Practice Question Set For A-Level
Subject : Physics
Paper-1 Topic : 6_ Further Mechanics

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Name of the Student:_____
Max. Marks : 22 Marks **Time : 22 Minutes**

Q1.

Over one hundred years ago, Rutherford supervised a series of experiments using a source of alpha particles and thin gold foil.

The initial kinetic energy of an alpha $\left({}^{4}_{2}\alpha\right)$ particle is 7.3×10^{-13} J.

(i) In a textbook, it states that an alpha particle with this energy would be brought to rest when it reached a distance of 5.0×10^{-14} m from the centre of the gold nucleus $\left({}^{197}_{79}\mathrm{Au}\right)$.

Deduce whether this statement is correct.

(4)

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(ii) Determine the initial momentum of the alpha particle.

(3)

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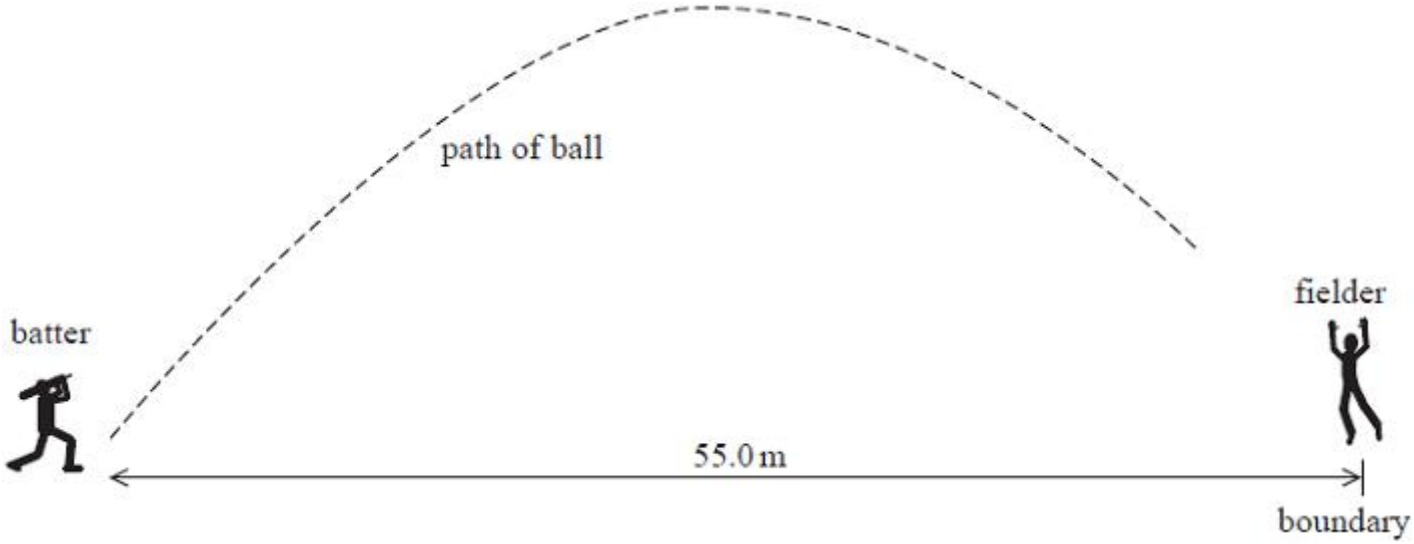
Initial momentum = ...

(Total for question = 7 marks)

Q2.

In cricket a fielder is often placed at the boundary edge as shown. If the fielder catches the ball, the batter is out.

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The ball was bowled. Just after the bat hit the ball, the ball had a velocity of 23.8 m s^{-1} at an angle of 50° to the horizontal.

(i) Show that the magnitude of the momentum of the ball, after it was hit, was about 3.3 N s.

mass of cricket ball = 0.140 kg

(1)

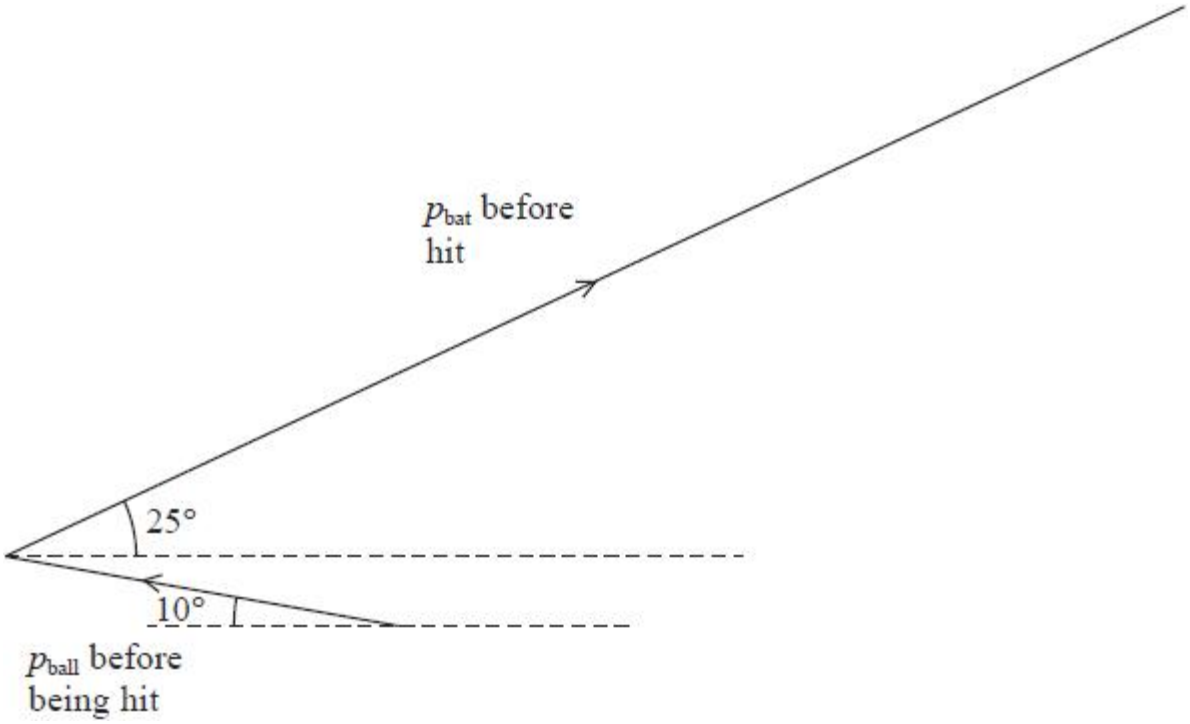
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(ii) The vector diagram below shows, accurately to scale, the momentum of the ball and the momentum of the bat before the hit.

Determine, by completing the vector diagram, the momentum of the bat after it hit the ball.
momentum of bat before hitting ball = 15.0 N s at 25° to the horizontal
momentum of ball before hitting bat = 4.6 N s at 10° to the horizontal

(5)



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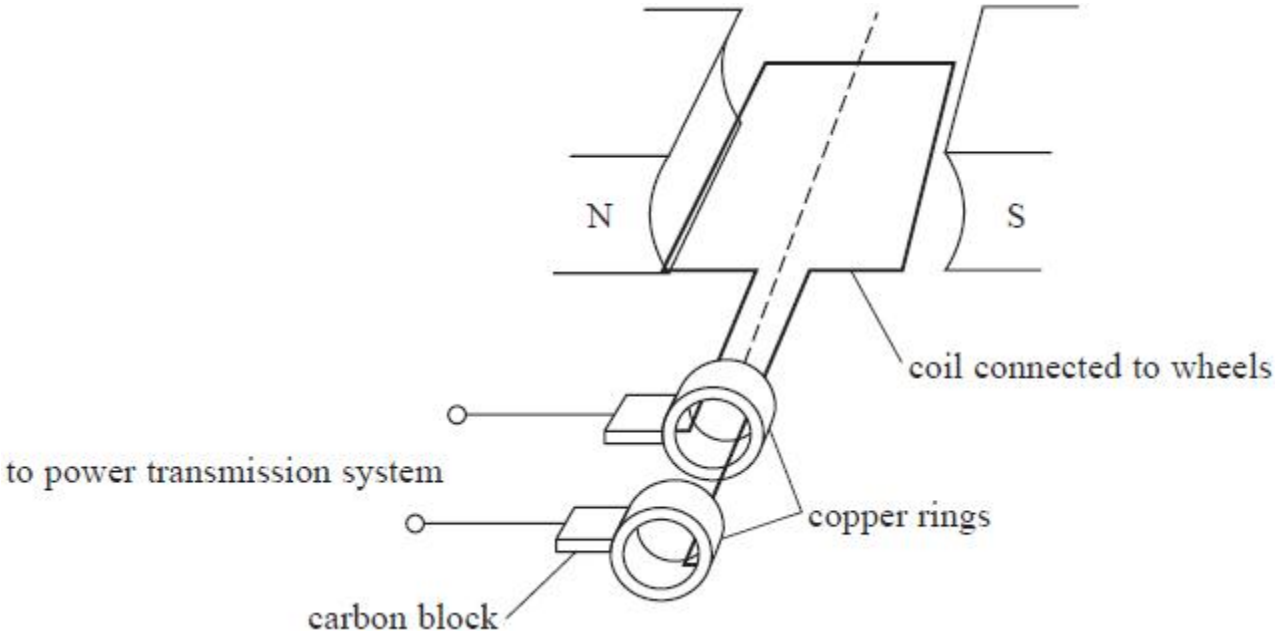
Momentum of bat after hitting ball = ...

at an angle of ..... to the horizontal

(Total for question = 6 marks)

Q3.

Regenerative braking supplies a current back to the power transmission system whilst slowing a vehicle. The arrangement shown can be used as a regenerative braking system on a train.



The coil rotates with the wheels of the train. Two copper rings are connected to the ends of the coil. The rings rotate with the coil and two carbon blocks make electrical contact with the rings as they rotate.

On curved tracks there is a maximum safe speed for the train.

(i) Explain why there is a maximum safe speed for a train travelling on a curved track.

(4)

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(ii) When the train travels at 200 km hour^{-1}, the minimum safe radius of curvature of the track is 1800 m.

Calculate the minimum safe radius of curvature for a speed of 360 km hour^{-1}.

(2)

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Minimum safe radius of curvature = ...

(Total for question = 6 marks)

Q4.

Astronauts on the 1971 Apollo 14 mission to the Moon brought back many rock samples. It is now believed that one of these contains a piece of rock that originated on Earth about 4 billion years (4×10^9 years) ago.

The piece of rock is believed to have been launched into space when an asteroid struck the Earth.

Four billion years ago, the Moon had a different orbital period, because it was closer to the Earth than it is today.

Calculate the period of the Moon's orbit four billion years ago, when the radius of its orbit was 1.34×10^8 m.

mass of Earth = 5.97×10^{24} kg

(3)

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Period = ...

(Total for question = 3 marks)

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