

3. Read the passage in the resource folder carefully, before answering the questions which follow.

Answer the following questions in your own words. Direct quotes from the original passage will not be awarded marks.

- (a) Explain concisely why a golf ball travels further in air than it would in a vacuum (see the first 6 paragraphs). [3]

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- (b) The end of paragraph 5 refers to Newton's third law. Explain which body is exerting a force on which other body for this **pair** of Newton's third law forces. [2]

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- (c) Give two reasons **why** a ball with dimples flies further than a smooth ball (pages 2 & 3). [2]

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- (d) Describe **how** dimples reduce drag on a golf ball. Word your answer carefully and concisely in your own words (as much as is possible). You will need to refer to pressures to obtain full marks (see The Origins of Drag, page 3). [4]

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- (e) The statement at the end of paragraph 10 seems to contradict one of the graphs. Point out this contradiction. [1]

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- (f) (i) Calculate an approximate value for the mass of a golf ball. See Graph 1 and paragraph 11. [2]

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- (ii) Using data from the appropriate graph, calculate the drag force acting on a smooth golf ball travelling at 50 ms^{-1} and spinning at 3000 revolutions per minute ($1 \text{ foot/second} = 0.305 \text{ ms}^{-1}$). [2]

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- (g) Aerodynamic theory suggests that drag is proportional to flight speed squared. Use values from an appropriate graph to show that this is approximately true for a smooth golf ball. **Do not convert the units; *ft/sec* is perfectly acceptable here.** [4]

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