

Newton's First Law

Mark Scheme 1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Physics
Exam Board	AQA
Topic	6.5 Forces
Sub-Topic	Newton's First 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)** (i) gravitational potential (energy)

1

- (ii) kinetic (energy) 1
- (b) (i) slope or gradient 1
- (ii) area (under graph)
do **not** accept region 1
- (iii) starts at same y-intercept 1
- steeper slope than original and cuts time axis before original
the entire line must be below the given line
allow curve 1
- (c) (i) 31
and
31
correct answers to 2 significant figures gains **3** marks even if
no working shown
both values to more than 2 significant figures gains **2** marks:
30.952.....
30.769....
65 / 2.1 and / or
80 / 2.6 gains **1** mark
if incorrect answers given but if both are to 2 significant
figures allow **1** mark 3
- (ii) student 1 incorrect because $80 \neq 65$ 1
- student 2 correct because average velocities similar

ecf from (c)(i)

1

student 3 incorrect because times are different

1

[12]

M4.(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]

- M5.** (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]