Question 15 (16 marks)

On February 6 1971, during the Apollo 14 mission, astronaut Alan Shepard hit a golf ball on the Moon. The golf club launched the ball at an angle of 24.1° to the ground with an initial speed of 45.0 m s^{-1}.

(a) Construct a free body diagram below, showing the force(s) acting on the golf ball about halfway between it being struck and its highest point. (2 marks)

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(b) Calculate the horizontal and vertical components of the initial velocity. (2 marks)

Answer u_h _____ m s^{-1}

Answer u_v _____ m s^{-1}

(c) Assuming the golf ball travelled over a level surface, calculate the

(i) time taken to hit the surface (2 marks)

Answer _____ s

(ii) horizontal distance the golf ball travelled. (2 marks)

Answer _____ m

(d)   The highest point on the Moon's surface is 1.08×10^4 m higher than the mean radius of the Moon. If the golf ball is hit horizontally from this peak, determine the initial velocity required for the golf ball to completely circle the Moon and return to approximately the same spot.   (4 marks)

Answer _____ m s⁻¹

(e)   Explain, with reference to relevant formulae, why the gravitational field on the Moon's surface is less than the field on Earth's surface.   (4 marks)

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