To be completed by candidate

NSN

School Code

1

SUPERVISOR'S USE ONLY

92047

NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

Level 1 Physics Earth Space Science RAS 2022

92047 Demonstrate understanding of physics concepts in the taiao

PILOT ASSESSMENT

Credits: Five

Achievement	Achievement with Merit	Achievement with Excellence
Describe physics concepts in the taiao.	Explain physics concepts in the taiao.	Analyse physics concepts in the taiao.

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 of the questions in this booklet.

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 2–8 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (▨). This area may be cut off when the booklet is marked.

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

You may find the following formulae useful.

$$F = ma \qquad v = \frac{\Delta d}{\Delta t} \qquad a = \frac{\Delta v}{\Delta t} \qquad P = VI \qquad V = IR$$

$$P = \frac{E}{t} \qquad \Delta E_{\text{p}} = mg\Delta h$$

$$E_{\text{k}} = \frac{1}{2}mv^2 \qquad g = 10 \text{ m s}^{-2} \qquad g = 10 \text{ N kg}^{-1}$$

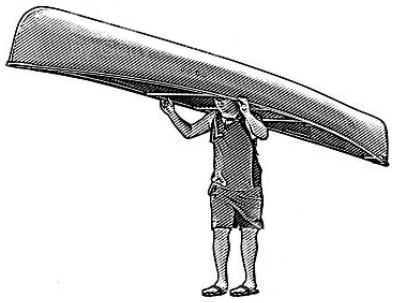
QUESTION ONE: SAM'S WAKA AMA

Waka ama is the New Zealand term for the sport of outrigger canoeing. The name distinguishes an outrigger canoe from other types of waka (canoes).

There are many types of waka, ranging from the single-seater W1 waka to the 12-seater W12 waka. Sam buys himself a carbon fibre waka, which is quite light. This is a one-man waka.

The waka is so light that Sam can lift it above his head.

(a) In the diagram below, draw labelled arrows to represent the forces acting on the waka while Sam is holding it.



https://www.istockphoto.com/illustrations/carrying-canoe

Sam then takes the waka to a nearby lake to practise.

(b) Sam paddles with enough force to cause him to speed up. His forward force is 121.5 N and the water creates a drag force of 29.8 N. The combined mass of Sam and his carbon fibre waka is 73.5 kg.

Show that the resultant force is 91.7 N, and **state its direction**.

(c) Calculate Sam's acceleration.

(d) Eventually, even though Sam paddles as hard as he can, the waka goes at a constant speed.

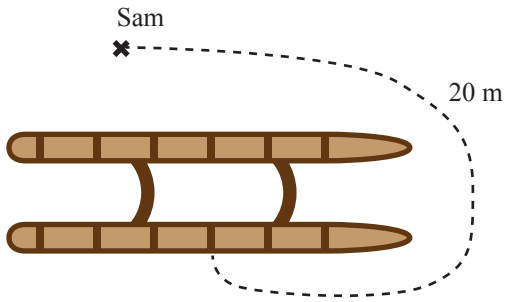
Explain, in terms of forces, why this happens.

(e) After practice, Sam secures his waka on his vehicle to go home. Sam jumps down to the ground after the waka is tied down. As Sam lands on the ground, there is an upwards reaction force acting on him.

Explain how the reaction force, while he lands on the ground, is different from the upwards reaction force that acted on him when he was standing on the back of his vehicle before he jumped.

QUESTION TWO: WAKA TANGATA

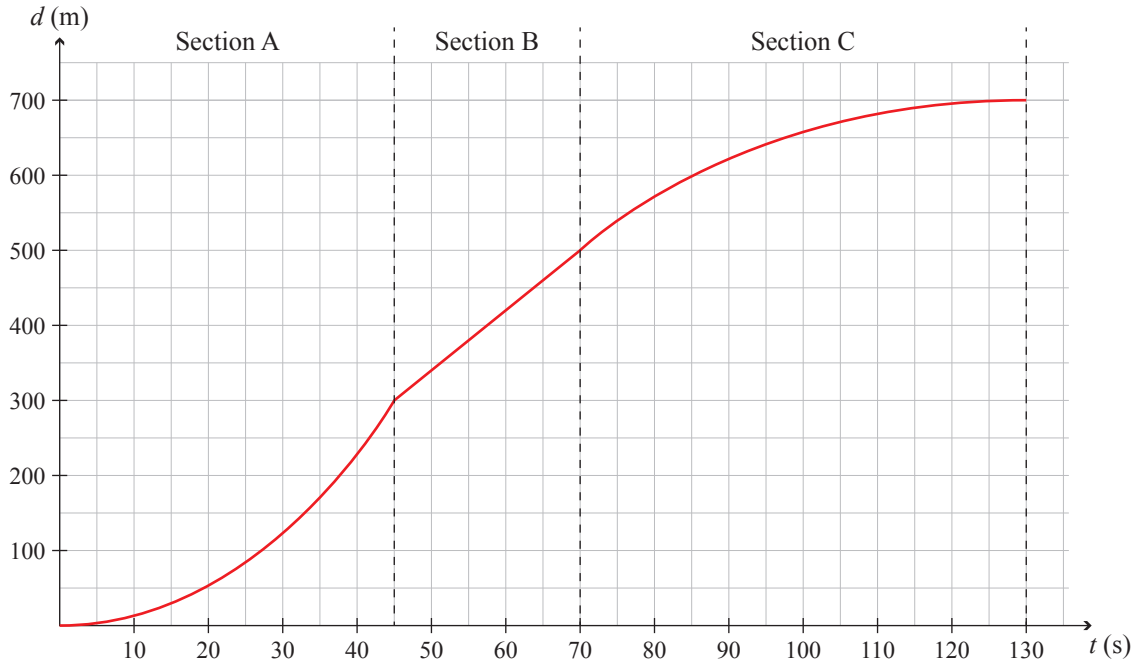
A waka tangata is a large waka built for educational purposes. Today, Sam and the other paddlers (kaihoe) go out on a waka tangata that seats twelve kaihoe. After karakia, Sam walks to his designated seat on the waka tangata. It is protocol (tikanga) not to step over the waka; he must walk around it.



(a) Sam walks with a speed of 1.7 m s^{-1}.

Refer to the diagram on the right to calculate the time it takes Sam to walk around the waka to his seat.

Later there is a 500 m race. The distance-time graph below describes the motion of the waka tangata before, during, and after the race.



(b) Describe the motion of the waka tangata in sections A, B, and C

Section A: _____

Section B: _____

Section C: _____

(c) Using the information from the graph, calculate the speed of the waka in section B (between 45 s and 70 s).

Show your working clearly.

(d) Show that the average speed of the waka between 0 s and 70 s is 7.1 m s^{-1}.

Explain why the average speed between 0 s and 70 s is different from the instantaneous speed at 60 s.

(e) Describe, in detail, the method you would use to calculate the acceleration of the waka between 20 s and 40 s from the distance–time graph shown opposite.

No calculations are necessary.

QUESTION THREE: WAKA AMA AND THE DRONE

Important waka ama competitions often involve one or more drones that film the waka on the water. A drone is a small, unmanned aircraft that uses several electric motors (pūkaha hiko) powered by a battery.

https://en.wikipedia.org/wiki/Quadcopter#/media/File:Quadcopter_camera_drone_in_flight.jpg

A particular drone has a mass of 0.625 kg. It is powered by six lithium-ion cells in series. Each cell provides 3.7 V.

(a) Show that the six cells combined in series provide 22.2 V.

(b) The drone rises slowly to be in position to film the waka.

Describe the energy changes as it moves directly upwards.

The drone has four 22.2 V electric motors (pūhaka hiko). They are connected in parallel to the battery.

(c) Explain, giving reasons, why the motors are connected in parallel to the battery, and not in series. You may draw diagrams to support your answer.

(d) One 22.2 V motor can draw a maximum current of 42.0 A.

Calculate its resistance.

(e) The drone climbs a vertical distance of 9.0 m. This takes a time of 2.1 s.

Show that the total current drawn from the battery is 1.2 A.

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

QUESTION NUMBER