

1.1 Energy Changes in a System

Question Paper

Course	AQA GCSE Physics
Section	1. Energy
Topic	1.1 Energy Changes in a System
Difficulty	Medium

Time allowed: 70
Score: /51
Percentage: /100

Question 1a

Figure 2 below shows a student doing a bungee jump from a stationary platform.

The bungee cord has an unstretched length of 30.0 m.

Figure 2



The mass of the student is 60.0 kg.

The gravitational field strength is 9.8 N / kg.

(a)

Write down the equation which links gravitational field strength (f), gravitational potential energy (E_p), height (h) and mass (m).

[1 mark]

[1 mark]

Question 1b

(b)

Using the equation from 1(a), calculate the change in gravitational potential energy from the position where the student jumps to the point 30.0 m below.

Give your answer to 3 significant figures.

[2 marks]

[2 marks]

Question 1c

(c)

75% of this change in gravitational potential energy is transferred to the student's kinetic energy store.

By how much does the student's kinetic energy store increase after falling 30.0 m?

[1 mark]

Kinetic energy gained = _____ J

[1 mark]

Question 1d

(d)

Calculate the speed of the student after falling 30.0 m.

Give your answer to two significant figures.

[4 marks]

[4 marks]

Question 2a

(a)

What is meant by specific heat capacity?

[2 marks]

[2 marks]

Question 2b

(b)

Quenching is a process used to change the properties of steel by rapidly cooling it.

During the quenching process, the steel is heated to a very high temperature and then placed in a container of cold water.

A steel rod is quenched by heating it to a temperature of $815\text{ }^{\circ}\text{C}$ before placing it in cold water.

The mass of the steel rod is 15 kg .

The final temperature of the rod and water is $60\text{ }^{\circ}\text{C}$.

Calculate the energy transferred from the steel rod to the water.

Use the correct equation from the Physics Equation Sheet.

Specific heat capacity of steel = $490\text{ J/kg }^{\circ}\text{C}$.

Give the answer to two significant figures.

[3 marks]

[3 marks]

Question 2c

(c)

The temperature of the steel rod eventually returns to room temperature.

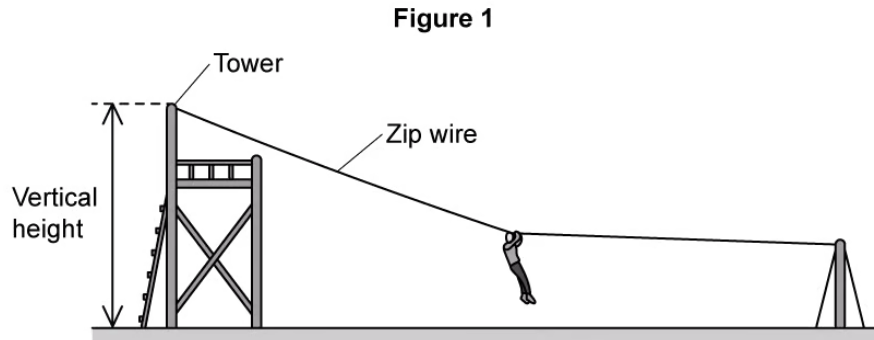
Compare the energies and movement of the particles in the steel rod and in the air at room temperature.

[3 marks]

[3 marks]

Question 3a

Figure 1 shows a person on a zip wire. The person's weight is 650 N.



(a)
The person has 15 000 J in their gravitational potential store at the top of the tower.

Determine the vertical height of the tower.

Give your answer to 3 significant figures.

[3 marks]

Vertical height of tower (3 significant figures) = m

[3 marks]

Question 3b

(b)
The height of the zip rope at the end of the ride is 2.5 m above ground.

Determine the change in gravitational potential energy over the course of the zip rope ride.

[3 marks]

[3 marks]

Question 3c

(c)

Determine the mass of the rider.

Give your answer to the nearest kg.

[2 marks]

[2 marks]

Question 3d

(d)

Write down an expression relating energy in the kinetic store (E_k) and energy in the gravitational potential store (E_p).

State the amount of energy in the rider's kinetic store when the rider is at the end of the zip rope.

You can assume frictional forces to be negligible.

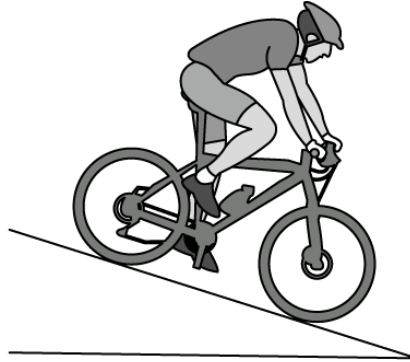
[2 marks]

[2 marks]

Question 4a

Figure 1 shows a cyclist riding down an incline.

Figure 1



(a)

Complete the sentences.

Choose answers from the box.

Each answer can be used once, more than once or not at all.

thermal	elastic potential	kinetic
nuclear	gravitational potential	chemical

[3 marks]

As the cyclist rides down the hill, the amount of energy in his store decreases.

As the cyclist accelerates, energy in his store increases.

When the cyclist uses his breaks to stop, energy is transferred to the store of the brake pads.

[3 marks]

Question 4b

(b)

In one journey, the cyclist applies his brakes.

The break pads increase in temperature from 13°C to 51°C .

The material of the break pads has a specific heat capacity of $517\text{ J/kg }^{\circ}\text{C}$.

The mass of the break pads is 0.043 kg

Calculate the change in thermal energy of the break pads.

Give your answer to 3 significant figures.

[3 marks]

Change in thermal energy (3 significant figures) = J

[3 marks]

Question 4c

The cyclist descends the hill on another journey, this time without braking.

(c)

The hill the cyclist rode down has a vertical height of 23.5 m .

20 kJ of energy was transferred from the **cyclist's** gravitational potential energy store as he rode from the top of the hill to the bottom.

Determine the mass of the cyclist.

Give your answer to 3 significant figures.

[4 marks]

Mass of cyclist (3 significant figures) = kg

[4 marks]

Question 4d

(d)

Calculate the maximum speed of the cyclist during his descent.

Assume now that there are no energy losses.

Give your answer to 1 significant figure.

[4 marks]

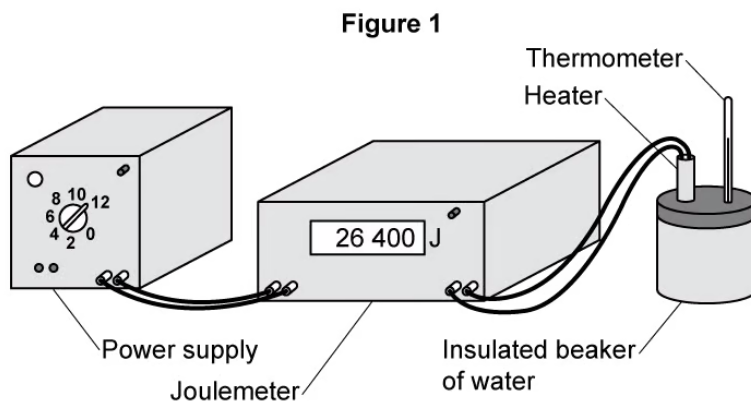
Maximum speed (1 significant figure) = m/s

[4 marks]

Question 5a

A group of students carry out an investigation into the specific heat capacity of water.

Figure 1 shows the equipment the students use.



(a)

Describe a method the students could use to determine the specific heat capacity of water.

[6 marks]

[6 marks]

Question 5b

(b)

State the purpose of insulating the beaker of water.

[1 mark]

[1 mark]

Question 5c

(c)

The students noticed that when the power supply was turned on, the water did not immediately begin to heat up.

Suggest **one** reason why.

[1 mark]

[1 mark]

Question 5d

(d)

The energy transferred to the heater in 600 s was 36 050 J.

The temperature of the water increased by 17°C.

The specific heat capacity of water is 4200 J/kg °C.

Determine the mass of water the students used.

[3 marks]

Mass of water = kg

[3 marks]