GCSE
PHYSICS

Topic Paper: 5.7 Momentum (Higher tier only)
Part 1 , 2 & 3 Mark Scheme

MARK SCHEME

110 Marks

M1. (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]

M2. (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 ×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]

M3. (a) (i) momentum = mass ×velocity

accept … ×speed ***or*** *any transposed version*

1

(ii) 11.2 to 11.3

0.75 ×15 for ***1*** *mark*

2

kg m/s down(wards) **or** Ns down(ward)

n.b. both unit ***and*** *direction required for this mark*

1

(iii) 11.2 to 11.3

accept same numerical answer as part (a)(ii)

accept answer without any unit ***or*** *with the same unit as in part (a)(ii), even if incorrect, but any other unit cancels the mark*

1

(iv) force = $\frac{\text{change in momentum}}{\text{time}}$

accept transposed version

1

(v) 112 to 113 **or** numerical value from (a)(ii) ×10

11.25 ÷0.1 ***or*** *(a)(ii) ÷0.1 for* ***1*** *mark*

2

newton(s)

or *N*

accept Newton(s)

do ***not*** *credit 'Ns'* ***or*** *n*

1

(b) (the user will experience a) large change in momentum

*do **not** credit just '… momentum changes'*

1

(but) seat belt increases the time for this to occur **or**
seat belt stops you hitting something which would stop you quickly

*do **not** credit just '… stops you hitting the windscreen etc.'*

1

(so) the force on the user is less(*)

1

(so) less chance of (serious / fatal) injury(*)

(*) depends on previous response re momentum or continued movement

1

[13]

M4.(a) (i)momentum before = momentum after

or

(total) momentum stays the same

accept no momentum is lost

accept no momentum is gained

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 ×8

2

kg m/s

this may be given in words rather than symbols

or

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]

M5. (i) momentum (change in) = mass ×velocity (change in)

accept ... speed

1

(ii) 9000

*1500 ×6 for 1 mark but **not** from incorrect equation*

2

kilogram metre(s) per second **or** kg m/s

1

(iii) **either** 7.5 (m/s)

or change in momentum of car B change in momentum of car A (1)
9000 = 1200 ×v (1)

or v = 9000 ÷1200 (1)

or error carried forward from part (ii)

examples
5 (m/s) if 6000 offered in (ii) (3)
12.5(m/s) if 15000 offered in (ii)
(3)

3

[7]

M6. (a) (i) 210

*allow **1** mark for correct substitution i.e. 35 ×6*

2

kg m/s **or** Ns

*do **not** accept n for N*
*accept 210 000g m/s for **3** marks*

1

(ii) 840

if answer given is not 840 accept their (a)(i) in kg m/s ÷0.25 correctly calculated for both marks
*allow **1** mark for correct substitution i.e. 210 ÷0.25 or their (a)(i) ÷ 0.25*

2

(b) increases the time to stop

accept increases impact time
*do **not** accept any references to slowing down time*

1

decreases rate of change in momentum

accept reduces acceleration/deceleration
reduces momentum is insufficient

1

reduces the force (on the child)

1

(c) any **two** from:

insufficient range of tests/thicknesses for required cfh

accept need data for thicknesses above 80 mm/ cfh 2.7 m
not enough tests is insufficient

(seems to be) some anomalous data

(repeats) needed to improve reliability (of data)

accept data/ results are unreliable
*do **not** accept maybe systematic/random error*
*do **not** accept reference to precision*

need to test greater range/variety of dummies

accept children for dummies
accept specific factor such as weight/height/size

2

(d) Tyres do not need to be dumped/burned/ less land-fill/ saves on raw materials

accept less waste
*do **not** accept recycling on its own*

1

[11]

M7. (a) 4 (m/s)

***1** mark for correct transformation of either equation*
***1** mark for correct substitution with or without transformation*
***1** mark for correct use of 0.6N*

*max score of **2** if answer is incorrect*

3

(b) **greater** change in momentum

or greater mass of air (each second)

or increase in velocity of air

accept speed for velocity

force upwards increased

lift force is increased

*do **not** accept upthrust*

1

or force up greater than force down

accept weight for force down

1

(c) increase the time **to stop**

1

decrease rate of change in momentum or same momentum change

accept reduced deceleration/ acceleration

1

reducing the force on the toy

*do **not** accept answers in terms of the impact/ force being absorbed*

*do **not** accept answers in terms of energy transfer*

*do **not** credit impact is reduced*

1

[8]

M8. (a) (i) linear scales used

do not credit if less than half paper used

1

points plotted correctly

all of paper used

1

(straight) line of best fit drawn

allow a tolerance of ± half square

1

(ii) correct **and** straight line through origin

***all** needed*

e.c.f. if their (a)(i) is straight but not through the origin - incorrect because line does not go through origin

credit a calculation that shows proportionality

1

(iii) 62 ± 0.5 (m)

*credit **1** mark for KE = 490000 **or** 490kJ*

*credit **1** mark for correct use of graph clearly shown*

2

(iv) any **one** from: wet **or** icy **or** worn **or** smooth road

accept slippery slope

brakes worn

accept faulty brakes

car heavily loaded

worn tyres

downhill slope

do not accept anything to do with thinking distance e.g. driver tired or drunk

1

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

accept correct transformation

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

accept $m/s^2 = \frac{m/s}{s}$

*do **not** accept acceleration* $= \frac{velocity}{time}$

1

(ii) 56

accept –56

1

(iii) deceleration is reduced

accept deceleration is slower

accept acceleration

1

force on car and or passengers is reduced

accept an answer in terms of change in momentum for full credit

1

[11]

M9. (a) (i) B unless unqualified

for 1 mark

1

(ii) B unless unqualified

for 1 mark

1

(iii) energy lost, doing work against air resistance/friction

for 1 mark

1

(b) intensity of gravity less (not zero)

for 1 mark

energies/restoring forces less

for 1 mark

2

[5]

M10. (a) there is a (maximum) forward force
drag/friction/resistance (**opposes** motion) (**not** pressure)
increases with speed
till forward and backward forces equal
so no net force/acceleration

any 4 for 1 mark each

4

(b) (i) F = ma
10 000 = 1250a
a = 8
m/s^2

for 1 mark each

4

(ii) $ke = 1/2\ mv^2$
$ke = 1/2\ 1250.48^2$
ke = 1 440 000
J

for 1 mark each

4

(iii) W = Fd
W = 10 000.144
W = 1 440 000
J

for 1 mark each

4

[16]

M11. (a) W = 65 ×10

(*allow* a maximum of 3 marks if candidate uses g = 9.8N / Kg (as ecf))

gains 1 mark

but

W = 650 (N)

(*allow* use of p.e.= m ×g ×h)

gains 2 marks

but

PE change = 650 ×1.25 **or** 65 ×10 ×1.25

gains 3 marks

but

PE change = 812.5 (J) (*allow* 813J or 812J)

gains 4 marks

4

(b) k.e. = p.e.

gains 1 mark

but

(speed)² = 812.5 ×2 / 65 **or** 812.5 = ½ ×65 ×(speed) ² ecf

gains 2 marks

but

speed = 5 (m/s) (*allow* 4.99 → 5.002)

(if answer = 25mls check working: 812.5 = ½ m ×v gains 1 mark for KE = PE)

(but if 812.5 = ½m ×v² = ½ ×65 ×v ² or $v^2 = \frac{2 \times 812.5}{65}$ gains 2 marks)

25, with no working shown gains 0 marks

gains 3 marks

3

[7]

M12. (a) the greater the mass / weight

1

then the greater the kinetic energy

accept the greater the momentum

accept greater mass / weight therefore greater force = 2

1

(b) (i)

Note: this calculation requires candidates to show clearly how they work out their answer

k.e. $\frac{1}{2}mv^2$
accept evidence of equation

1

86 400 (J) at 12 m/s
*accept ½ ×1200 ×12 ² **or** 86.4 KJ*

1

194 400 (J) at 18 m/s
*accept ½ ×1200 ×18 ² **or** 194.4KJ*

1

increase in k.e. = 108 000
NB 10800 = 0 marks
N.B. if no working at all then max 3 for a correct numerical answer

1

joules **or J**
*accept 108 kilojoules **or** kJ*

1

(ii) explanation that ke $\propto v^2$

1

[8]

M13. (a) 47250

*answers of 1350/ 33750/ 48600 gain **1** mark*
*allow **1** mark for correct substitution using both 18 and 3*

2

(b) (i) 47250 or their (a)
accept statement 'same as the KE (lost)'
ignore any units

1

(ii) transformed into heat/ thermal energy
sound on its own is insufficient
accept transferred/ lost/ for transformed
*do **not** accept any other form of energy included as a list*

1

[4]