AQA GCSE Physics | 8463

SPECIFICATION POINT 4.5.6.2.1

Newton's First Law

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**5**
Available paper years	**2011–2025**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

4.5.6.2.1 Newton's First Law

Answer 01 · Mark scheme

Question 1

question	answers	extra information	mark
1(a)(i)	120		1
1(a)(ii)	20	accept 140-their (a)(i) provided answer is not negative	1
1(a)(iii)	as speed increases drag force / water resistance / friction / **D** increases (until) **D** = 140 N or (until) **D** = **T**	 forces balance is insufficient	1 1 1
1(b)(i)	(average) speed (of swimmer)		1
1(b)(ii)	any **two** from: • more data • force may vary (a lot) / change • give more <u>reliable average</u>	 accept results for data do **not** accept more accurate data ignore references to anomalies ignore accurate / precise	2

Question 1 continues on the next page . . .

4.5.6.2.1 Newton's First Law

PHY2H

Question 1 continued . . .

question	answers	extra information	mark
1(b)(iii)	examples of acceptable responses: • most / some females produce smaller forces • most / some males produce larger forces • some females swim as fast as males but use a smaller force • most of the faster swimmers are male • most of the slower swimmers are female • range of the (average) speed of males is smaller than the range of the (average) speed of females • range of the (average) force of the males is greater than the range of the (average) force of the females	do **not** accept <u>all</u> females produce smaller forces do **not** accept <u>all</u> males produce larger forces do **not** accept <u>all</u> males swim faster do **not** accept <u>all</u> females swim slower	1
1(b)(iv)	exert maximum (hand) force (throughout the swim / stroke)	accept (any method to) increase (hand) force practise more is insufficient	1
Total			**10**

4.5.6.2.1 Newton's First Law

Answer 01 · Mark scheme January 2011 | PHY2H | Original Q1 | Legacy

PHY2H

4.5.6.2.1 Newton's First Law

Answer 02 · Mark scheme

June 2015 | PH3HP | Original Q2 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. ref.
2(a)(i)	D		1	AO2 P3.2.4b
2(a)(ii)	friction		1	AO1 P3.2.4b
2(a)(iii)	any **two** from: • the speed / velocity • the radius of the bend • the mass (of the car)	 the radius is insufficient accept curvature of the road size of the bend is insufficient accept distance of car from centre (of bend) accept weight for mass	2	AO1 P3.2.4c
2(b)	the car has a wide base the car has a low centre of mass / gravity	accept any description of a wide base e.g. the wheels are far apart accept wide wheel base do **not** accept long wheel base a large surface area is insufficient wide tyre(s) is insufficient accept any description of low centre of mass e.g. mass is close to the ground a down force is insufficient	1 1	AO2 P3.2
Total			6	

4.5.6.2.1 Newton's First Law

Answer 02 · Mark scheme

June 2015 | PH3HP | Original Q2 | Legacy



4.5.6.2.1 Newton's First Law

Answer 03 · Mark scheme

June 2019 | 8463/2H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6.1	the tendency of an object to continue in its state of rest or motion	allow how difficult it is to change the velocity of an object	1	AO1/1 4.5.6.2.1 iso
6.2	(soft foam) increases the time taken to stop or increases the time taken to decrease momentum	allow increases impact/contact time allow increases the time of the collision do not accept slows down time	1	AO1/1 4.5.7.3
	decreases the rate of change in momentum	allow reduces acceleration/deceleration reduces momentum is insufficient allow increases the time to reduce the momentum to zero for **2** marks	1	
	reducing the force (on the egg)	allow impact for force	1	

4.5.6.2.1 Newton's First Law

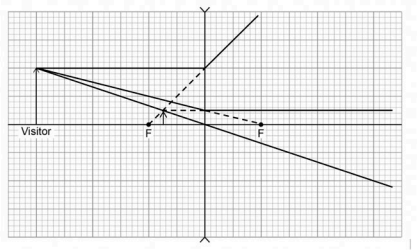
6.3		an answer 4.5 (m/s) scores **4** marks an answer 4500 scores **3** marks		AO2/1 4.5.7.3
	180 ms = 0.18 s	if incorrectly or not converted, subsequent marks may still be awarded for correct method and calculations	1	
	$800 = \frac{32 \times v}{0.18}$		1	
	$v = \frac{800 \times 0.18}{32}$		1	
	v = 4.5 (m/s)		1	
	Alternative method 180 ms = 0.18 s (1) $\Delta mv = 144$ (kgm/s) (1) $\Delta v = 144 \div 32$ (1) v = 4.5 (m/s) (1)			
	Alternative method 180 ms = 0.18 s (1) $a = 25$ (m/s^2) (1) $25 = \Delta v \div 0.18$ (1) v = 4.5 (m/s) (1)			
Total			**8**	

4.5.6.2.1 Newton's First Law

Answer 04 · Mark scheme

November 2020 | 8463/2H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	any **two** correct lines drawn from the top of the visitor and passing through the lens image drawn at the correct position and with the correct orientation	allow construction lines that are not dashed mark only scores if first two marks scored. a convex lens diagram scores **0** marks 	2 1	AO2 4.6.2.5
04.2	Decreases		1	AO3 4.6.2.5
04.3	Iron		1	AO1 4.7.2.1
04.4	there is a current in the solenoid / circuit creating a magnetic field attracting the bolt	allow a charge flows through the solenoid / circuit allow the solenoid / coil is magnetised	1 1 1	AO1 4.7.2.1

4.5.6.2.1 Newton's First Law

Answer 04 · Mark scheme

04.5	1.50 cm = 0.015 m 2.88 = k × 0.015 k = 2.88 / 0.015 k = 192 (N/m)	 this mark may be awarded if distance is incorrectly/not converted this mark may be awarded if distance is incorrectly/not converted allow a correctly calculated answer using an incorrectly/not converted distance	1 1 1 1	AO2 4.5.3

04.6	Any **two** from: • increase the current (in the solenoid / circuit) • add more turns to the solenoid • use a spring with a lower spring constant	 allow any sensible suggestion for increasing the current such as increasing the p.d. / power of the battery **OR** using lower resistance wire in the solenoid do **not** allow increase the number of coils allow use a weaker spring	2	AO3 4.7.2.1
Total			**14**	

4.5.6.2.1 Newton's First Law

Answer 05 · Mark scheme

June 2025 | 8463/2H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	car **X** has a smaller maximum acceleration (than car **Y)**		1	AO3 4.5.6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	increases the time taken (for the driver to come to a stop) (so) the rate of change of momentum decreases **or** the deceleration / acceleration of the driver is less (so) the force (on the driver) is reduced	allow for MP1 **and** MP2 the change of momentum is the same but over a greater time	1 1 1	AO1 4.5.6.2.2 4.5.7.3

4.5.6.2.1 Newton's First Law

Answer 05 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	$0 - 18^2 = 2 \times a \times 24$		1	AO2 4.5.2
	$a = -\frac{324}{48}$		1	4.1.1.2 4.5.6.2.2 4.5.6.1.5
	$a = -6.75$	the equation $v^2 - u^2 = 2as$ must have been used to score subsequent marks	1	4.5.7.3
	$F = 1400 \times (-) 6.75$		1	
	9450 (N)		1	
	OR			
	$E_k = \frac{1}{2} \times 1400 \times 18^2$ (1)			
	$=226\ 800$ (1)	the equation $E_k = \frac{1}{2} m v^2$ must have been used to score subsequent marks		
	$226\ 800 = F \times 24$ (1)			
	$F = \frac{226\ 800}{24}$ (1)			
	9450 (N) (1)			
	OR			
	average velocity = (18 + 0) / 2 (1)			
	$24 = 9 \times t$ (1)			
	$t = \frac{24}{9}$ (1)	subsequent marks may be awarded if t has been calculated using initial velocity rather than average velocity		
	$F = \frac{1400 \times 18}{\frac{24}{9}}$ (1)			
	9450 (N) (1)			

4.5.6.2.1 Newton's First Law

Answer 05 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	work is done by friction (in the brakes) (some of the kinetic) energy (of the vehicle) is transferred as thermal energy (in the brakes)	ignore friction alone	1 1	AO1 4.5.6.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	the brakes will overheat the driver will lose control of the car		1 1	AO1 4.5.6.3.4

Total Question 6	13

4.5.6.2.1 Newton's First Law

Answer 03 · Examiner comments — June 2019 | 8463/2H | Original Q6

Question 6 (Standard/high demand)

06.1 Incorrect answers often tried to define or use Newton's first or second laws and very occasionally third law. The students that did score this mark were usually precise and word perfect.

06.2 Although the context may be different this was basically a question asking student to explain a safety feature. The imprecise use of language meant that there were very few full mark answers. Some answers had the idea of the increased time but missed the 'to stop' part. Students that did score a mark often did so for the idea of the reduced force on foam or the increased force on concrete. Many less effective responses referred to the density of foam versus concrete or that foam is soft due to air pockets which absorb force. A lot of answers referred to energy changes.

06.3 Many students could not convert milliseconds to seconds. A significant minority thought 180ms were equal to 3 seconds. Those students who first calculated acceleration did not end up with the correct answer because they then tried using $v^2=u^2+2as$. There were many responses using w=mg, KE= $1/2mv^2$ or otherwise using the values given. However about half of the students used a correct method and scored either 3 or 4 marks.

Answer 04 · Examiner comments — November 2020 | 8463/2H | Original Q4

Question 4 (Standard and standard/high demand)

04.1 This part was poorly answered. Many students drew the ray diagram for a convex lens.

04.2 75% of students correctly identified how the image changed.

04.3 80% of students knew that the bolt should be made from iron.

04.4 There were some good, clear and logical explanations given. However some of the students failed to link the switch closing to a current in the circuit. The final marking point was missed by a significant number of the students who failed to give an 'action' acting on the bolt i.e. attraction or pulling etc.

04.5 There were many correct answers given with the working out clearly shown. A significant number of the students failed to score all 4 marks as the attempt to convert to metres was incorrect. A smaller proportion of the students tried calculating energy stored. Some of those scored 1 mark for showing a correct conversion from 1.50cm to 0.015m.

04.6 It was not always clear if the students were writing about the spring or the solenoid. The most common way of scoring one mark was for 'increasing the current' or a correct description of how this could be achieved. Answers simply in terms of 'increasing the magnetic field' were insufficient for credit to be awarded.

4.5.6.2.1 Newton's First Law

Answer 05 · Examiner comments June 2025 | 8463/2H | Original Q6

6.1

This question was well answered with a number of students explaining their answer by linking it to F=ma showing a clear understanding of the link between variables. Students sometimes expanded their answers unnecessarily adding a detailed explanation as to why car X would have a lower maximum acceleration. Converse argument of car Y would have a greater maximum acceleration were common for this question.

6.2

This question topic proved difficult, as it has in previous exam series with only 15 % of the students scoring all 3 marks. Many answers did not show a scientific understanding of the concept, merely referring to the cushioning effect of airbags. Very few students scored the 2nd mark point being unaware of how the rate of change of momentum changed or deceleration. There were also a significant number of incorrect references to 'slowing down time'.

6.3

Just over 40 % of the students gained full marks for this multi-step calculation. Those who did mostly chose to use the equations of motion method before substituting their value of acceleration into F=ma. Very few students approached the problem from the kinetic energy method. The method using the average velocity was commonly used. However, very few students realised the necessity to use average velocity in their solution and were as a result a factor of two out in their final answer. This method also highlights that many students do not know which equations relate to constant velocity, and which relate to changing velocity.

Answer 05 · Examiner comments June 2025 | 8463/2H | Original Q6

6.4

Only a tiny minority of the students gained the 1st mark point for explaining why braking causes an increase in the temperature of the brakes, the majority failing to grasp the link between work done and frictional force. Many incorrectly referred to friction between the wheels and the road.

6.5

Just over half of the students gained marks for stating the risks of a large deceleration. Many students referenced crashes in their responses, notably involving the vehicle behind. Students rarely mentioned overheating, failing to make the link between this question and 6.4.