

Newton's Second Law

Mark Scheme1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Physics
Exam Board	AQA
Topic	6.5 Forces
Sub-Topic	Newton's Second Law
Difficulty Level	Silver Level
Booklet	Mark Scheme 1

Time Allowed: 58 minutes

Score: /56

Percentage: /100

Grade Boundaries:

- M1.(a)** the time it took from seeing the green light to pressing a key 1
- (b) he could have been distracted 1
- (c) boys have a shorter reaction time than girls
or
reaction time improves with practice 1
- (d) collect more data / larger sample size
must link to response in 1.3
or
take more repeat readings per person 1
- (e) reaction time will have less effect (as distance increases) 1
- because it is a smaller proportion of the total race time 1
- (f) **Level 3 (5–6 marks):**
A coherent description of the race, which uses data from the graph, including discussion of the meanings of the changing gradient of both of the lines.
- Level 2 (3–4 marks):**
Multiple pieces of data taken from the graphs used to evidence a comparison between the runners. Likely to include discussion of the meaning of the (changing) gradient of one of the lines. Answer not coherently structured.

Level 1 (1–2 marks):

Some data taken from the graph, but may be limited to one aspect or simple readings.

Lack of coherence in answer.

0 marks:

No relevant content.

Indicative content

- A starts at constant speed *for 440 m / 60 s*
- A then slows down *from 60 s*
- the gradient for B is lower at the start so B starts at a slower speed
- the gradient for B increases so B accelerates
- B overtook A *at 700 m / 114 s*
- B has a greater top speed because the maximum gradient is greater
- B won the race *in 126 s / beat A by 34 s*

6

(g) tangent drawn at 60s

1

data obtained using correct information

1

5.5(m / s)

accept answer in range 5.3 to 5.7

1

[15]

M2.(a) acceleration = change in velocity / time taken

allow $a = \Delta v / t$

1

(b) $= \frac{(5 - 3)}{6}$

1

−0.33 (m / s²)

1

allow 0.33 m / s^2 with no working shown for 2 marks

(c) force = mass \times acceleration

allow $F = m a$

1

(d) 70×0.33

allow ecf from 4.3

1

23.1 (N)

allow 23.1 with no working shown for 2 marks

1

(e) before throwing the bag the momentum of the skater and bag is zero

1

when it is thrown the bag has momentum forwards

1

because momentum before = momentum after

1

the skater has equal backwards momentum so will move backwards

1

[10]

M3.(a) (produces) a force from water on the boat

1

in the forward direction

accept in the opposite direction

this must refer to the direction of the force not simply the boat moves forwards

an answer produces an (equal and) opposite force gains 1 mark

1

(b) (i) 1.5

*allow 1 mark for correct substitution, ie $\frac{16-4}{8}$ or $\frac{12}{8}$
provided no subsequent step shown
ignore sign*

2

m/s²

1

(ii) 102 *or* their (b)(i) \times 68 correctly calculated
*allow 1 mark for correct substitution, ie 1.5×68
or their (b)(i) \times 68
provided no subsequent step shown*

2

(iii) greater than
reason only scores if greater than chosen

1

need to overcome resistance forces
*accept named resistance force
accept resistance forces act (on the water skier)
do **not** accept gravity*

1

[9]

M4. (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 distance

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/s²

do **not** accept mps²

1

[10]

M5. (a) 2.75

allow **1** mark for correct substitution, ie $\frac{11}{4}$
 $\frac{23 - 12}{4}$
or
 provided no subsequent step shown

2

m/s²

1

(b) driving force increases

1

frictional force increases

accept air resistance / drag for frictional force

1

driving force > frictional force

1

[6]

- M6.** (a) (i) accelerating
accept getting faster
accept speed / velocity increasing 1
- (ii) acceleration increases
accept velocity / speed increases more rapidly
do **not** accept velocity / speed increases 1
- (b) (i) acceleration = $\frac{\text{change in velocity}}{\text{time (taken)}}$

accept $a = \frac{V - U}{t}$ **or** $a = \frac{V_1 - V_2}{t}$

do **not** accept velocity for change in velocity
do **not** accept change in speed

do **not** accept $a = \frac{V}{t}$ 1
- (ii) 15
allow **1** mark for an answer of 900 **or** for correct use of 540 seconds 2
- (iii) velocity includes direction
accept velocity is a vector (quantity)
accept converse answer 1

[6]