

**WJEC Physics GCSE**  
**Topic 2.2: Newton's laws**  
**Mark Schemes for Questions by**  
**topic**

1.

Mark	Answer	Accept	Neutral answer	Do not accept
6	<p><b>Indicative content:</b>            According to Newton's 1<sup>st</sup> law for the rocket to change its state of motion it must have been acted on by a resultant force when the engines are fired.            According to Newton's 3<sup>rd</sup> law the gases that are pushed out of the rocket creates an equal and opposite force on the rocket. This is the thrust force.            Newton's 2<sup>nd</sup> law tells us the relationship between the resultant force and the acceleration is given by <math>F = ma</math> or force equals rate of change of momentum. The resultant force arises because the thrust is bigger than the weight.</p> <p><b>5-6 marks</b>            The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p><b>3-4 marks</b>            The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p><b>1-2 marks</b>            The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p><b>0 marks</b>            The candidate does not make any attempt or give a relevant answer worthy of credit.</p>			
6				

2.

Question		Marking details	Marks
2.	(a)	$\frac{(800-200)(1)}{80(1)} = 7.5 \text{ (1-ans) [m/s}^2\text{]}$ <p><b>Award 1 mark for 600 anywhere</b></p>	3
	(b) (i)	<p><b>Indicative content:</b></p> <p>When the parachute is opened, a big air resistance force is produced that acts upwards. This is bigger than the person's weight (downwards), the resultant force is upwards and so the person decelerates. As the speed decreases, the air resistance (or resultant force) decreases and the deceleration decreases. Eventually the speed becomes so low that the air resistance and weight become equal and the person falls at a (low) constant speed.</p> <p><b>5 – 6 marks</b> The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p><b>3 – 4 marks</b> The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p><b>1 – 2 marks</b> The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p><b>0 marks</b> The candidate does not make any attempt or give a relevant answer worthy of credit.</p>	6
	(ii)	<p>Bigger parachute / surface area (1)            To give a bigger air resistance / upward force (1)            To equal the [bigger] weight (1)  <b>Either the 2<sup>nd</sup> mark must be linked to the 1<sup>st</sup> mark or the 3<sup>rd</sup> mark must be linked to the 2<sup>nd</sup> mark.</b></p>	3
<b>Question total</b>			<b>[12]</b>

3.

Sub-section	Mark	Answer	Accept	Neutral answer	Do not accept
(a)	3				2 lines originating from 1 car
(b)	3	resultant force = $2\,500 - 1\,000 = 1\,500$ [N] (1) $a = \frac{F}{m} = \frac{1\,500}{1\,200}$ subs (1) <b>ecf on 1 500</b> $1.25$ [m/s <sup>2</sup> ] answer (1)	$\frac{3\,500}{1\,200} = 2.92$ [m/s <sup>2</sup> ] award 2 marks $\frac{2\,500}{1\,200} = 2.08$ [m/s <sup>2</sup> ] award 2 marks		An ecf for any force other than 3 500 unless it is clearly shown that it is their resultant force
(c)	i	1	N.B. the answer <b>must be half</b> of the answer in (b) [0.625 m/s <sup>2</sup> ]	0.63	0.62 or 0.6
	ii	1	It increases		
	iii	2	Drag <b>or</b> it equals driving force / forces are balanced / no $\Sigma F$ (1) so $a$ becomes zero / reaches a constant speed (1) <b>The 2<sup>nd</sup> mark can only be awarded if it is linked to the 1<sup>st</sup> mark.</b>	Forces are the same Terminal velocity	Any reference to weight don't award 1 <sup>st</sup> mark Reaches a maximum speed for the 2 <sup>nd</sup> mark
<b>Total</b>	<b>10</b>				

## 4.

Question		Marking details	Marks
6.	(a)	Rocket exerts force on exhaust gases (1) which exert [equal but opposite] force on rocket causing it to take-off (1) Do not credit a statement of N's 3 <sup>rd</sup> law out of context.	2
	(b)	(i) <b>Indicative content:</b> [Ignore changes to $g$ ] Using $F = ma$ , $(1.5 \times 10^7 - 9.5 \times 10^6) = 9.5 \times 10^5 \times a$ so $a = 5.789 \text{ [m/s}^2\text{]}$ . The acceleration increases because the weight decreases as fuel is used up, thus increasing the resultant upward force (thrust remains constant). The acceleration is directly proportional to the resultant force. The acceleration also increases because the mass decreases (acceleration is inversely proportional to mass). <b>5 – 6 marks</b> The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. <b>3 – 4 marks</b> The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. <b>1 – 2 marks</b> The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. <b>0 marks</b> The candidate does not make any attempt or give a relevant answer worthy of credit.	6
		(ii) $mg\Delta h = 320 \times 1.35 \times 120000 [= 51\,840\,000 \text{ J}]$ Correct value for $m$ (320 kg)(1), correct value for $g \times 1.35$ (1), correct value for $\Delta h \times 120\,000$ (1). No mark for answer. Award 3 marks for 51 840 000 Award 2 marks for 51 840 or $1.54 \times 10^{11}$ or $1.14 \times 10^{12}$ Award 1 mark for 384 000 or $1.54 \times 10^8$ or $1.14 \times 10^9$	3
		(iii) Energy is converted / transferred / changed (1) (not <u>lost</u> , but accept <u>lost and changes</u> ) to <u>work being done</u> against <u>friction</u> [in the atmosphere] / increasing the heat energy or temperature <u>of the</u> atmosphere and/or probe or parachute (1) <b>Either mark can be awarded on its own but only award 2 marks if they are linked.</b>	2
		<b>Question total</b>	<b>[13]</b>
		<b>HIGHER TIER PAPER TOTAL</b>	<b>[60]</b>

5. (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)

*allow 1 mark for correct substitution, ie  $\frac{16-4}{8}$  or  $\frac{12}{8}$*

*provided no subsequent step shown*

*ignore sign*

2

m/s<sup>2</sup>

1

(ii)

**or**

their (b)(i) × 68 correctly calculated

*allow 1 mark for correct substitution, ie 1.5 × 68*

**or** their (b)(i) × 68

*provided no subsequent step shown*

2

(iii) greater

*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]