

## Projectiles and Satellites Questions – NAT 5

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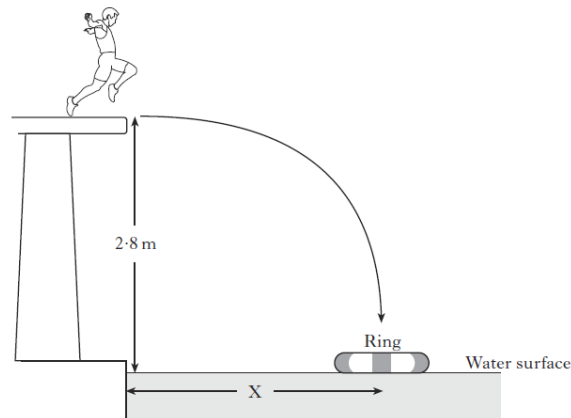
1) An astronaut drops a steel ball bearing on to the surface of the Moon from rest. The Moon has a gravitational field strength of  $1.6\text{Nkg}^{-1}$ .

It takes 1.4s for the ball bearing to hit the surface of the Moon.

- a) Calculate the **vertical speed** of the ball bearing just before it hits the Moon's surface.
- b) If the astronaut throws the ball bearing horizontally from the same height, then how long does it take the ball bearing to fall on to the Moon's surface? **Explain your answer.**

2) In a TV game show, contestants are challenged to run off a horizontal platform, and land in a rubber ring that is floating in a swimming pool.

The platform is 2.8m above the water surface.



a) A contestant has a mass of 60kg.

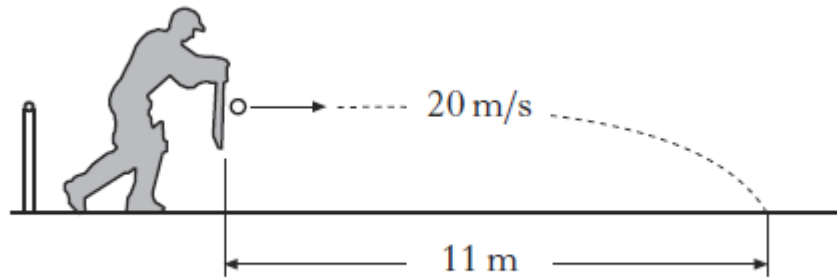
He runs off a platform with a horizontal velocity of  $3\text{ms}^{-1}$  and takes 0.85s to reach the water surface in the centre of the ring.

- i) Calculate the **horizontal distance X** from the poolside to the centre of a ring.
- ii) Calculate the **vertical velocity** of the contestant as he reaches the water surface.

b) Another contestant has a mass of 70kg.

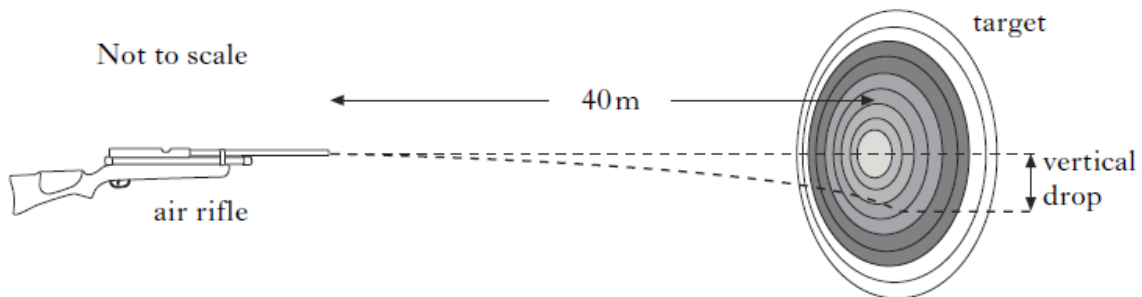
Will he need to run faster, slower or with the same horizontal velocity as the first contestant to land in the ring? **Explain your answer.**

- 3) A cricketer strikes a ball. The ball leaves his bat at  $20\text{ms}^{-1}$  and it hits the ground at a point 11m from where it was struck.



- Calculate the **time** of flight of the ball.
- Calculate the **vertical speed** of the ball as it hits the ground.
- Sketch a graph** of the vertical speed against time of the ball putting numerical values on both axes.
- Calculate the **vertical distance** travelled by the ball during its flight.
- Explain** why the ball will not travel 11m in this shot in practice.

- 4) At a firing range a pellet is fired horizontally at a target 40m away.

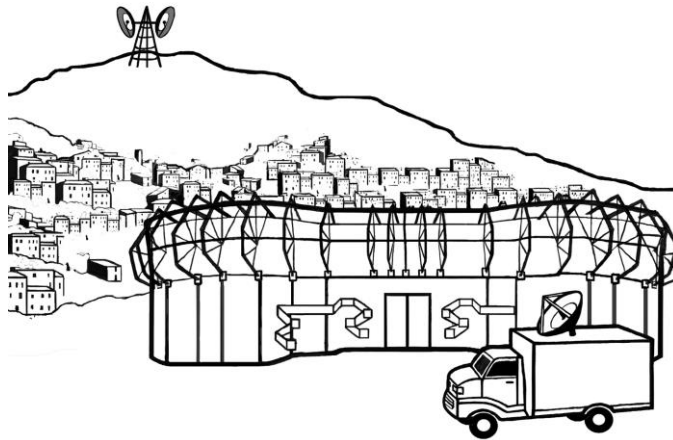


If the pellet takes 0.25s to reach the target, then calculate or find:

- Horizontal velocity** that the pellet leaves the gun with.
  - Horizontal velocity** that the pellet hits the target with.
- The **vertical velocity** that the pellet hits the target with.
- The **vertical drop** shown in the diagram.

5) A football match is being broadcast live from Dundee. Signals from the football stadium are transmitted to a television studio in Glasgow via a relay station on top of a nearby hill.

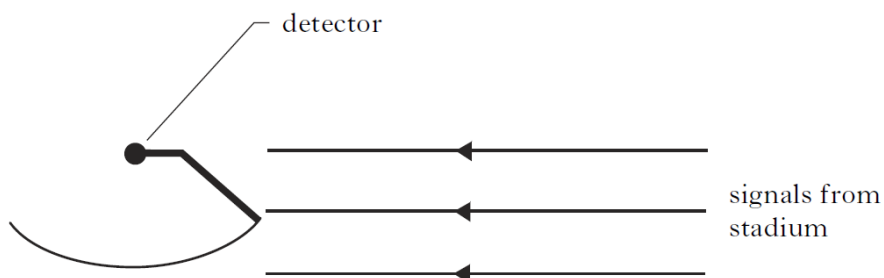
At the relay station a curved reflector is placed behind a detector of the television signals.



a) i) **State the purpose** of the curved reflector.

ii) **Complete the diagram** below to show the effect of the curved reflector on the signal at the relay station.

b) During the match, strong winds cause the reflector to move to a new position as shown.



**State the effect** that this has on the signal received at the detector.

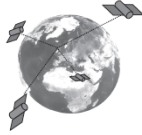
6) A live debate in the Houses of Parliament is transmitted from London to Washington via a satellite.

The satellite is in a geostationary orbit and the signals are transmitted by microwaves.

The frequency of the microwaves being used is 12GHz.

**Calculate the wavelength** of the microwaves.

7) A satellite navigation system receives radio signals transmitted by satellites in orbit around the Earth.



The satellite navigation system finds its location by calculating the distance the transmitted signals travel.

- a) In addition to the speed of the signals, **what other quantity** must be known to calculate the distance?
- b) i) **What do** radio waves transfer?
  - ii) What speed do the radio waves travel at and how does this compare to the speed of sound?
  - iii) What does the **period** of a satellite **depend on**?
- c) A curved reflector is often used to make the signals received from a satellite stronger.

**Complete the diagram below** to show the effect of the curved reflector on the transmitted signals.



8) Two next door neighbours are watching a live football match on television.

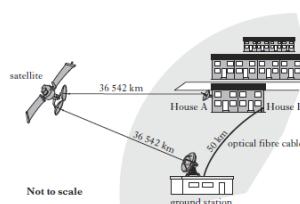
Signals are sent at the same time to a geostationary satellite and to an optical fibre system.

**House A** receives the signal using a **satellite dish** while **house B** uses an **optical fibre cable**.

- a) **State** what is meant by a geostationary satellite.
- b) **What is** an optical fibre?
- c) **Complete the table below** by entering the speed of each signal.

Signal	Transmission speed in m/s
Satellite	
Optical fibre	

d) The distance travelled by each signal is shown on the diagram below.



One neighbour hears cheering from the house next door before seeing a goal scored.

**Calculate the time delay** between hearing the cheer and seeing the goal scored.

9) A satellite sends microwaves to a ground station on Earth.



a) The microwaves have a wavelength of **60mm**.

i) **Calculate the frequency** of the waves.

ii) **Determine the period** of the waves.

b) The satellite sends radio waves along with the microwaves to the ground station.

Will the radio waves be received by the ground station **before, after** or at the **same time** as the microwaves?

c) When the microwaves reach the ground station they are received by a curved reflector.

**Explain using a diagram** why a curved reflector is used.