

# Newton's Second Law

## Mark Scheme

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

**Time Allowed:** 60 minutes

**Score:** /59

**Percentage:** /100

**Grade Boundaries:**

<b>M1.(a)</b>	arrow of equal size pointing vertically downwards <i>judged by eye</i>	1
	labelled 'weight'	1
(b)	the upwards force is greater than the downwards force	1
	because air resistance increases	1
(c)	$v^2 = (2 \times 2 \times 209) + 8^2$	1
	$v = \sqrt{900}$	1
	$v = 30 \text{ (m / s)}$	1
	<i>allow 30 (m / s) without working shown for 3 calculation marks</i>	
(d)	vertical force (300 N) drawn with a suitable scale	1
	horizontal force (60 N) drawn to the same scale	1

resultant force drawn in correct direction

1

value of resultant in the range 304 N – 308 N

1

[11]

**M2.(a)** the forces are equal in size and act in opposite directions

1

(b) (i) forwards / to the right / in the direction of the 300 N force  
*answers in either order*

1

accelerating

1

(ii) constant velocity to the right

1

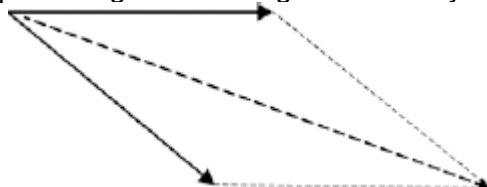
(iii) resultant force is zero  
*accept forces are equal / balanced*

1

so boat continues in the same direction at the same speed

1

(iv) parallelogram or triangle is correctly drawn with resultant



3

value of resultant in the range 545 N – 595 N

*parallelogram drawn without resultant gains 1 mark*

*If no triangle or parallelogram drawn:*

*drawn resultant line is **between** the two 300 N forces gains 1 mark*

*drawn resultant line is between and longer than the two 300 N forces gains 2 marks*

1

[10]

**M3.** (a) (i) a single force that has the same effect as all the forces combined  
*accept all the forces added / the sum of the forces / overall force*

1

(ii) constant speed (in a straight line)  
*do **not** accept stationary*

**or** constant velocity

1

(b) 3

*allow 1 mark for correct substitution into transformed equation*

*accept answer 0.003 gains 1 mark*

*answer = 0.75 gains 1 mark*

2

m/s<sup>2</sup>

1

(c) as speed increases air resistance increases  
*accept drag / friction for air resistance*

1

reducing the resultant force

1

[7]

**M4.** (a) (i) gravity/weight

1

(ii) 2193750000000 or  $2.19 \times 10^{12}$

**not**  $2.19^{12}$

*allow 1 mark for the correct conversion to 7500 (m/s)*

*allow one mark for answer 2193750(J)*

2

transferred to heat

*ignore extras of sound and light*

*accept changed to heat*

*accept lost due to friction*

1

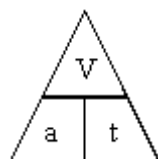
(b) (i) acceleration =  $\frac{\text{change in velocity}}{\text{time (taken)}}$

*accept word speed instead of velocity*

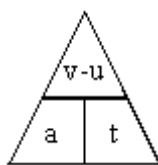
*accept*  $a = \frac{v - u}{t}$

**or** correct rearrangement

*do not accept*



*even if subsequent calculation correct*



can gain credit if subsequent calculation correct

1

(ii) 2

ignore + or – signs

m/s<sup>2</sup> 1

accept m/s/s or ms<sup>-2</sup>

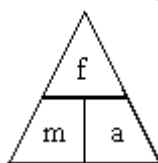
2

(c) (i) force = mass × acceleration

accept correct rearrangement

accept  $F = m \times a$

do not accept



unless subsequent calculation correct

1

(ii) 156 000

accept 78 000 × their (b)(ii)(only if (b)(i) correct)

1

[9]

**M5.** (i) force = mass × acceleration

accept  $F = m \times a$

accept upper **or** lower case letters

accept equation using correct units

accept



if subsequent method correct

1

(ii) 0.007

allow 1 mark for correct transformation or substitution

2

[3]

- M6.** (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)  $F = ma$   
 $10\,000 = 1250a$   
 $a = 8$   
 $\text{m/s}^2$   
for 1 mark each

4

- (ii)  $ke = \frac{1}{2} mv^2$   
 $ke = \frac{1}{2} 1250.48^2$   
 $ke = 1\,440\,000$   
J  
for 1 mark each

4

- (iii)  $W = Fd$   
 $W = 10\,000.144$

$$W = 1\,440\,000$$
$$J$$

for 1 mark each

4

[16]

**M7.** 12 100

correct answer with no working = 3  
if answer incorrect, allow 1 mark for force = mass  $\times$  acceleration  
 $1210 \times 10 = 2$  force / weight = mass  $\times$  gravity is neutral  
N.B. no marks for correct answers with incorrectly recalled relationship

[3]