3.14 Forces, Newton's Laws and Momentum: 10-minute Pack

Total Marks

AQA 8464 · Calculator allowed · about 10 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Amara, a cyclist, and her bicycle have a combined mass of 78 kg. The resultant forward force acting on Amara and her bicycle is 156 N. Use the equation force = mass x acceleration (F = m x a).

(a) Calculate Amara's acceleration. **(2)**

.....

(b) State what would happen to Amara's acceleration if the same resultant force acted on a greater combined mass (for example, if she carried a heavy backpack). **(1)**

(Total for Question 1 is 3 marks)

2 Modern cars include safety features such as seat belts, airbags and crumple zones, designed to reduce the risk of injury to passengers during a collision. In a collision, a passenger's speed must be reduced to zero, which requires a resultant force to act on them. Use ideas about force, deceleration and time to explain how these safety features work to reduce the risk of injury.

(Total for Question 2 is 6 marks)

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Mark scheme · 3.14 Forces, Newton's Laws and Momentum: 10-minute Pack

Question 1

(a) rearranges and substitutes: a = 156 / 78	**M1**
(a) 2.0 m/s^2 cao	**A1**

(a) Answer: 2.0 m/s^2

(b) the acceleration would be smaller (decrease), because acceleration is inversely proportional to mass for a given force, oe	**B1**

(b) Answer: The acceleration would be smaller.

Question 2

Level 1 One or two isolated, correct statements are made, for example that airbags stop a passenger hitting the dashboard or that seat belts hold a passenger in their seat, with little or no reference to force, deceleration or time.	**1-2**
Level 2 Identifies that these features increase the time taken for the passenger to come to rest during a collision, and links this to a smaller deceleration or force, but the explanation covers at most one feature in detail or the logical chain from time to force is incomplete.	**3-4**
Level 3 A clear, logically sequenced explanation covering at least two safety features, showing that each increases the time taken for the passenger's speed to reach zero during a collision; this produces a smaller deceleration, and since force = mass x acceleration, a smaller deceleration means a smaller force acts on the passenger's body, reducing the risk of injury. Correct use of the terms force, deceleration and time throughout.	**5-6**

Indicative content:

- seat belts stretch slightly, increasing the time taken for the wearer to decelerate to a stop
- airbags inflate to cushion the passenger, increasing the time taken for the head and chest to decelerate
- crumple zones crumple/deform in a collision, increasing the time taken for the car (and its occupants) to decelerate to a stop
- for the same change in speed, increasing the time taken decreases the deceleration
- using force = mass x acceleration, a smaller deceleration means a smaller force acts on the passenger
- a smaller force on the passenger's body reduces the risk of injury
- without these features, the same change in speed would happen in a much shorter time, producing a much larger deceleration and force

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