

# Momentum

## Mark Scheme 1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Physics
Exam Board	AQA
Topic	6.5 Forces
Sub-Topic	Momentum
Difficulty Level	Gold Level
Booklet	Mark Scheme 1

**Time Allowed:** 60 minutes

**Score:** /59

**Percentage:** /100

**Grade Boundaries:**

M1.(a)	mass	1
	velocity	1
(b)	kg m / s	1
(c)	momentum before = momentum after	1
	and before diving in the momentum of the diver and (small) boat is zero	1
	after diving the diver has forwards momentum / momentum to the right	1
	therefore the (small) boat has equal backwards momentum / equal momentum to the left	1
(d)	the boat moves back more slowly	1
	because there is more mass (but momentum stays the same)	1
(e)	as she swims there is a drag force	1

as speed increases so does the drag force

1

she accelerates less

1

drag force = thrust force

*accept resultant force = 0*

1

the swimmer reaches terminal velocity

1

[14]

**M2.(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]

**M3.(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]

**M4.(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 steep accept 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  $16\,000 \times 5$  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  $\pm 4$  s

1

[7]

- M5.(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 =  $8 \text{ m/s}$  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]

- M6.** (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 as 22 (kgm/s) and  
allow 1 mark for correct statement, eg momentum before = momentum after  
**or**  
allow 2 marks for a numerical expression of above, eg  
 $55 \times 0.4 = m \times 10$   
**or**  $0 = (55 \times 0.4) + (m \times (-10))$

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]

**M7.** (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

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

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]

- M8.** (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  $1200 \times 8$

2

kg m/s  
this may be given in words rather than symbols  
**or**  
Ns

1

- (ii) 3 or their (b)(i)  $\div$  3200 correctly calculated  
allow **1** mark for stating momentum before = momentum after  
**or**  
clear attempt to use conservation of momentum

2

[7]



