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NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

SUPERVISOR'S USE ONLY

Level 2 Physics, 2013

91171 Demonstrate understanding of mechanics

2.00 pm Wednesday 13 November 2013
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 2–8 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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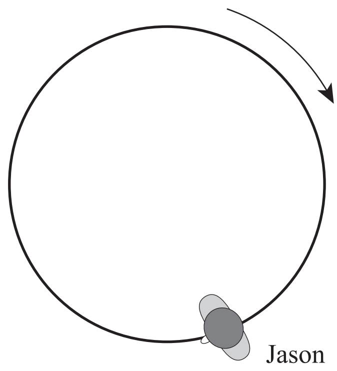
QUESTION ONE: MOTION

Jason spends a day at an amusement park.

He stands on a merry-go-round, which turns at a constant speed.

The diagram below shows Jason standing on the merry-go-round, which is going around in a clockwise direction.



(a) On the diagram above, draw an arrow on Jason to show the direction of his velocity at that point.

(b) The radius of the merry-go-round is 4.0 m. The merry-go-round takes 15 s to do a complete circle. Jason has a mass of 65 kg.

Calculate the centripetal force needed to keep Jason moving in a circle.

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(c) Jason then goes for a ride on a go-kart. Towards the end of the ride, he decelerates at 2.5 m s^{-2} and comes to a stop in 4.2 seconds.

By calculating Jason's initial velocity, determine the distance he travels while coming to a stop.

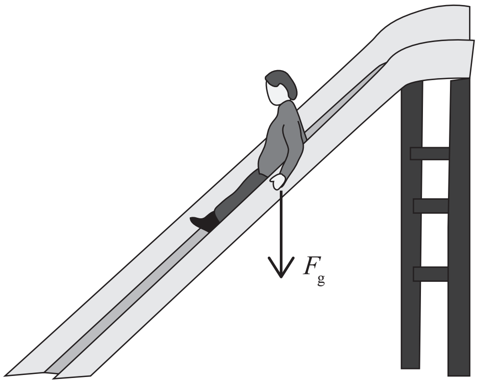
(d) Jason sits on a slide, as shown in the diagram on the right.

He is sliding down at **constant** speed.

(i) State the size of the **net** force on Jason.

(ii) On the diagram on the right, draw the remaining forces (as labelled vectors) acting on Jason.

F_g has been drawn for you.



(iii) Complete and label the **vector addition** diagram of the forces acting on Jason.

(He continues to slide at constant speed.)

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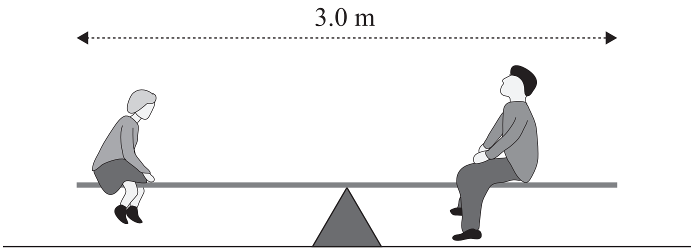
QUESTION TWO: FORCES AND MOTION

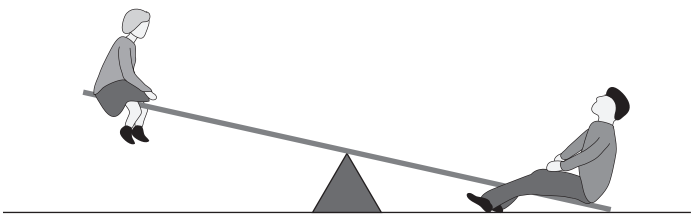
The diagram below represents a **see-saw** on a pivot at its **centre** with Jane and her dad sitting on opposite sides such that the see-saw is in equilibrium. The mass of the see-saw itself is 60 kg.

(a) On the diagram below, draw labelled vectors to show all the forces acting on the see-saw.



(b) Jane and her dad move to opposite ends of the see-saw.

The diagram below shows what happens when Jane sits at one end of the see-saw while her dad sits at the other end.



Jane's mass	=	30 kg
Jane's dad's mass	=	72 kg
mass of see-saw	=	60 kg
length of see-saw	=	3.0 m

Calculate the size of the support force from the ground at the end where Jane's dad sits.

Round your answer to the correct number of significant figures.

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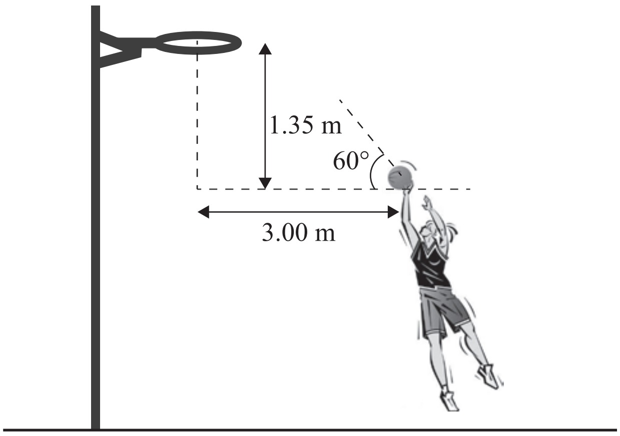
Hillary attempts to throw a basketball into a hoop.

(c) Explain the effect of the force(s) acting on the ball, once it has left Hilary's hand until it reaches maximum height.

You may ignore the effects of air resistance.

(d) On another occasion, Hillary stands 3.0 metres from the hoop. She throws a ball with an initial velocity of 6.5 m s^{-1} at an angle of 60° to the horizontal. The hoop is 1.35 m above the bottom of the ball when it is thrown initially.



Carry out calculations to determine whether or not the ball will go through the hoop.

Begin your answer by calculating the horizontal and vertical components of the initial velocity of the ball.

QUESTION THREE: MOMENTUM AND ENERGY

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Each bumper car has a rubber bumper all round it.

(a) The mass of a bumper car is 240 kg. Jason has a mass of 65 kg and is travelling at a speed of 2.4 m s^{-1}.

Calculate the size of the momentum of Jason and his bumper car.

(b) The bumper cars are designed to minimise injury.

Discuss the reasons for the bumper cars having rubber bumpers all round them.

Assume cars with and without bumpers have the same mass. Assume change in velocity is the same with and without bumpers.

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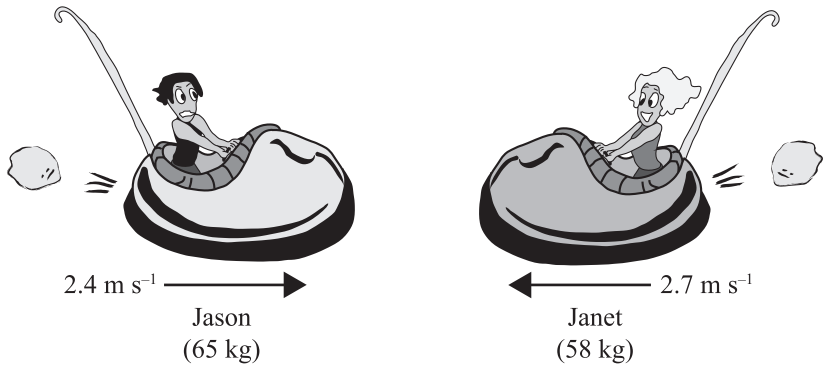
(c) Jason collides head-on with Janet who is in another bumper car. The bumpers don't work properly and after collision both cars lock together. The mass of each bumper car is 240 kg. Jason has a mass of 65 kg and Janet has a mass of 58 kg. They are travelling towards each other in opposite directions, Jason with a speed of 2.4 m s^{-1} to the right and Janet with a speed of 2.7 m s^{-1} to the left.



Calculate their combined velocity after collision.

Include a direction with your answer.

(d) The rubber bumper in Jason's bumper car has a spring constant of 78 000 N m^{-1}. On one occasion he collides with the wall, causing a compression of 15 cm.

(i) Calculate the elastic potential energy stored in the rubber bumper.

(ii) Determine the impulse if the collision lasted for 0.80 s. Include a unit with your answer.

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

QUESTION NUMBER

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