Name:_____

Assignment due:

St Patrick's College, Silverstream

Ni

PHYSICS

Mechanics Assignment 6

Circular Motion

Level 2

90255 Demonstrate understanding of mechanics

You may find the following formulae useful

$$v = \frac{\Delta d}{\Delta t} \qquad a = \frac{\Delta v}{\Delta t} \qquad v_f = v_i + at$$

$$d = v_i t + \frac{1}{2}at^2 \qquad d = \frac{v_i + v_f}{2}t \qquad v_f^2 = v_i^2 + 2ad$$

$$a_c = \frac{v^2}{r}$$

$$F = ma \qquad \tau = Fd \qquad F = -kx$$

$$F_c = \frac{mv^2}{r} \qquad p = mv \qquad \Delta p = F\Delta t$$

$$E_p = \frac{1}{2}kx^2 \qquad E_k = \frac{1}{2}mv^2 \qquad \Delta E_p = mg\Delta h$$

$$W = Fd \qquad P = \frac{W}{t}$$

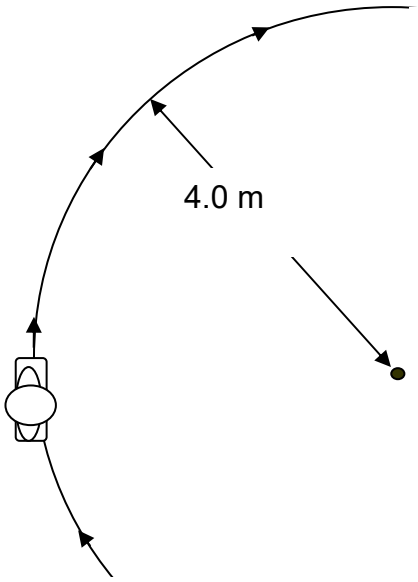
$g = 9.8 ms^{-2}$

NZIP 2008

QUESTION ONE: SKATEBOARDING

Rowena now gets back on her skateboard. She travels at a steady speed round the garden edging in a semi-circular path as shown in the diagram below.

(e) On the diagram below, draw an arrow to show the direction of the frictional force acting on the wheels of the skateboard that enables her to travel the semi-circular path.



The maximum frictional force acting on the wheels of the skateboard that enables Rowena to travel in the semi-circular path is 108 N. The radius of the circular path is 4.0 m. Rowena has a mass of 26.0 kg and the mass of the skateboard is 2.5 kg.

(f) Calculate the maximum speed at which Rowena and her skateboard can travel round the semi-circular path without slipping.

_____

_____

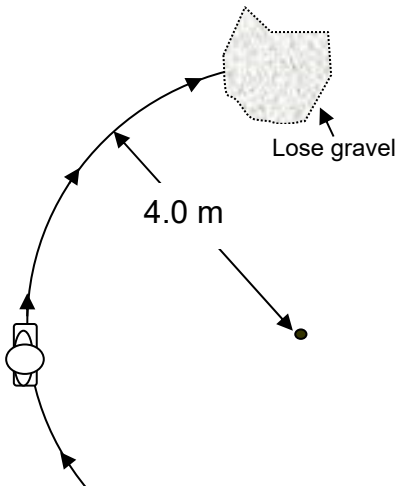
_____

_____

_____

speed = _____

As Rowena travels in the semi-circular path at the maximum speed she lands onto a patch of loose gravel which provides almost no friction.



(g) On the diagram above draw an arrow to show the direction of Rowena's travel as she lands on the patch of loose gravel. Explain why she travels in the direction as shown by your answer.

Explanation: _____

_____

_____

_____

_____

Later Rowena travels round another curved path at 1.5 times the speed in question (f). The maximum frictional force acting on the wheels of the skateboard is 108 N.

(h) Compare the radius of this curved path to that of in question (f).

_____

_____

_____

_____

_____

_____

_____

Assessor's use only

NZIP 2007

QUESTION TWO: CIRCULAR MOTION

Jeff is a water-skier. He is being pulled by a cable attached to a speedboat, at a constant speed v of 8.74 m s^{-1}, as he performs a circular turn of radius r equal to 20.6 m.

(a) Jeff is accelerating while performing the circular turn, though he is travelling at a constant speed. Explain clearly why this so.

(b) Describe the direction of Jeff's acceleration while performing the circular turn.

(c) Describe what provides the force acting on Jeff while performing the circular turn and state its direction.

(d) Calculate the value of Jeff's acceleration while performing the circular turn. Give the answer to the **correct number of significant figures**. Give the **correct unit**.

_____

_____

_____

_____

_____

(e) Jeff manages to complete a **half** circle in making the turn. Calculate the time taken to do this (The circumference C of a circle is given by the formula: $C = 2\pi r$).

_____

_____

_____

_____

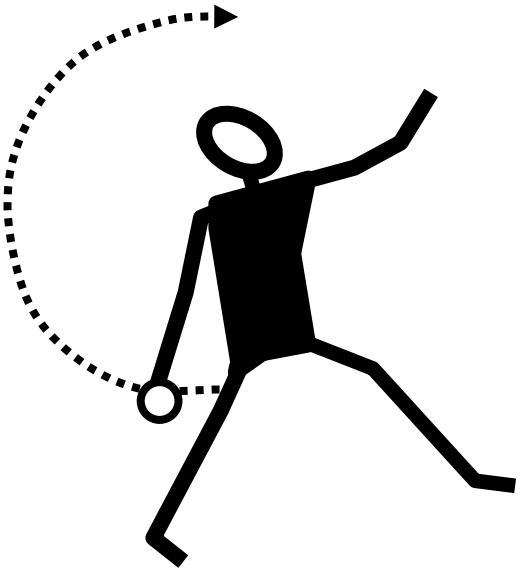
_____

NZIP 2006

Tamarah and Aaron went to a cricket match.

QUESTION ONE: THE OPENING BOWLER

(d) During the last stage of the bowling action the ball is moved in a circular path. Add arrows and labels to the diagram below to represent the ball's acceleration and velocity at the instant shown.



A bowler is not allowed to throw the ball when bowling. Hence, as the bowler bowls, his arm moves in a circle and he releases the ball at the appropriate instant.

(e) Explain the physics of this action that means the ball can travel from the bowler to the batter.

_____

_____

_____

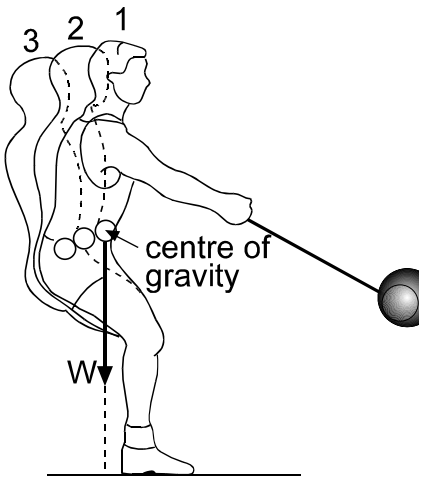
_____

_____

NZIP 2005

QUESTION TWO: The hammer throw

A 'hammer' is a ball of mass 7.26kg on the end of a wire and handle.



In a hammer throw event, an athlete spins three times on the spot, and in each spin, the hammer is made to move faster in a circular path. The illustration above shows three positions of the athlete. Position 1 is during the first spin and position 3 is in the last. It can be seen that the athlete must lean further back during each spin.

(a) Why must the athlete lean back further as the hammer gains speed?

_____

_____

_____

_____

(b) Calculate the tension in the wire, (i.e. the centripetal force on the hammer), when the ball has gained a speed of 25 ms^{-1}. Assume that the hammer is moving in a circle of radius 1.5 m.

_____

_____

_____

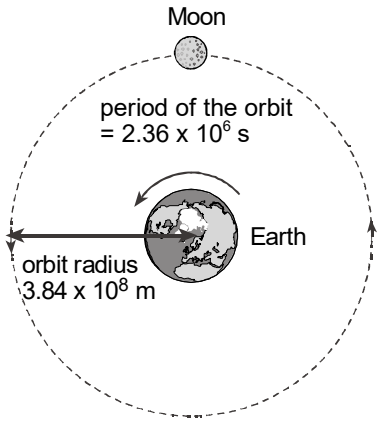
_____

_____tension = _____N

NZIP 2004

QUESTION FOUR: CIRCULAR MOTION

The diagram shows the Moon's circular orbit around the Earth. The radius of its orbit about the centre of the earth is **3.84 x 10^8 m**. The period of the orbit is **2.36 x 10^6 s**



(a) The Moon travels in its orbit with a **constant speed** but it has an **acceleration**. Give a clear explanation of why this is.

_____

_____

_____

_____

(b) Show that the **speed** of the Moon in its orbit is **1.02 x 10^3 m s^{-1}**. The circumference of a circle is **$2\pi r$**.

_____

_____

_____

(c) The mass of the moon is **7.30 x 10 ^{22} kg**. Calculate the **size** of the **centripetal force** acting on the Moon in its orbit.

_____

_____

_____

_____

_____

Force = _____

(d) State the **direction** of the centripetal force acting on the Moon in its orbit.

_____