A Level · OCR · Physics

31 mins 3 questions

Structured Questions

Linear & Projectile Motion

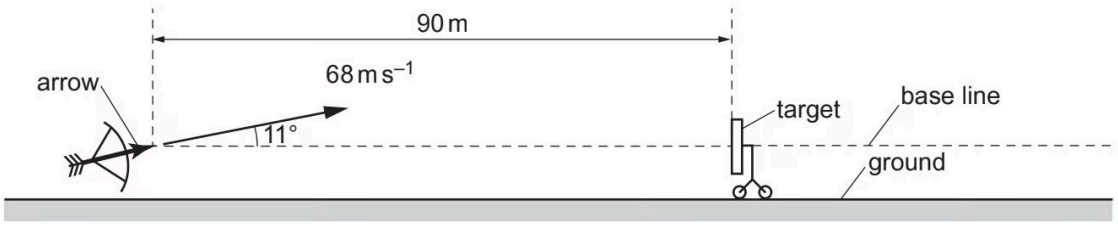
SUVAT Equations / Investigating Motion & Collisions / Acceleration & Free Fall / Braking & Reaction Times / Projectile Motion

Medium (1 question)	/10
Hard (2 questions)	/21
Total Marks	**/31**

Scan here to return to the course
or visit savemyexams.com

Medium Questions

1 (a) An archer fires an arrow towards a target as shown below.



The diagram is **not** drawn to scale.

The centre of the target is at the same height as the initial position of the arrow. The target is a distance of 90 m from the arrow. The arrow has an initial velocity of 68 ms^{-1} and is fired at an angle of 11° to the horizontal.

Air resistance has negligible effect on the motion of the arrow.

Describe how the kinetic energy of the arrow changes during its journey from when it is fired until it reaches its maximum height.

.....

.....

(2 marks)

(b) Show that the time taken for the arrow to reach its maximum height is about 1.3 s.

.....

.....

(2 marks)

(c) The arrow misses the target.

Calculate the horizontal distance, measured along the base line, by which the arrow misses the target.

horizontal distance = ... m

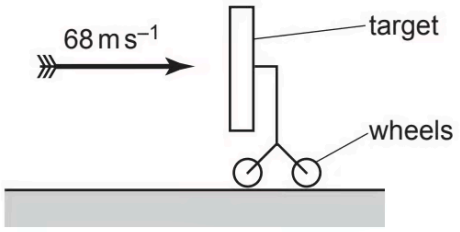
.....

.....

.....

(3 marks)

(d) The arrow is now fired horizontally at 68 m s^{-1} into the target at very close range.



The arrow sticks into the target. The collision between the arrow and the target is inelastic.

i) Explain what is meant by an **inelastic collision**.

[1]

ii) The target is mounted on wheels. The target has a much larger mass than the mass of the arrow.

Using ideas of momentum, explain the velocity of the target immediately after the arrow sticks into the target.

[2]

.....

.....

(3 marks)

Hard Questions

1 (a) A car is travelling along a straight road at 18 ms^{-1}.

The driver sees an obstacle and after 0.50 s applies the brakes. The **stopping** distance of the car is 38 m.

Calculate the magnitude of the deceleration of the car when the brakes are applied.

deceleration = ... ms^{-2}

(3 marks)

(b) A student rolls a marble at different speeds on a carpet to model the braking of a car.

The student wishes to investigate how the total distance x travelled before the marble stops (braking distance) depends on its initial speed v. The speed v and distance x are related by the equation $\frac{1}{2}mv^2 = Fx$ where m is the mass of the marble and F is the constant frictional force acting on the marble.

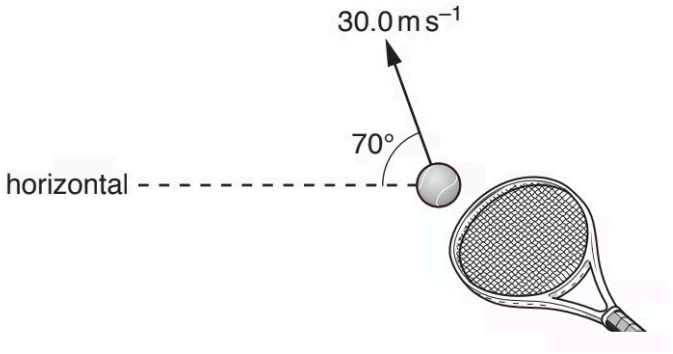
- Describe how an experiment can be conducted in the laboratory to investigate the relationship between v and x.
- Explain how the data can be analysed to determine F.

(6 marks)

2 (a) A tennis ball is struck with a racket.

The initial velocity v of the ball leaving the racket is 30.0 m s^{-1} and it makes an angle of 70° to the horizontal as shown in Fig. 16.

Air resistance is negligible



i) Calculate the vertical component of the initial velocity of the ball.

vertical component = ...m s^{-1} **[1]**

ii) Use your answer in **(i)** to show that the ball reaches a maximum height *h* of about 40 m.

h = ... m **[2]**

iii) Explain why the kinetic energy of the ball is not zero at maximum height.

[1]

iv) The mass m of the ball is 57.0 g.

Calculate the kinetic energy E_k of the ball when it is at its **maximum** height.

E_k = ... J **[2]**

(6 marks)

(b) A metal ball is rolled off the edge of a horizontal laboratory bench. The initial horizontal velocity of the ball is *v*. The ball travels a horizontal distance *x* before it hits the level floor.

Use your knowledge of projectile motion to suggest the relationship between *v* and *x*. Describe how an experiment can be safely conducted to test this relationship and how the data can be analysed.

(6 marks)