

2.1 Motion

Question Paper

Course	DPIB Physics
Section	2. Mechanics
Topic	2.1 Motion
Difficulty	Hard

Time allowed: 60
Score: /44
Percentage: /100

Question 1a

A rock is thrown off a cliff at a height of 150 m and lands 90 m away.

(a)

(i)

Calculate the speed at which it was thrown.

[2]

(ii)

State an assumption required to obtain your answer.

[1]

[3 marks]

Question 1b

(b)

Determine the angle at which the rock makes impact with the ground.

[2]

[2 marks]

Question 1c

The rock is loaded into a catapult and is launched at 40° elevation from the ground toward a castle wall, with a speed of 27 m s^{-1} . The castle wall is 50 m away and is 12 m high.

(c)

Determine whether the rock makes it over the wall.

[4]

[4 marks]

Question 1d

(d)

Prove that the maximum range of any projectile that starts and ends at ground level is achieved when launched at an angle of elevation of 45° .

You may wish to use the double angle formula:

$$\sin 2A = 2 \sin A \cos A$$

[4]

[4 marks]

Question 2a

A truck driver's initial speed is 4.0 m s^{-1} when they begin to accelerate at 6.0 m s^{-2} . After 3.0 seconds, they decelerate at 5.0 m s^{-2} to stop at a set of traffic lights.

(a)

Calculate the distance between the traffic lights and the point where the truck began to accelerate.

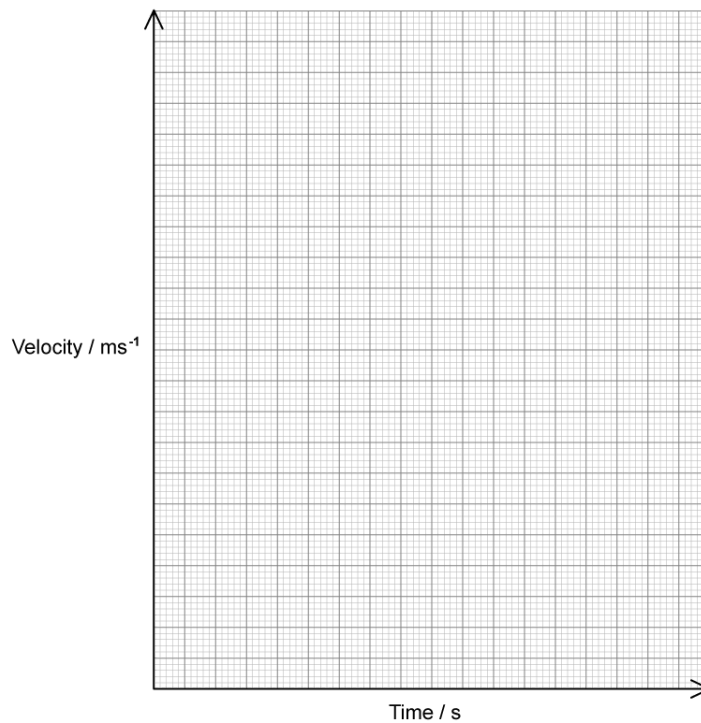
[4]

[4 marks]

Question 2b

(b)

Draw the velocity-time graph on the axes provided for the motion of the truck in part (a).



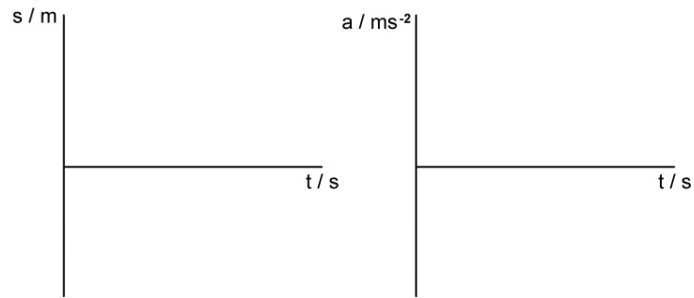
[4]

[4 marks]

Question 2c

(c)

Sketch the displacement-time and acceleration-time graphs for the truck on the pair of axes provided. Label each axes appropriately.

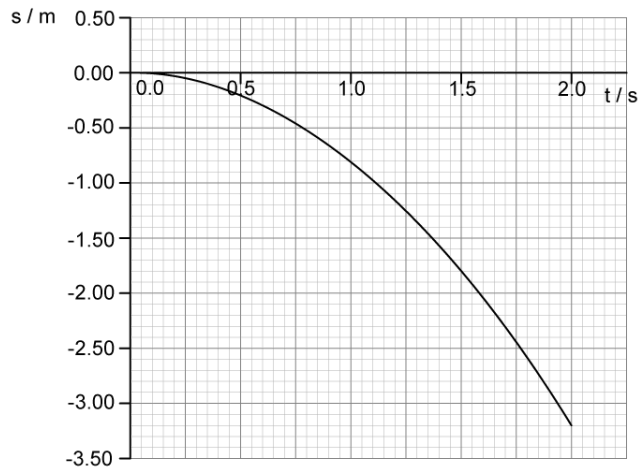


[4]

[4 marks]

Question 3a

An object is released near the surface of the Moon at time $t = 0$. The graph shows the variation of displacement s with time t of the object from the point of release.



(a)

(i)

State the significance of the negative values of s

[1]

(ii)

State an assumption about the point of release of the object.

[1]

[2 marks]

Question 3b

(b)

Use the graph to determine a value for the acceleration of free fall close to the surface of the Moon.

[2]

[2 marks]

Question 3c

(c)

Use the graph to estimate the instantaneous velocity of the object at $t = 1.5$ s.

[3]

[3 marks]

Question 3d

(d)

(i)

Sketch, on the axes provided in part (a), a graph that would show the variation of displacement s with time t if the same object was released close to the surface of the Earth.

[2]

(ii)

Describe and explain the features of your sketch.

[2]

[4 marks]

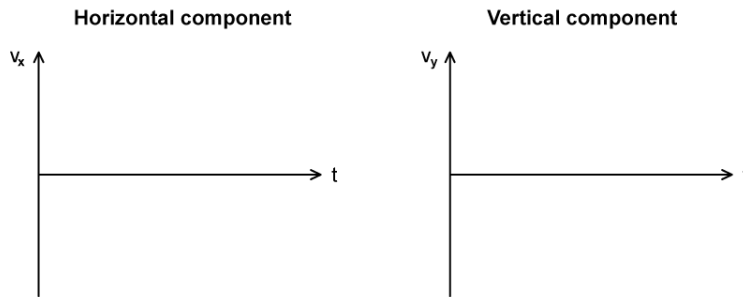
Question 4a

A projectile is launched from sea level at some angle to the ground θ with an initial velocity v .

(a)

On the axes below, sketch graphs to show how the horizontal and vertical components of the velocity of the ball v_x and v_y change with time t until the projectile hits the ground.

Assume that air resistance is negligible.



[4]

[4 marks]

Question 4b

(b)

In the space provided, sketch lines to represent:

(i)

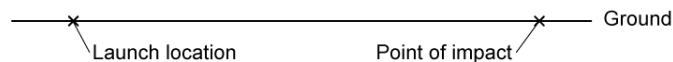
The trajectory of the projectile as described in part (a) between the launch location and the point of impact. Label this line X.

[1]

(ii)

The trajectory of the same projectile, launched from the same location, if air resistance was not negligible. Label this line Y.

[3]



[4 marks]