NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 2 Physics, 2014

91171 Demonstrate understanding of mechanics

2.00 pm Tuesday 18 November 2014
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– 11 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

ASSESSOR'S USE ONLY

QUESTION ONE: BASKETBALL

Rachel is on her way to basketball practice. Her ball has a mass of 0.60 kg.

(a)   Rachel drops the ball from a balcony. It takes the ball 1.2 seconds to reach the ground.

Calculate the size of the **impulse** on the ball during the time it takes to fall.

(b)   Is the momentum of the **ball** conserved as it falls?

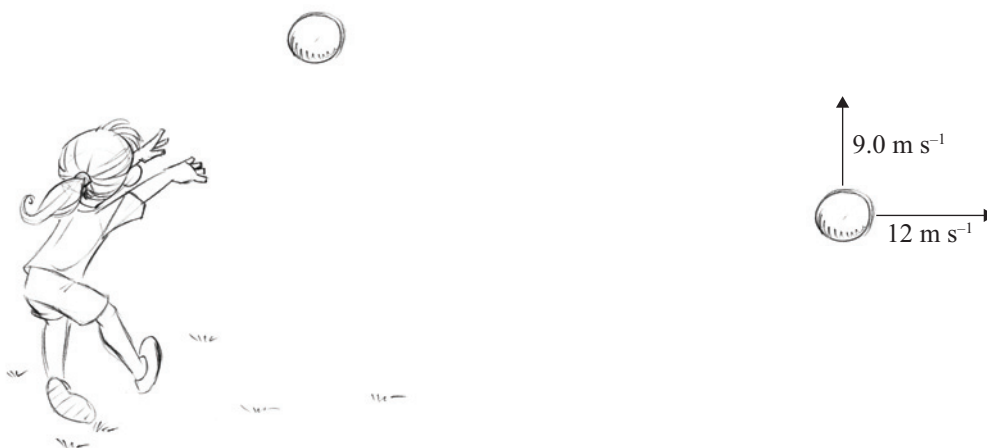Explain your answer with reference to the conditions required for momentum conservation.

(c)   Rachel throws the ball so it has a **vertical** component of velocity of 9.0 m s^{-1} and a **horizontal** component of velocity of 12 m s^{-1}, as shown in the diagram below.

9.0 m s^{-1}

12 m s^{-1}

State the size of the **vertical** component of velocity AND the **horizontal** component of velocity when the ball reaches the highest point.

Explain your answer.

You may ignore air resistance.

Vertical component = _____

Explanation: _____

_____

_____

_____

Horizontal component = _____

Explanation: _____

_____

_____

_____

(d) When the ball is compressed, it **acts** like a spring with a spring constant of 1200 N m^{-1}.

When Rachel throws the ball at the wall, the ball compresses a distance of 9.0 mm.

The ball has a mass of 0.60 kg.

- Calculate the elastic potential energy stored in the ball when it is momentarily stationary against the wall.
- Calculate the maximum possible speed at which the ball rebounds.
- State any assumptions you make.

Elastic potential energy stored: _____

_____

Maximum possible rebound speed: _____

_____

_____

_____

_____

Assumptions made: _____

_____

QUESTION TWO: AT THE GYM

Jamie is doing a workout. He is using a barbell with weights on it.
The total mass of the bar with the weights on it is 120 kg.

(a)   Calculate the work done on the bar if Jamie lifts it 0.55 m
vertically at constant speed.

_____

_____

(b)   Jamie puts the barbell on two supports and changes the weights on the bar. With no weights
on one end and a 30 kg weight on the other end, the support force provided by the right-hand
support is zero.

   •   Draw labelled arrows on the diagram showing the forces on the bar.

   •   Use the concept of torque to calculate the weight of the bar. Assume it is a uniform bar.

weight

15 cm

90 cm

bar

m = 30 kg
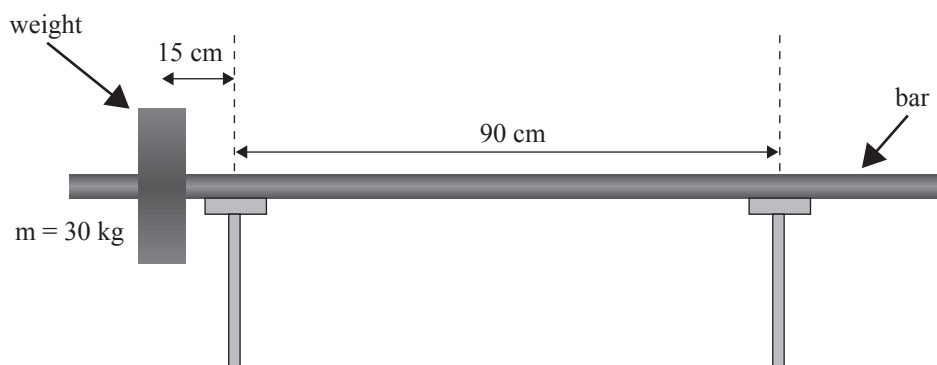
If you need to redraw your labels, use the spare diagram on page 9.

_____

_____

_____

(c)   After doing some weights, Jamie goes across to the punch-bag, which is a large bag hanging
from a chain. The bag has a mass of 35 kg. Jamie pulls the bag horizontally, using the rope
tied to a ring at the top of the bag, until the chain is at an angle of 30° to the vertical, as shown
in the diagram opposite.

   (i)   Draw the three forces acting on the ring at the top of the bag.

   (ii)   By drawing a vector addition diagram of the three forces acting on the ring at the top of
the bag, determine the size of the tension force on the chain.
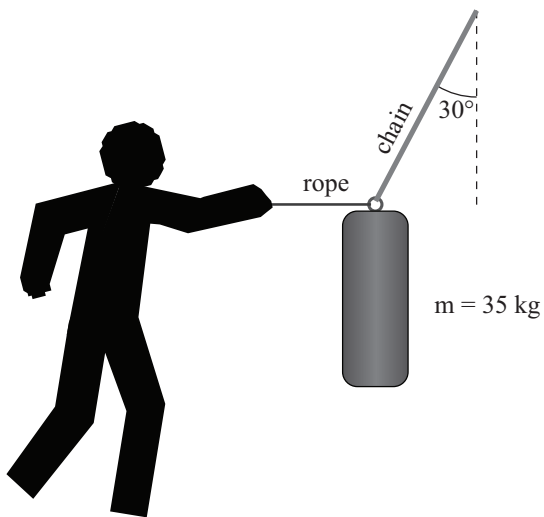
Vector diagram

If you need to redraw your diagram, use the spare diagram on page 9.

chain

30°

rope

m = 35 kg

_____

_____

_____

_____

_____

_____

_____

(d)   Jamie punches the bag horizontally. He then puts on a glove with thick padding and punches the bag again with the same velocity.

Discuss the difference between the two punches in terms of:

•   the stopping time of his fist

•   the force on the bag.

State any assumptions you make.

_____

_____

_____

_____

_____

_____

_____

_____

QUESTION THREE: SHAMILLA DRIVES TO THE GYM

Shamilla and her car have a combined mass of 1100 kg. She is driving at **constant velocity**.

(a)   Calculate the size of the vertical force the road produces on the car.

_____

_____

(b)   Shamilla says that 'even though the car is moving, it is in equilibrium'.

Explain what this statement means.

_____

_____

_____

_____

(c)   A short time later, Shamilla's car accelerates from a speed of 2.0 m s^{-1} to a speed of 22.0 m s^{-1}, covering a distance of 72 m.

Calculate the size of the average net force on the car while it accelerates.

_____

_____

_____

_____

_____

_____

(d) Shamilla drives her car at constant speed around a corner, and then drives over some ice, as shown in the diagram below. You can assume there is no friction between the ice and the tyres.

Shamilla's car

ice

- Describe the net force on the car (if any) before and after she reaches the ice.

- Explain how the net force (if any) affects the motion of the car before and after she reaches the ice.

QUESTION FOUR: SHAMILLA DRIVES HOME

Shamilla and her car have a combined mass of 1100 kg.

(a)   Calculate the total momentum of the car and Shamilla when the car has a velocity of 18 m s^{-1}.

Include the correct unit with your answer.

(b)   Calculate the size and the direction of the momentum change of the car as it slows from a velocity of 18 m s^{-1} to a velocity of 11 m s^{-1}.

(c)   Shamilla puts her foot on the brake, and the car slows down.

Explain the principle of energy conservation in this situation, and identify the transfer of energy caused by braking.

(d)   Calculate the average rate at which the brakes transfer energy as the car slows from a velocity of 18 m s^{-1} to a velocity of 11 m s^{-1} in a time of 6.0 s.
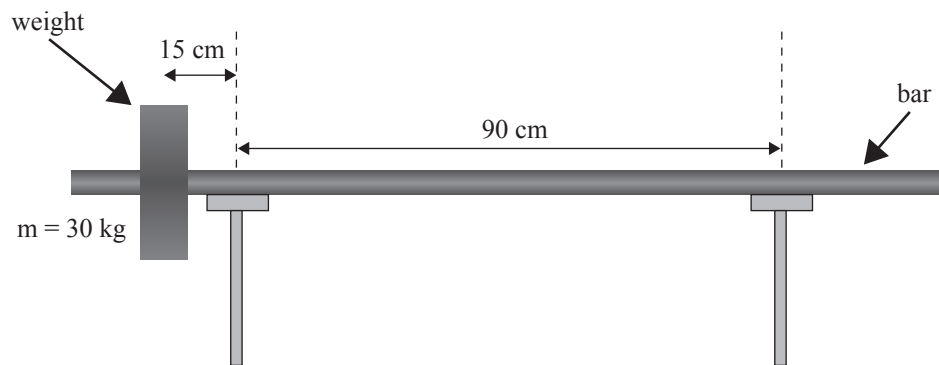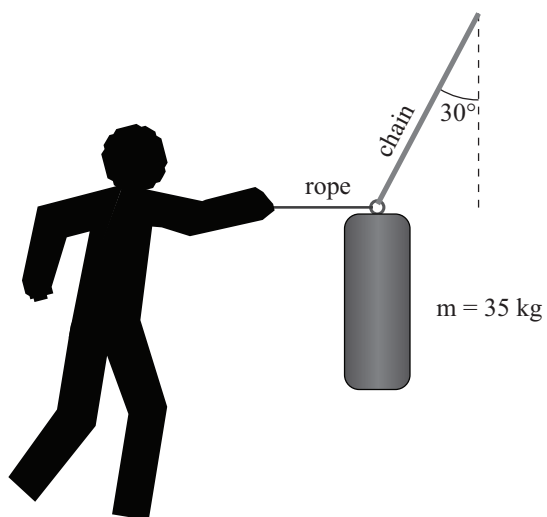
If you need to redraw your diagrams from Question Two, draw them below. Make sure it is clear which diagram you want marked.
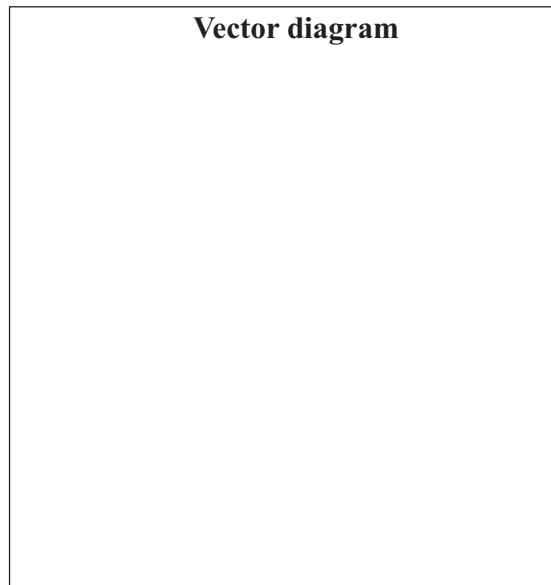
(b)

weight

15 cm

90 cm

bar

m = 30 kg

(c)

chain

30°

rope

m = 35 kg

Vector diagram

QUESTION
NUMBER

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

QUESTION
NUMBER

**QUESTION
NUMBER**

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

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