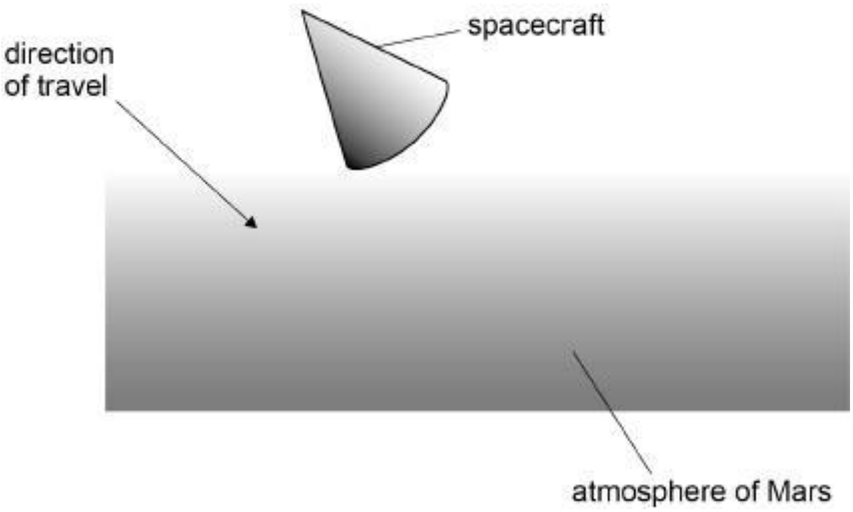
Practice Question Set For A-Level
Subject : Physics
Paper-1 Topic: Mechanics And Materials

Name of the Student:____
Max. Marks : 23 Marks **Time : 23 Minutes**

Q1.

A spacecraft entering the atmosphere of Mars must decelerate to land undamaged on the surface.

Figure 1



(a) **Figure 1** shows the spacecraft of total mass 610 kg entering the atmosphere at a speed of 5.5 km s^{-1}.

Calculate the kinetic energy of the spacecraft as it enters the atmosphere. Give your answer to an appropriate number of significant figures.

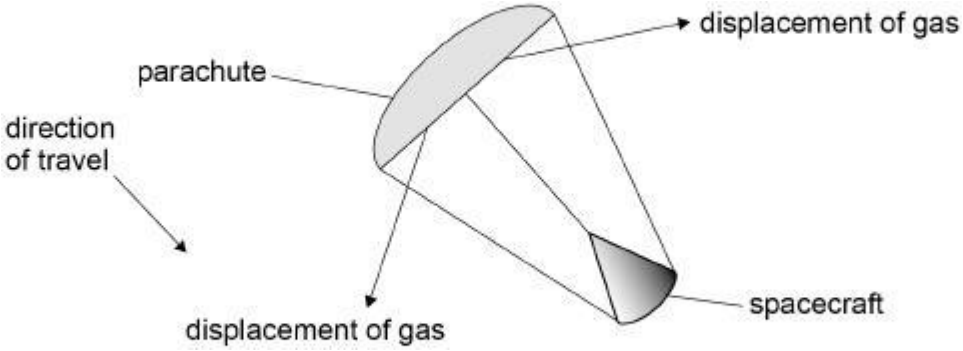
kinetic energy = ________________ J

(3)

(b) A parachute opens during the spacecraft's descent through the atmosphere.

Figure 2 shows the parachute–spacecraft system, with the open parachute displacing the atmospheric gas. This causes the system to decelerate.

Figure 2



Explain, with reference to Newton's laws of motion, why displacing the atmospheric gas causes a force on the system **and** why this force causes the system to decelerate.

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(4)

(c) As the parachute–spacecraft system decelerates, it falls through a vertical distance of 49 m and loses 2.2×10^5 J of kinetic energy.
During this time, 3.3×10^5 J of energy is transferred from the system to the atmosphere.
The total mass of the system is 610 kg.

Calculate the acceleration due to gravity as it falls through this distance.

acceleration due to gravity = ________________ m s^{-2}

(3)

(d) Dust from the surface of Mars can enter the atmosphere. This increases the density of the atmosphere significantly.

Deduce how an increase in dust content will affect the deceleration of the system.

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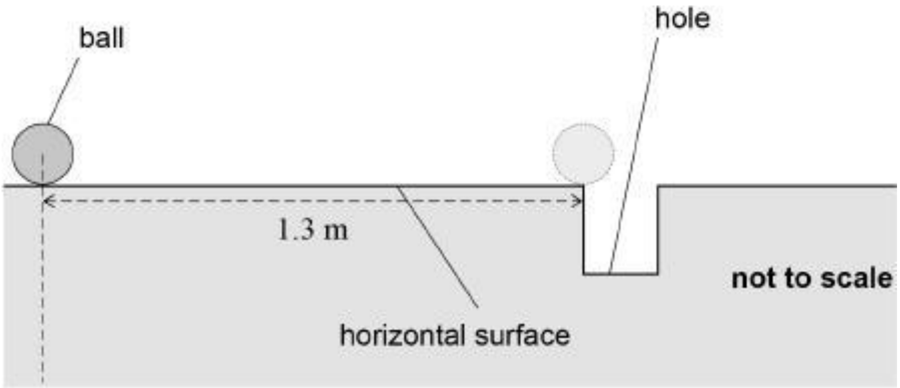
(3)

(Total 13 marks)

Q2.

(a) **Figure 1** shows a golf ball at rest on a horizontal surface 1.3 m from a hole.

Figure 1



A golfer hits the ball so that it moves horizontally with an initial velocity of 1.8 m s^{-1}. The ball experiences a constant deceleration of 1.2 m s^{-2} as it travels to the hole.

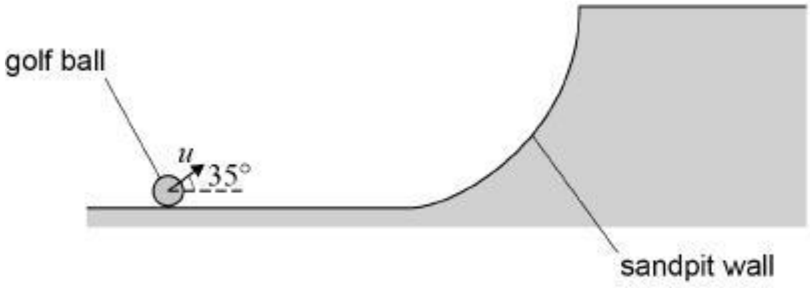
Calculate the velocity of the ball when it reaches the edge of the hole.

velocity = _______________ m s^{-1}

(2)

(b) Later, the golf ball lands in a sandpit. The golfer hits the ball, giving it an initial velocity u at 35° to the horizontal, as shown in **Figure 2**. The horizontal component of u is 8.8 m s^{-1}.

Figure 2



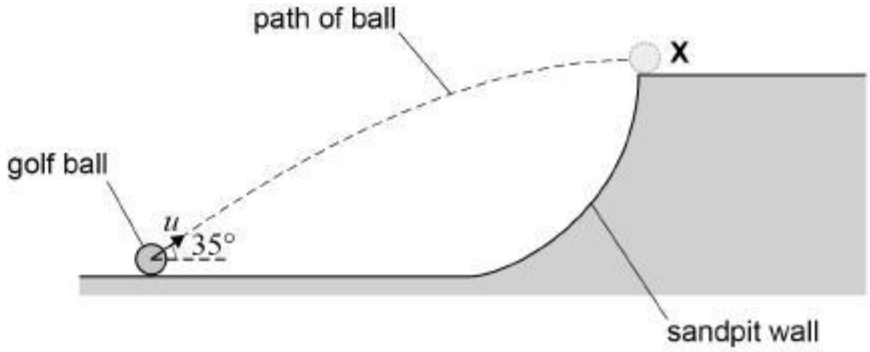
not to scale

Show that the vertical component of u is approximately 6 m s^{-1}.

(1)

(c) The ball is travelling horizontally as it reaches **X**, as shown in **Figure 3**.

Figure 3



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Assume that weight is the only force acting on the ball when it is in the air.

Calculate the time for the ball to travel to **X**.

time = _______________ s

(2)

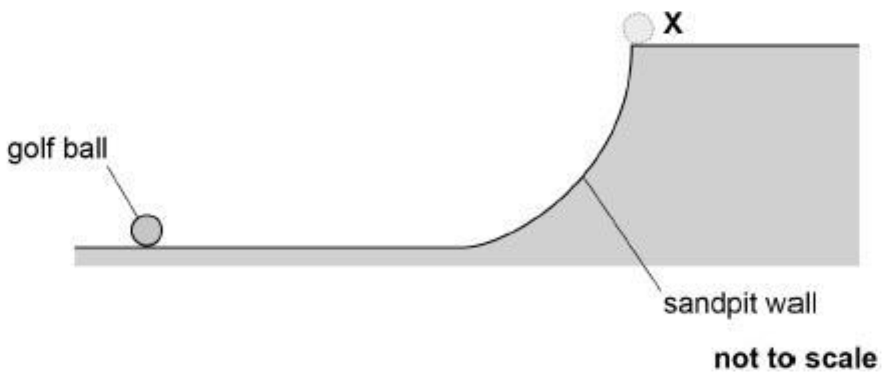
(d) Calculate the vertical distance of **X** above the initial position of the ball.

vertical distance = _______________ m

(2)

The golfer returns the ball to its original position in the sandpit. He wants the ball to land at **X** but this time with a **smaller** horizontal velocity than in **Figure 3**.

Figure 4



(e) Sketch on **Figure 4** a possible trajectory for the ball.

(1)

(f) Explain your reason for selecting this trajectory.

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(2)
(Total 10 marks)