

91171



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if you have NOT written in this booklet

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Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 2 Physics 2025

91171 Demonstrate understanding of mechanics

Credits: Six

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of mechanics.	Demonstrate in-depth understanding of mechanics.	Demonstrate comprehensive understanding of mechanics.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

Make sure that you have Resource Sheet L2–PHYSR.

In your answers use clear numerical working, words, and/or diagrams as required.

Numerical answers should be given with an appropriate SI unit.

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–16 in the correct order and that none of these pages is blank.

Do not write in the margins (✂✂✂). This area will be cut off when the booklet is marked.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

QUESTION ONE: ACCELERATION

A rugby player accelerates uniformly from rest at 0.680 m s^{-2} and runs 22.0 m.



Source: <https://www.odt.co.nz/sport/rugby/black-ferns-sevens-win-cape-town>

- (a) How long did it take to run the 22.0 m?

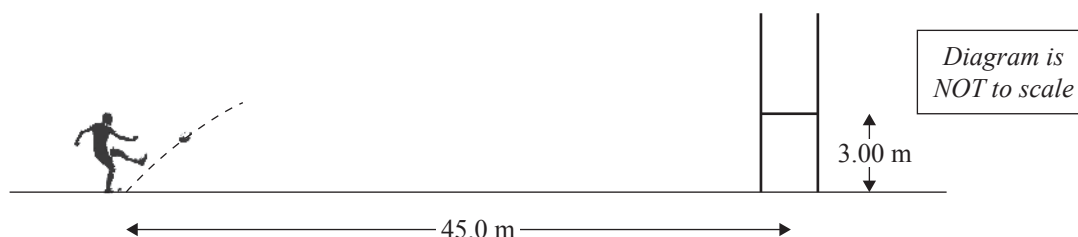
- (b) While stopping, a player runs into a tackle bag at speed v . The tackle bag compresses a distance x like a spring as the player comes to a stop.



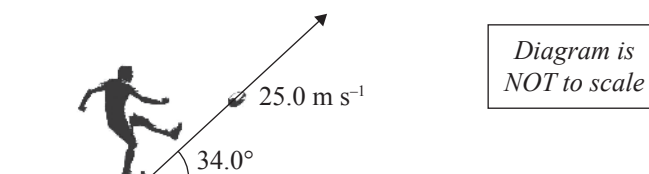
Source: <https://www.canterburysports.co.nz/product/silver-fern-tackle-bag-junior/>

Assuming all the player's energy is transferred to the bag, state and justify what would happen to the distance the bag was compressed if the player was moving at twice the speed.

- (c) To take a penalty shot, the ball is placed on the ground and kicked towards the goal posts. To make the penalty shot, the ball must go over the crossbar, which is 3.00 m above the ground and 45.0 m from where the ball is kicked.



A player taking a penalty shot kicks the ball at 25.0 m s^{-1} at 34.0° to the ground.



By performing appropriate calculations, decide whether the ball makes it over the crossbar before hitting the ground.

QUESTION TWO: MOMENTUM

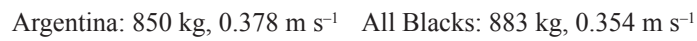
A 80.0 kg player moves at 4.30 m s^{-1} .

- (a) Calculate the player's momentum and give the correct unit.

Momentum: _____ Unit: _____

- (b) Explain why using momentum to study collisions is more useful than using kinetic energy.

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Calculate the speed and direction of the combined scrums immediately after they collide and stick together.

- (d) The ball comes out of the scrum and a player sprints towards the line. The player is tackled and brought to a stop by colliding with thick pads (cushions) that are on the bottom of the goalpost.



Source: <https://www.perennial.co.nz/products/rugby-post-pads>

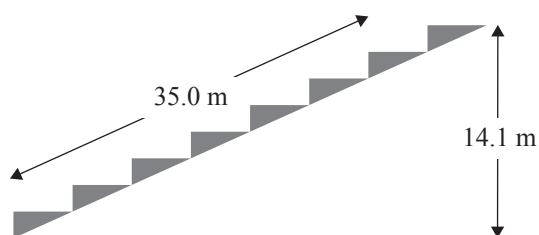
Explain how having these pads on the post help protect a player when they collide with the post.

QUESTION THREE: ENERGY

When warming up, players run up the stairs.



Source: <https://www.abc.net.au/news/2016-10-07/top-three-exercises-youre-probably-doing-wrong/7909150>



- (a) Calculate the work done by a 68.3 kg player who runs up the stairs once.

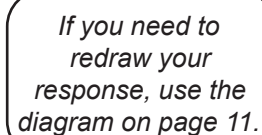
- (b) Another warm up activity is short sprints.

During one sprint, the 68.3 kg player accelerates from rest to 7.52 m s^{-1} in 4.35 s.

Calculate the average power produced by the player during this sprint.



Source: <https://www.bbc.com/sport/rugby-union/61819827>



- Add labelled arrows to the above diagram, to show all the forces acting on the bench.
- By calculating torques about support A, calculate the value of the forces acting on the bench at A and B.

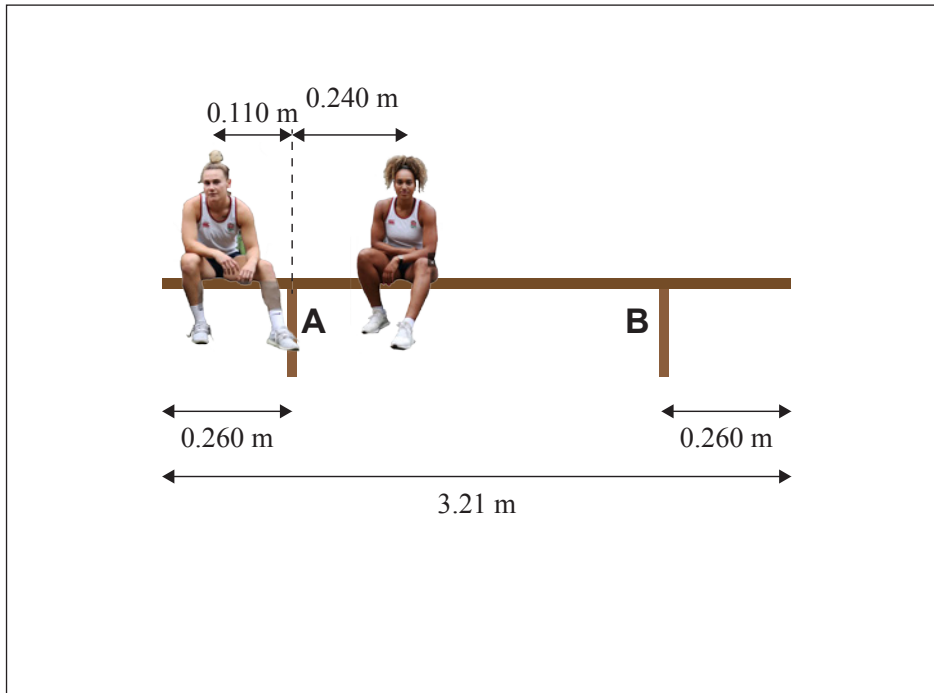
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- Figure A**
- Figure B**

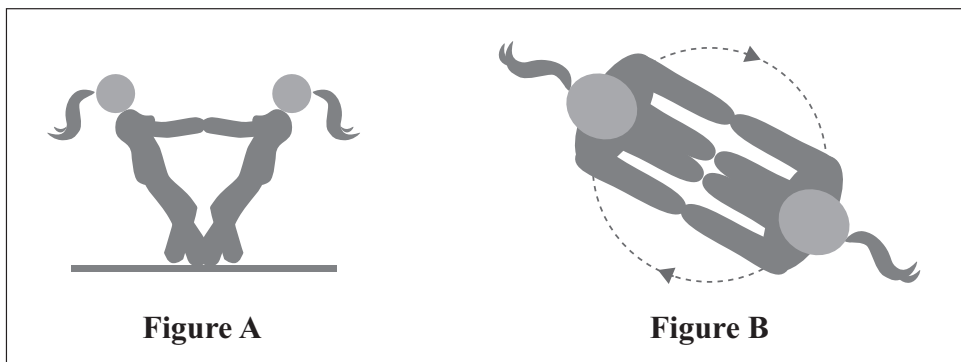
- Add an arrow to the Figure B above to show the direction of acceleration on one of the players.
- Explain how it is possible for the players to be moving at a constant speed yet accelerating.

SPARE DIAGRAMS

If you need to redraw your response to Question Three (c), use the diagram below. Make sure it is clear which answer you want marked.



If you need to redraw your response to Question Three (d), use the diagram below. Make sure it is clear which answer you want marked.



**Extra space if required.
Write the question number(s) if applicable.**

QUESTION
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