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NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 2 Physics, 2012

91171 Demonstrate understanding of mechanics

2.00 pm Wednesday 14 November 2012
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 space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–10 in the correct order and that none of these pages is blank.

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

TOTAL

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You are advised to spend 60 minutes answering the questions in this booklet.

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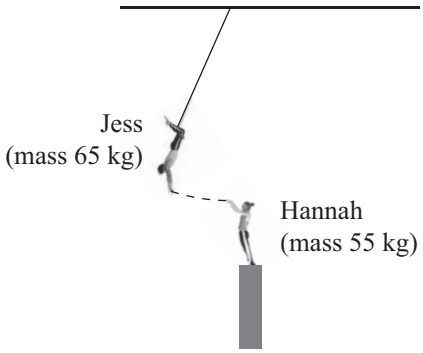
QUESTION ONE: THE TRAPEZE

Jess is a trapeze artist at the circus. As part of her act she hangs on a long rope and swings downwards. When she gets to the lowest point she grabs onto Hannah and they keep moving together.

Jess has a mass of 65 kg.

Hannah has a mass of 55 kg.



(a) Name the important quantity that is conserved as Jess swings down.

(b) Name the important quantity that is conserved as Jess grabs onto Hannah and they move together.

(c) Immediately after Jess grabs Hannah, they move together at a speed of 5.5 m s^{-1}.

Calculate the **vertical height** that Jess dropped down.

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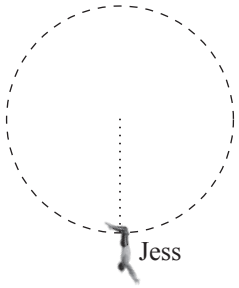
(d) In the diagram below draw an arrow to show the direction of the tension force when Jess is at the lowest point in her swing.



(e) Jess is moving in a circular path. When she gets to the lowest point in her swing, and just before she grabs onto Hannah, the tension force in the rope is **greater** than the gravity force acting on her.

Explain why.

QUESTION TWO: THE SEE-SAW

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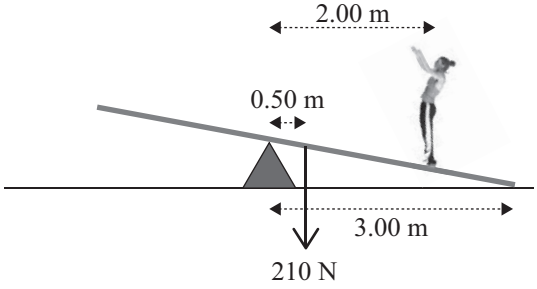
In their next act, Hannah (55 kg) stands on a see-saw. The see-saw has a weight of 210 N.



(a) Calculate the **size** and **direction** of the force that the floor exerts on the **right hand** end of the see-saw.

All distances are shown on the diagram.

($g = 9.8$ m s^{-2})

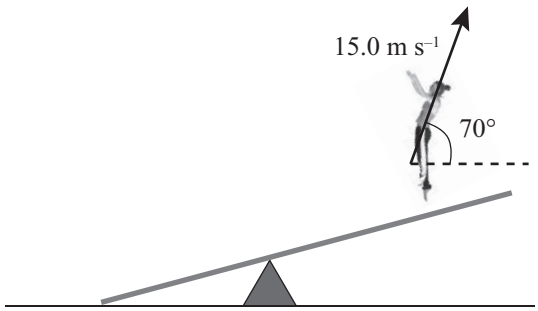
direction of the force _____

(b) Round your answer to part (a) to the correct number of significant figures.

State the reason for your choice of significant figures in part (a).

Jess drops vertically onto the other end, causing Hannah to be thrown into the air.

When Jess lands on the see-saw, Hannah is thrown into the air at a speed of 15.0 m s^{-1}, at an angle of 70º to the horizontal as shown in the diagram.



(c) Calculate the time that Hannah takes to reach the highest point of her trajectory.

(d) When Hannah takes off, the horizontal component of her velocity is 5.1 m s^{-1}.

State the **size** and **direction** of her velocity at the highest point.

Explain your answer.

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QUESTION THREE: THE ELASTIC ROPE

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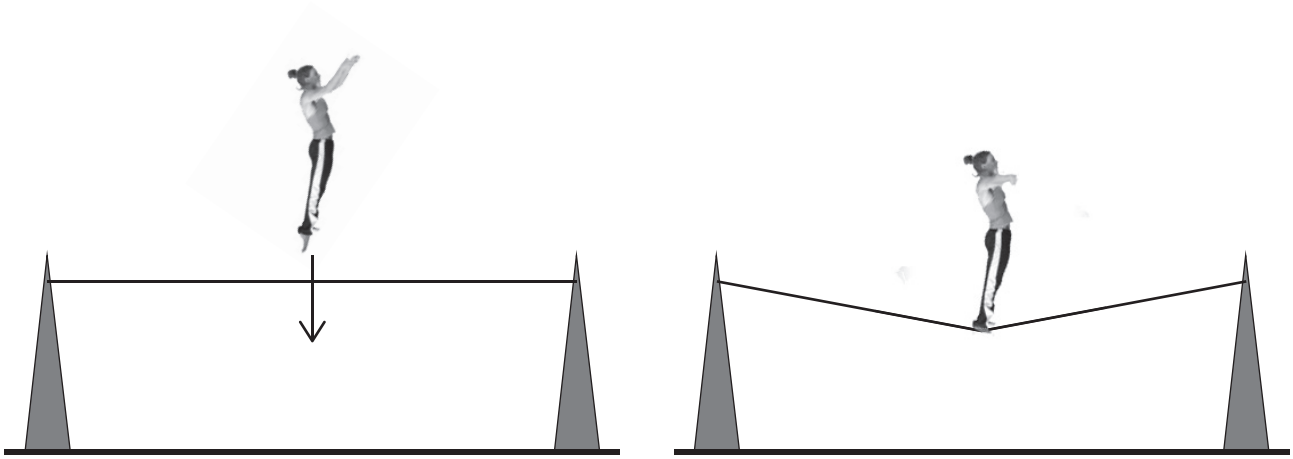
In the second part of her act, Hannah flies through the air and lands on an elastic rope, which is held under tension between two supports, as shown in the diagram below.



(a) Name the main energy changes that occur as Hannah is falling AND as she is coming to a stop.

Falling _____ → _____

Stopping _____ → _____

(b) Hannah doesn't like the rope to be too tight when she lands on it.

State the direction of the force on her from the rope.

Explain, in terms of the force acting on Hannah, why the rope should not be too tight when she lands on it.

Direction of force: _____

Explanation: _____

_____

_____

_____

(c) An elastic rope is suspended from a beam so that it is hanging vertically down. Hannah hangs vertically down on the elastic rope. The rope is stretched 0.60 m below its normal position when Hannah hangs from it.

Calculate the elastic potential energy stored in the elastic rope.

(Hannah has a mass of 55 kg.)

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QUESTION FOUR: CHARLIE THE CLOWN

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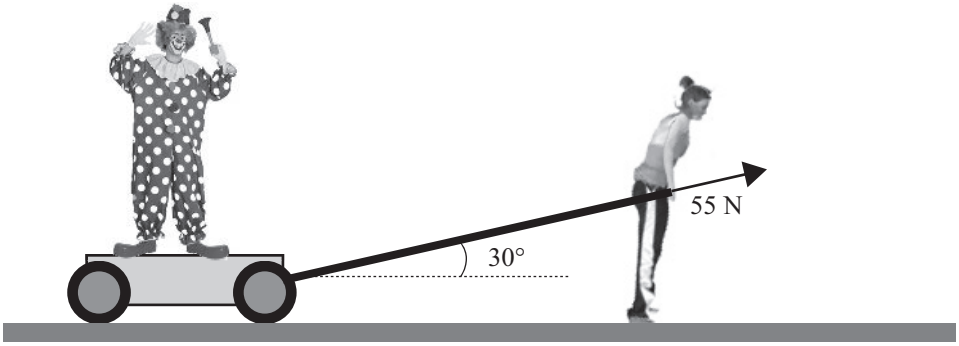
The Clown makes his entrance riding on a cart pulled by Hannah. The clown and cart have a combined mass of 85 kg. The handle of the cart makes an angle of 30º to the horizontal as shown in the diagram below. Hannah applies a force of 55 N to the handle.



(a) Calculate the size of the **horizontal component** of the force on the handle.

(b) The cart is in equilibrium.

- State what "equilibrium" means in terms of the forces acting.
- Describe what it tells you about the velocity of the cart.
- On the diagram above, draw **labelled arrows** showing the direction of any non-vertical forces acting on Hannah.

(c) Explain how Hannah can make the cart and clown accelerate **without** changing the **size** of the force she exerts on the handle. (Reducing friction is not a possibility.)

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

QUESTION NUMBER

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