Projectile Motion 2

Have a go at the following exam equations.

2   Fig. 2.1 shows the path of a metal ball fired at a velocity of 24 m s⁻¹ at an angle of 30° to the horizontal.
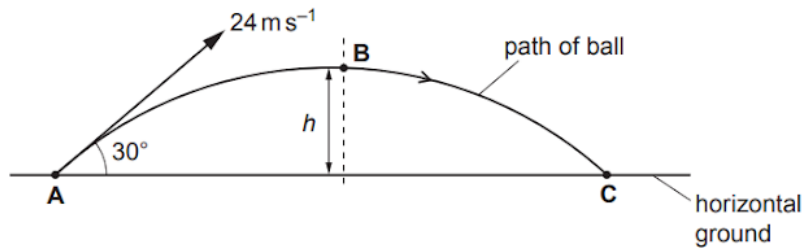

Fig. 2.1

Air resistance has negligible effect on the motion of the metal ball. The ball is fired from point **A** and it reaches its maximum height at point **B**. The mass of the ball is 450 g.

(a) State the direction of the acceleration of the ball during its flight.

.... [1]

(b) Calculate the horizontal and vertical components of the velocity of the ball at **A**.

horizontal velocity = ... m s⁻¹

vertical velocity = ... m s⁻¹ [2]

(c) Explain why the gravitational potential energy gained by the ball as it moves from **A** to **B** is not equal to its initial kinetic energy at **A**.

....

....

.... [1]

(d) Calculate the maximum vertical height h of the ball.

$h =$ .... m **[3]**

[Total: 7]

5. The astronauts of Apollo 14 played golf on the Moon. They struck a number of shots such as the one shown below.
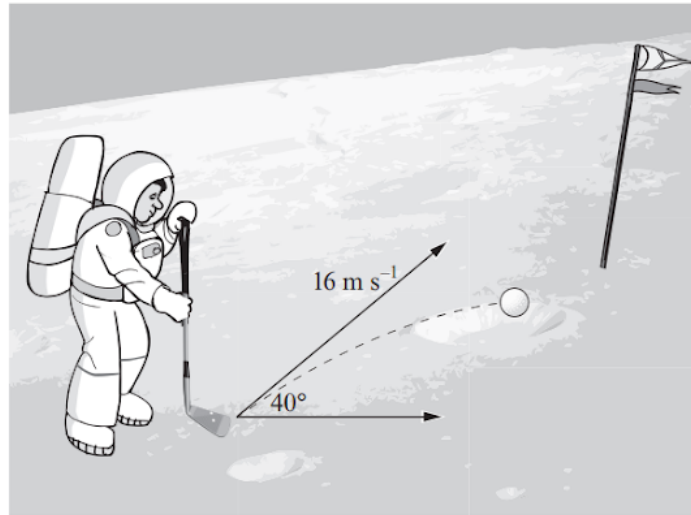
(a)   (i)   Calculate the horizontal and vertical components of velocity of the golf ball at the instant it was struck.   [2]

....

....

....

....

      (ii) Describe the essential difference between the horizontal and vertical components of velocity during the flight of the ball.   [1]

....

....

....

(b) The acceleration due to gravity on the Moon is 1.6 m s^{-2}. Assuming the shot is played on horizontal ground, calculate

(i)   the total time of flight,   [3]

....

....

....

....

....

....

(ii) the horizontal distance the ball travels,   [1]

....

....

(iii) the maximum height reached.   [2]

....

....

....

....

(c) A similar golf shot is played on Earth. Give two reasons why your answer to *(b)*(iii) would be different.   [2]

1. ....

....

2. ....

....

18 Champagne bottles are often opened by 'firing' the cork out of the bottle. The world record for the horizontal distance travelled by a fired cork is 53 m.

The high pressure inside the bottle produces an average force of 150 N on the cork as it leaves the bottle. This force acts on the cork over a distance of 2.5×10^{-2} m.

(a) Show that the work done on the cork is about 4 J.

(2)

....

....

....

(b) Calculate the maximum speed at which the cork could leave the bottle.

  mass of cork $= 7.5 \times 10^{-3}$ kg

(2)

....

....

....

Speed = ...

(c) The cork is fired from ground level at an angle of 40° to the horizontal with a speed of 32 m s⁻¹.

(i)   Show that the vertical component of the velocity is about 20 m s⁻¹.

(1)

(ii) Calculate the horizontal distance travelled by the cork through the air.

(5)

Distance = ...

(d) Suggest an explanation for the difference between your calculated value and the world record distance.

(2)

(Total for Question 18 = 12 marks)