufficient information

1

(b) (i) stopping distance = thinking distance + braking distance

1

(ii) any **two** from:
factors must be to do with increasing braking distance

• smooth road / loose surface

• rain / snow / ice
accept wet road/ petrol spills
*do **not** accept condition of road unless suitably qualified*

• badly maintained brakes
accept worn brakes
accept bad/ worn/ rusty brakes
*do **not** accept old brakes*

Page 4

- worn tyres

  accept bald tyres
  accept lack of grip on tyres
  *do **not** accept old tyres*

- downhill slope/gradient

- heavily loaded car

2

[6]

M3. (a) **A** constant speed / velocity

accept steady pace

*do **not** accept terminal velocity*

*do **not** accept stationary*

1

B acceleration

accept speeding up

1

C deceleration

accept slowing down

accept accelerating backwards

accept accelerating in reverse

*do **not** accept decelerating backwards*

1

(b) (i) the distance the car travels under the braking force

accept braking <u>distance</u>

1

(ii) speed/velocity/momentum

1

(c) (i) 5000 (N) to the left

***both** required*

accept 5000(N) with the direction indicated by an arrow drawn pointing to the left

accept 5000(N) in the opposite direction to the force of the car (on the barrier)

accept 5000(N) towards the car

1

(ii) to measure/detect forces exerted (on dummy / driver during the collision)

1

(iii)   4

   *allow **1** mark for showing a triangle drawn on the straight part*
   of the graph
   ***or** correct use of two pairs of coordinates*

                           2

  m/s^2

   *do **not** accept mps^2*

                           1

                             [10]

M4. (a) (i) <u>gravitational potential</u> (energy)

1

(ii) <u>kinetic</u> (energy)

1

(b) (i) slope or gradient

1

(ii) <u>area</u> (under graph)
do **not** accept region

1

(iii) starts at same y−intercept

1

steeper slope than original and cuts time axis before original
the entire line must be below the given line
allow curve

1

(c) (i) 31
and
31

correct answers to 2 significant figures gains **3** marks even if
no working shown

both values to more than 2 significant figures gains **2** marks:
30.952…...
30.769….

65 / 2.1 and / or
80 / 2.6 gains **1** mark

if incorrect answers given but if both are to 2 significant
figures allow **1** mark

3

(ii) student 1 incorrect because 80 ≠ 65

1

student 2 correct because average velocities similar

ecf from (c)(i)

1

student 3 incorrect because times are different

1
[12]

M5.   (a)   *gravitational / gravity / weight*
                          *do **not** accept gravitational potential*

1

(b)   *accelerating*
                          accept speed / velocity increases

1

the distance between the drops increases

1

but the time between the drops is the same
                   accept the time between drops is (always) 5 seconds
                   accept the drops fall at the same rate

1

(c)   (i)   *any **one** from:*

- *speed / velocity*

- *(condition of) brakes / road surface / tyres*

- *weather (conditions)*
    accept specific examples, eg wet / icy roads
    accept mass / weight of car friction is insufficient
    reference to any factor affecting thinking distance negates
    this answer

1

(ii)   *75 000*
               *allow **1** mark for correct substitution, ie 3000 × 25 provided*
               no subsequent step shown
               ***or** allow **1** mark for an answer 75**or** allow **2** marks for*
               75 k(+ incorrect unit), eg 75 kN

2

joules / J
          *do **not** accept j*

*an answer 75 kJ gains **3** marks*

for full marks the unit and numerical answer must be consistent

1

[8]