M1. (a) **D** – **E**

reason only scores if D – E chosen

1

shallowest slope / gradient

accept smallest distance in biggest time
accept longest time to travel the same distance
accept the line is not as steepaccept it is a less steep line
*do **not** accept the line is not steep*

1

(b) 80 000

*allow **1** mark for correct substitution, ie 16 000 × 5 provided no subsequent step shown*

2

(c) (i) straight line starting at origin

accept within one small square of the origin

1

passing through t = 220 and d = 500

1

(i) 186

accept any value between 180 and 188
accept where their line intersects given graph line correctly read ±4 s

1

[7]

M2. (a) 4.2

*2 marks for correct substitution **and** transformation, ie 1155/275*

*allow **1** mark for correct resultant force with a subsequent incorrect method, ie 1155*

*allow **1** mark for an incorrect resultant force with a subsequent correct method,*

*eg answers of 7.27 or 10.34 gain **1** mark*

3

(b) (i) YES

marks are for the explanation

any **two** from:

- data (from police files) can be trusted
- data answers the question asked

  allow a conclusion can be made from the data
- large sample used

NO

any **two** from:

- the sample is not representative
- the sample size is too small
- accident files do not indicate age / experience of riders

  *an answer YES and NO can score **1** mark from each set of mark points*

2

(ii) more accidents with motorbikes up to 125 cc

*accept for **2** marks an answer in terms of number of under 125 cc to accidents ratio compared correctly with number of over 500 cc to accidents ratio*

1

even though there are fewer of these bikes than bikes over 500 cc

1

(c) (i) increases the time taken to stop

accept increases collision time

1

decreases rate of change in momentum

accept reduces acceleration / deceleration

accept $F = \frac{\Delta mv}{\Delta t}$

reduces momentum is insufficient

1

reduces the force (on the rider)

1

(ii) YES

any sensible reason, eg:

the mark is for the reason

- cannot put a price on life / injury

  accept may save lives

- fewer (serious) injuries

  accept reduces risk of injury

- reduces cost of health care / compensation

NO

any sensible suggestion, eg:

- money better spent on …

  needs to be specific

- total number of riders involved is small

1

[11]

M3. (a) 98

*allow **1** mark for correct substitution*
ie ½ × 0.16 × 35 × 35 provided no subsequent step shown
an answer of 98 000 scores 0

2

(b) (i) 9.6

*allow **1** mark for (change in velocity =) 60*
ignore negative sign

2

(ii) 9600

ignore negative sign
or their (b)(i) ÷ 0.001 correctly calculated, unless (b) (i) equals 0

1

(c) increases the time

1

to reduce/change <u>momentum</u> (to zero)

only scores if 1st mark scored
decreases rate of change of momentum scores both marks provided there are no contradictions
accept decreased acceleration/deceleration
equations on their own are insufficient

1

[7]

M4. (a) direction

1

(b) 54 000

*allow **1** mark for calculating and identifying momentum as 10 800*

or

*allow **1** mark for correct substitution into second equation*

ie $\frac{1200 \times 9}{0.2}$

2

(c) increases the time taken (for head) to stop

accept increases impact time

*do **not** accept reference to slowing down time unless qualified*

1

decreases rate of change in momentum

accept reduces acceleration / deceleration

*accept increases the time taken to reduce momentum to zero is worth **2** marks*

reduces momentum is insufficient

1

reduces the <u>force</u> (on the head)

1

[6]

M5. (a) (moving in) different / opposite directions

accept one has positive momentum the other negative momentum

accept they have different velocities

1

(b) (i) momentum before = momentum after**or**(total) momentum stays the same

accept no momentum is lost

accept no momentum is gained

1

(ii) 2.2

*allow **1** mark for calculation of teenagers' momentum as22 (kgm/s) and*

*allow **1** mark for correct statement, eg momentumbefore = momentum after*

or

*allow **2** marks for a numerical expression of above, eg*

55 × 0.4 = m × 10

***or** 0 = (55 × 0.4) + (m × (-10))*

3

*(c) any **two** from:*

- *work is done*
- *(against) friction*

  any reference to increasing friction negates this marking point
- *(transforming) (kinetic) energy into heat*

2

[7]

M6.*(a) (i) momentum before = momentum after*

accept no momentum is lost

accept no momentum is gained

or*(total) momentum stays the same*

1

(ii) an external force acts (on the colliding objects)

accept colliding objects are not isolated

1

(b) (i) 9600

allow 1 mark for correct calculation of momentum before or after ie 12000 or 2400

or

correct substitution using change in velocity = 8 m/sie 1200 × 8

2

kg m/s

or

Ns

this may be given in words rather than symbols

*do **not** accept nS*

1

(ii) 3 or their (b)(i) 3200 correctly calculated

allow 1 mark for stating momentum before = momentum after

or

clear attempt to use conservation of momentum

2

[7]

M7. *(a)* *Zero / 0*

Accept none

Nothing is insufficent

1

velocity / speed = 0

accept it is not moving

paintball has not been fired is insufficient

1

(b) *0.27*

*allow **1** mark for correct substitution, ie p = 0.003(0) × 90 provided no subsequent step*

2

(c) *equal to*

1

[5]

M8. *(a) momentum before (jumping) = momentum after (jumping)*

accept momentum (of the skateboard and skateboarder) is conserved

1

before (jumping) momentum of skateboard and skateboarder is zero

accept before (jumping) momentum of skateboard is zero

accept before (jumping) total momentum is zero

1

after (jumping) skateboarder has momentum (forwards) so skateboard must have (equal) momentum (backwards)

answers only in terms of equal and opposite forces are insufficient

1

(b) 7

*accept –7 for **3** marks*

*allow **2** marks for momentum of skateboarder equals 12.6*

or

0 = 42 × 0.3 + (1.8 × –v)

or

*allow **1** mark for stating use of conservation of momentum*

3

[6]