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NZQA | Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 1 Physics, Earth and Space 2026

92047 Demonstrate understanding of a physical system using energy concepts

Credits: Five

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of a physical system using energy concepts.	Explain a physical system using energy concepts.	Analyse a physical system using energy concepts.

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.

Pull out Resource Booklet 92047R from the centre of this booklet.

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 2–16 in the correct order and that none of these pages is blank.

Do not write in the margins (▨). This area will be cut off when the booklet is marked.

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

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QUESTION ONE: ROLLER COASTERS

A motor pulls a roller coaster to the top of a hill. The roller coaster is then free to roll down to the bottom of the hill.



Adapted from: www.shutterstock.com/image-vector/children-ride-roller-coaster-sky-background-1969218523

(a) Explain all the energy changes to the roller coaster as it moves from the **top** of the hill until it is **halfway** from the bottom.

You may use diagrams or words to describe these changes.

(b) The mass of the roller coaster and people inside is 2000 kg and the height of the hill is 50 m. Calculate the minimum work done in getting the roller coaster to the top of the hill.

Remember to show your working.

(c) The motor pulling the roller coaster is replaced by one that pulls the coaster to the top in a **shorter amount of time**.

Discuss how this would affect the **work done**, and the **power** of this motor.

- Use relevant formulae to support your answer.
- Discuss the relationship between the variables in each formula.

Calculations are not required.

(d) At the bottom of the hill, the roller coaster is travelling at 30 m s^{-1}.

The mass of the roller coaster and people is 2000 kg and the height is 50 m.



Adapted from: www.shutterstock.com/image-vector/children-ride-roller-coaster-sky-background-1969218523

Discuss the difference between the gravitational potential energy at the top of the hill and the kinetic energy at the bottom of the hill.

To answer this question you will need to consider:

- the gravitation potential energy at the top of the hill
- the kinetic energy at the bottom of the hill
- a discussion of the difference between these two values.

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The assessment continues on the following page.

QUESTION TWO: HEATED JACKETS

Aarush buys a jacket that has inbuilt electric heaters.



Source: www.amazon.ae/Heated-Jacket-Jackets-Unisex-Battery/dp/B0BLK18HTY

(a) Aarush needs to purchase a power source separately. It is recommended that Aarush uses a 20 W power source.

Show that electrical energy output to the jacket in 10 minutes is 12 000 J.

(b) The power source is stated as 20 W, 6 V.

Calculate the total resistance of the heating circuit in the jacket.

Remember to show all working and units.

(c) Aarush notices that one section of the jacket stops working, but the remaining heating sections continue to stay warm.

Explain how only one section stopping working could tell Aarush if the wiring of the jacket is in series or parallel.

A diagram of the circuit used may help your discussion.

(d) When turned on, the heating circuit warms up the jacket. At the start the jacket has a temperature of 10 °C. The mass of the jacket is 1.5 kg and the specific heat capacity of the jacket is 1000 J (kg °C)$^{-1}$.

Calculate the **final temperature** of the jacket after 10 minutes.

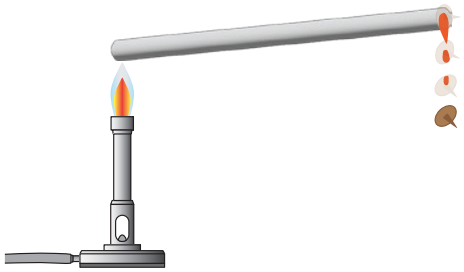
To answer this question you will need to consider:

- that the energy produced by the power source is 12 000 J from (a)
- any assumptions that you have made
- the change in temperature.

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The assessment continues on the following page.

QUESTION THREE: HEAT TRANSFER

Olivia sets up a demonstration to show how a drawing pin, attached with wax to the end of an aluminium rod, will fall off when the other end of the rod is heated by a Bunsen burner for a length of time, as in the picture.



(a) Explain the term **latent heat** as it applies to Olivia's demonstration.

(b) Discuss why the wax melts and the pin falls off.

To answer this question you will need to:

- state the type of energy transfer involved
- discuss particle movement to explain how the wax gets hotter.

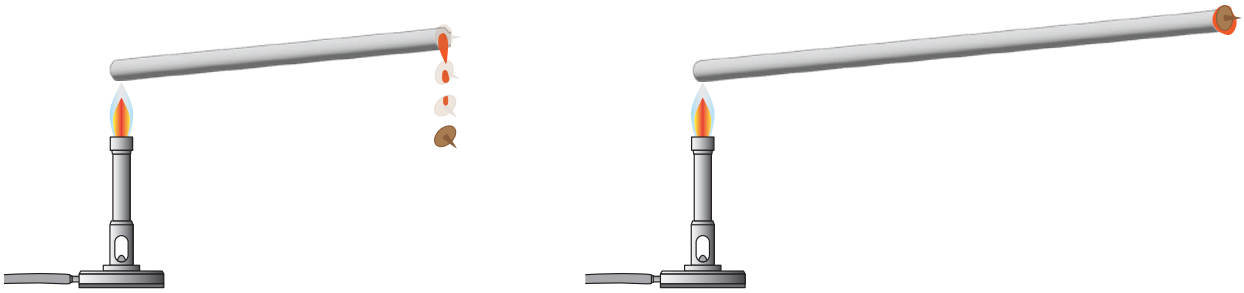
You may include a labelled diagram.

(c) The wax has been heated to just before its melting point.

Calculate the amount of thermal energy needed to melt the 0.001 kg of wax at the end of the rod.
The latent heat of fusion of wax is 95 000 J kg^{-1}.

Question Three continues on the following page.

(d) If the Bunsen burner supplies the same amount of thermal energy, to a longer rod, the pin does not fall off.



Use ideas of heat transfer to discuss why the pin stays on the rod.

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