

Mark schemes

- 1.** (a) (i) $0.15 \times 0.08 = 0.012$ 1
- (ii) kg m/s 1
- (iii) equal to 1
- (b) momentum of the air increases
or
force backwards increases
accept air moves faster
accept momentum backwards increases
accept pushes more air back(wards) 1
- so momentum of the toy must increase
or
the force forwards (on the toy) increases
accept momentum forwards must increase
it = toy 1
- [5]**
- 2.** (a) Zero / 0
Accept none
Nothing is insufficient 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 $p = 0.003(0) \times 90$ provided no subsequent step 2
- (c) equal to 1
- [5]**

- 3.** (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
 $0 = 42 \times 0.3 + (1.8 \times -v)$
or
allow 1 mark for stating use of conservation of momentum 3
- [6]**
- 4.** (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/s
ie 1200 \times 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]

5.

(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 force (on the head)

1

[6]

6.

(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 x 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

[9]

7.

(a) (i) distance travelled under the braking force
accept distance travelled between applying the brakes and stopping

1

(ii) any **one** from:

- icy / wet roads
accept weather (conditions)
- (worn) tyres
- road surface
accept gradient of road
- mass (of car and passengers)
accept number of passengers
- (efficiency / condition of the) brakes.
friction / traction is insufficient

1

(iii) greater the speed the greater the braking force (required)
must mention both speed and force

1

(b) 22.5

allow 1 mark for showing correct use of the graph with misread figures

or

for showing e.g. $90 \div 4$

an answer 17 gains 1 mark

any answer such as 17.4 or 17.5 scores 0

2

(c) (i) momentum before = momentum after

or

(total) momentum stays the same

accept no momentum is lost

accept no momentum is gained

ignore statements referring to energy

1

(ii) 5

allow 2 marks for correctly obtaining momentum before as 12 000

or

allow 2 marks for

$1500 \times 8 = 2400 \times v$

or

allow 1 mark for a relevant statement re conservation of momentum

or

allow 1 mark for momentum before = 1500×8

3

(d) the seat belt stretches

1

driver takes a longer (*impact*) time to slow down and stop (than a driver hitting a hard surface / windscreen / steering wheel)

1

for the (same) change of momentum

accept so smaller deceleration / negative acceleration

1

a smaller force is exerted (so driver less likely to have serious injury than driver without seat belt)

or

the seat belt stretches (1)

do not accept impact for force

driver travels a greater distance while slowing down and stopping (than a driver hitting a hard surface / windscreen / steering wheel) (1)

for (same) amount of work done (1)

accept for (same) change of KE

a smaller force is exerted (so driver less likely to have serious injury than driver without seat belt) (1)

do not accept impact for force

1

[13]