Energy part 1 AQA Triple Physics

Name: _____

Class: _____

Date: _____

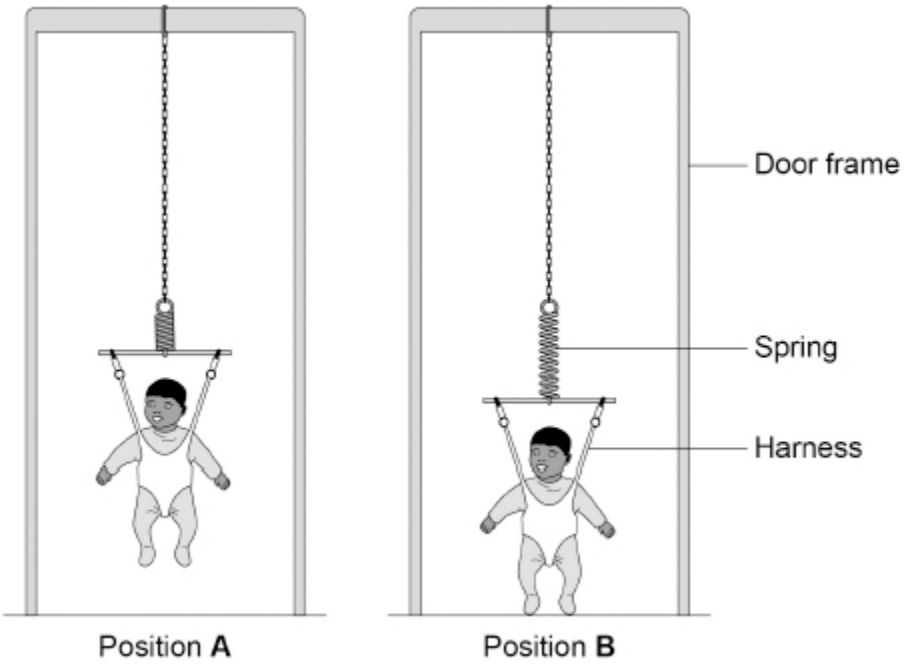
Time: **62 minutes**

Marks: **61 marks**

Comments:

1. A baby bouncer is a harness attached to a spring that hangs from a door frame.

The figure above shows a baby in a baby bouncer in two positions.



(a) The baby bouncer should not be used with babies that have a mass greater than 12 kg.

Suggest **one** reason why.

_____

_____

_____

(1)

(b) In positions **A** and **B** the baby is stationary.

Describe the energy transfers as the baby moves from position **A** to position **B**.

_____

_____

_____

_____

_____

_____

(3)

(c) In one position the extension of the spring is 8.0 cm.

The elastic potential energy stored by the spring is 4.0 J.

Calculate the spring constant of the spring.

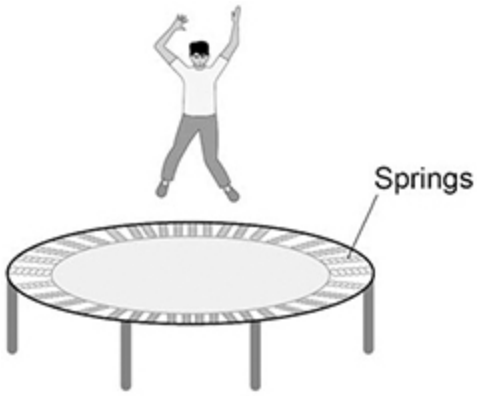
Use the Physics Equations Sheet.

Spring constant = _____ N/m

(4)

(Total 8 marks)

2. The figure shows a boy bouncing on a trampoline.



(a) The boy falls from the position in the figure above towards the trampoline.

Complete the sentences.

Choose answers from the box.

chemical	**elastic potential**	**gravitational potential**
kinetic	**nuclear**	

As the boy falls, there is a decrease in his _____ energy.

As the boy falls, there is an increase in his _____ energy.

(2)

(b) As the boy lands on the trampoline, each spring stretches 0.015 m.

spring constant of each spring = 120 000 N/m

Calculate the energy stored by each spring.

Use the equation:

$$\text{elastic potential energy} = 0.5 \times \text{spring constant} \times (\text{extension})^2$$

_____

_____

_____

Elastic potential energy = _____ J

(2)

(c) There are 40 springs on the trampoline.

Calculate the total energy stored by the 40 springs when each spring is stretched by 0.015 m.

Use your answer from part (b)

_____

_____

Total energy stored = _____ J

(1)

(d) The kinetic energy of the boy as he lands on the trampoline is 600 J.

The maximum kinetic energy of the boy after he bounces is 45% of his kinetic energy as he lands.

Calculate the maximum kinetic energy of the boy after he bounces.

_____

_____

_____

Maximum kinetic energy = _____ J

(2)

(e) Why is the kinetic energy of the boy after he bounces less than his kinetic energy as he lands?

Tick (✓) **one** box.

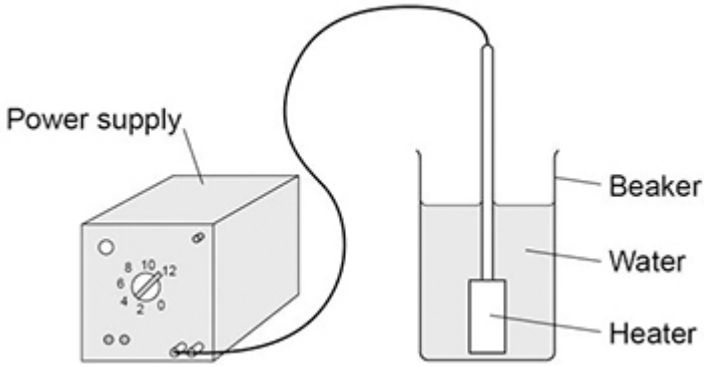
Energy is not conserved.	☐
Energy is transferred to the surroundings.	☐
The springs transfer energy to the boy.	☐

(1)

(Total 8 marks)

3. A student determined the specific latent heat of vaporisation of water.

The figure shows some of the equipment used.



(a) The student measured a mass of water and put it into the beaker.

What measuring instrument should the student have used to measure the mass of the water?

Tick (✓) **one** box.

balance ☐

joulemeter ☐

newtonmeter ☐

thermometer ☐

(1)

(b) The power output of the heater stayed the same throughout the experiment.

What type of variable was the power output of the heater?

Tick (✓) **one** box.

Categoric variable ☐

Control variable ☐

Dependent variable ☐

Independent variable ☐

(1)

(c) The student turned on the heater and heated the water until it reached boiling point.

The student continued to heat the water so that it boiled for several minutes.

The mass of the water remaining in the beaker was measured again.

Give **one** way the beaker of boiling water could be moved safely to measure its new mass.

_____

_____

_____

(1)

(d) The mass of water that turned into steam was 0.0090 kg.

The heater transferred 25 200 J of energy to the water to turn it into steam.

Calculate the specific latent heat of vaporisation of water given by the student s data.

Use the Physics Equations Sheet.

Choose the unit from the box.

J	**kg**	**J/kg**

_____

_____

_____

_____

Specific latent heat of vaporisation = _____ Unit _____

(4)

(e) What was a source of error in the student s experiment?

Tick (✓) **one** box.

The transfer of thermal energy from the heater to the water ☐

The transfer of thermal energy from the surroundings to the water ☐

The transfer of thermal energy from the water to the heater ☐

The transfer of thermal energy from the water to the surroundings ☐

(1)

(Total 8 marks)

4. The figure below shows a large wind farm off the coast of the UK.

The mean power output of the wind farm is 696 MW, which is enough power for 580 000 homes.

(a) Calculate the mean power needed for 1 home.

Give your answer in watts.

Mean power needed for 1 home = _____W

(2)

(b) On one day the demand for electricity in the UK was 34 000 MW.

Suggest **two** reasons why wind power was not able to meet this demand.

1. _____

2. _____

(2)

(c) Some of the energy from the wind used to rotate a wind turbine is wasted.

An engineer oils the mechanical parts of a wind turbine.

Explain how oiling would affect the efficiency of the wind turbine.

(3)

(d) In most homes in the UK there are many different electrical devices.

Explain why people should be encouraged to use energy efficient electrical devices.

_____

_____

_____

_____

_____

(2)

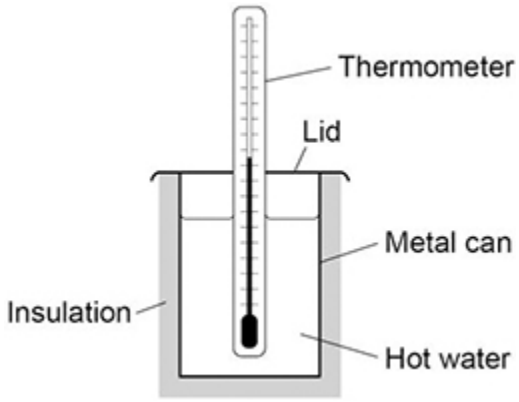
(Total 9 marks)

5. A student investigated the insulating properties of two different materials.

The same thickness of each material was used.

Figure 1 shows some of the equipment used by the student.

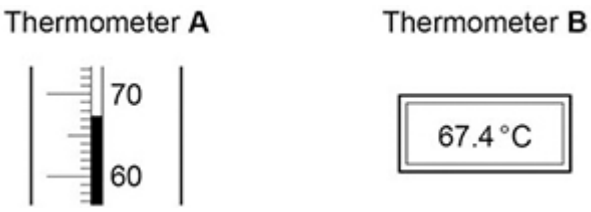
Figure 1



The student used two different types of thermometer to measure the temperature changes.

Figure 2 shows a reading on each thermometer.

Figure 2



(a) What is the resolution of thermometer **B**?

Tick (✓) **one** box.

0.1 °C ☐

0.4 °C ☐

67.0 °C ☐

67.4 °C ☐

(1)

(b) Complete the sentence.

Choose the answer from the box.

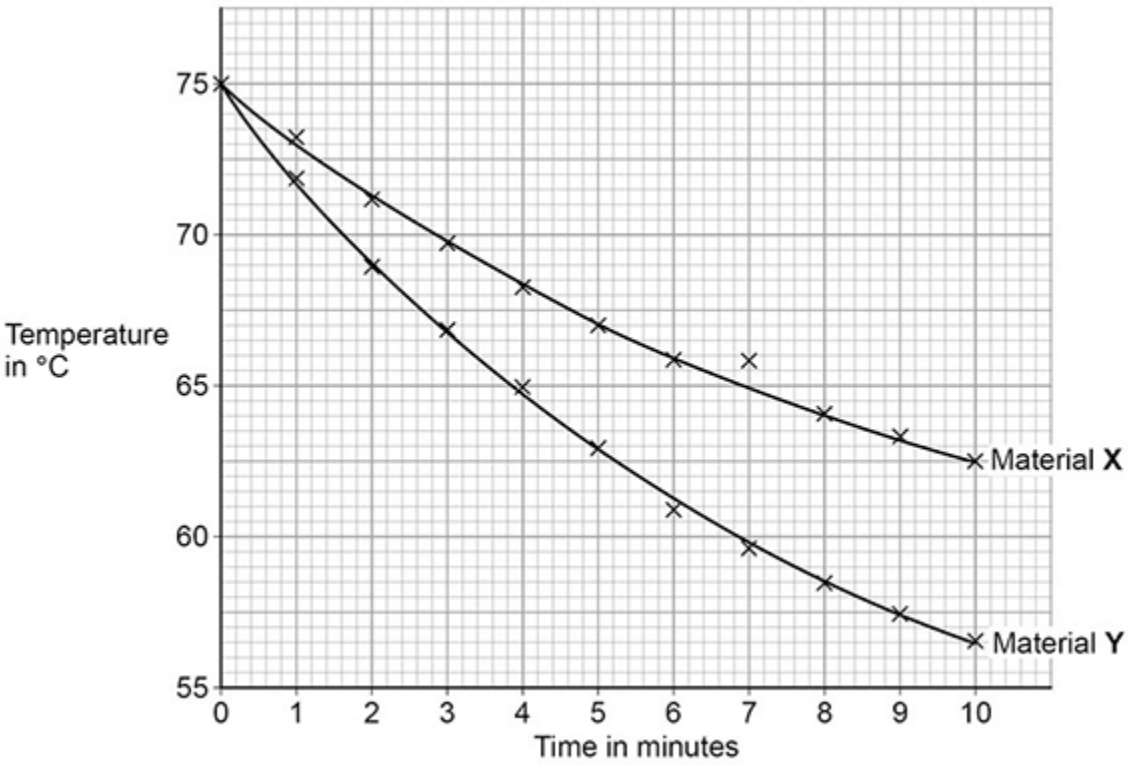
a smaller	**the same**	**a bigger**

Thermometer **A** has _____ chance of being misread than thermometer **B**.

(1)

Figure 3 shows the results.

Figure 3



(c) The mass of water used was 0.12 kg.

specific heat capacity of water = 4200 J/kg °C

Determine the total change in thermal energy of the water when Material **X** was used.

Use values from **Figure 3**.

Use the Physics Equations Sheet.

_____

_____

_____

_____

_____

_____

Total change in thermal energy = _____J

(4)

(d) There is an anomalous result on **Figure 3**.

Draw a ring around the anomalous result.

(1)

(e) Give **two** conclusions that can be made from **Figure 3**.

1. _____

_____

_____

2. _____

_____

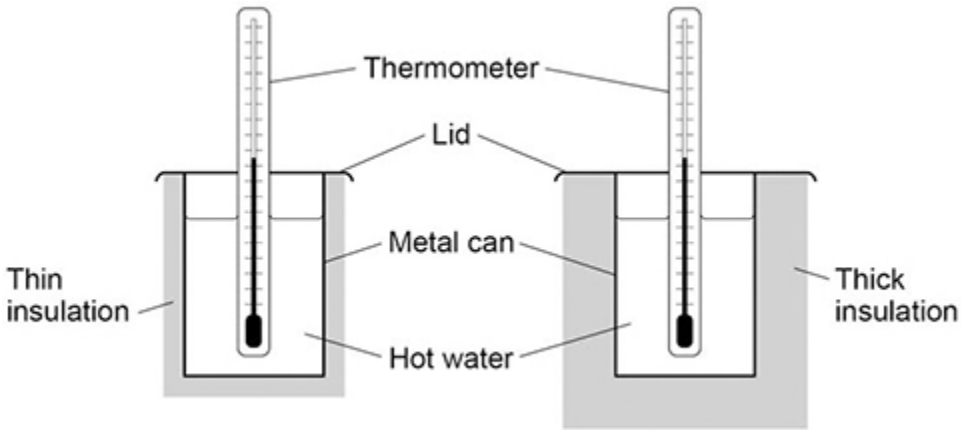
_____

(2)

Another student investigated how the thickness of the insulation affected the rate of cooling of hot water.

Figure 4 shows some of the equipment used.

Figure 4



(f) How would using thick insulation affect the rate of cooling of hot water compared with using thin insulation?

Tick (✓) **one** box.

The rate of cooling would be higher. ☐

The rate of cooling would be lower. ☐

The rate of cooling would not change. ☐

(1)

(g) Predict how using thick insulation would affect the temperature of the water after 10 minutes compared with using thin insulation.

Tick (✓) **one** box.

The temperature would be higher. ☐

The temperature would be lower. ☐

The temperature would be the same. ☐

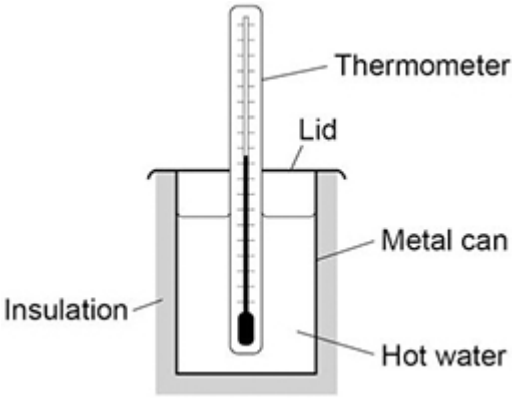
(1)

(Total 11 marks)

6. A student investigated the insulating properties of different materials.

Figure 1 shows some of the equipment used by the student.

Figure 1



This is the method used:

1. Wrap insulating material around the can.
2. Put a fixed volume of boiling water in the can.
3. Place the lid on the top of the can.
4. Measure the time taken for the temperature of the water to decrease by a fixed amount.
5. Repeat steps 1 – 4 using the same thickness of different insulating materials.

(a) Identify the independent variable and the dependent variable in this investigation.

Independent variable _____

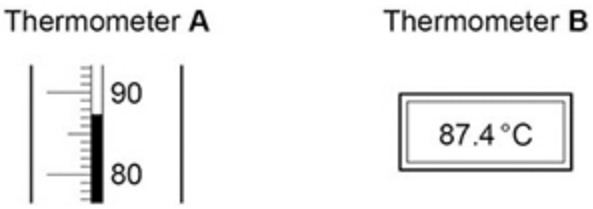
Dependent variable _____

(2)

The student used two different types of thermometer to measure the temperature changes.

Figure 2 shows a reading on each thermometer.

Figure 2



(b) What is the resolution of thermometer **B**?

Resolution = _____ °C

(1)

(c) Thermometer **A** is more likely to be misread.

Give **one** reason why.

_____

_____

_____

(1)

(d) For one type of insulating material, the temperature of the water decreased from 85.0 °C to 65.0 °C.

The energy transferred from the water was 10.5 kJ.

specific heat capacity of water = 4200 J/kg °C

Calculate the mass of water in the can.

Use the Physics Equations Sheet.

Mass = _____ kg

(3)

(e) The table below shows the results for two insulating materials.

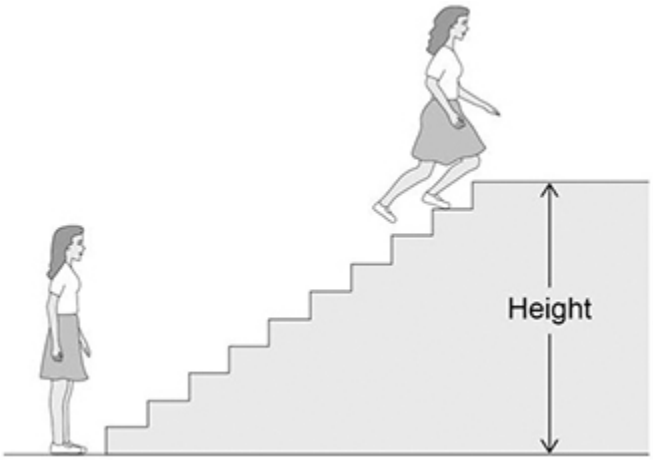
Material	**Time for temperature to decrease by 20 °C in seconds**
X	450
Y	745

Explain how the results in above table can be used to compare the thermal conductivity of the two materials.

(2)

(Total 9 marks)

7. The figure below shows a girl doing an experiment to determine her power output by running to the top of some stairs.



(a) The mass of the girl was 60.0 kg.

The height of the stairs was 175 cm.

The girl ran to the top of the stairs in 1.40 s.

gravitational field strength = 9.8 N/kg

Calculate the power output of the girl.

Use the Physics Equations Sheet.

Power = _____ W

(5)

(b) The **total** power output of the girl was greater than the answer to part (a).

Suggest **two** reasons why.

1. _____

_____

2. _____

_____

(2)

(c) A boy took more than 1.40 s to run up the same stairs.

The power output of the boy was the same as the power output of the girl.

What conclusion can be made about the boy's mass?

Tick (✓) **one** box.

The boy's mass was greater than the girl's mass. ☐

The boy's mass was lower than the girl's mass. ☐

The boy's mass was the same as the girl's mass. ☐

(1)

(Total 8 marks)

1. (a) spring may become permanently extended

ignore reference to limit of proportionality

allow the harness / spring / chain may break

or

extension of the spring may be too great (so the baby's feet are always on the floor)

ignore baby may be injured / harmed / may hit doorframe

1

(b) (in position **A**) the baby has gravitational potential energy

allow E_p for gravitational potential energy

1

(as the baby moves down this) is transferred to kinetic energy

allow E_k for kinetic energy

(of the baby) and / then elastic potential energy (of the spring)

allow E_e for elastic potential energy

1

(in position **B**) all the energy is elastic potential energy

ignore energy dissipated to the surroundings

1

(c) e = 0.080 (m)

1

$4.0 = ½ \times k \times 0.080^2$

allow a correct substitution using an incorrectly / not converted value of e

1

$$k = \frac{4.0}{(0.5 \times 0.080^2)}$$

allow a correct rearrangement using an incorrectly / not converted value of e

1

k = 1250 (N/m)

allow an answer consistent with their value of e

1

[8]

2. (a) gravitational potential

1

kinetic

1

this order only

(b) $E_e = 0.5 \times 120\,000 \times 0.015^2$

1

$E_e = 13.5$ (J)

1

(c) $E = 540$ (J)

*allow their answer from part **(b)** × 40*

1

(d) $E_k = 0.45 \times 600$

1

$E_k = 270$ (J)

1

(e) energy is transferred to the surroundings

1

[8]

3. (a) balance

1

(b) control variable

1

(c) use tongs / gloves
or
use a heatproof mat

allow other sensible methods of avoiding contact with hot beaker eg using a cloth

allow wait for the beaker (and hot water) to cool down

1

(d) $25\,200 = 0.0090\ L$

1

$$L = \frac{25\,200}{0.0090}$$

1

$L = 2\,800\,000$
or
$L = 2.8 \times 10^6$

1

J/kg

1

(e) the transfer of thermal energy from the water to the surroundings

1

[8]

4. (a) P = 696 000 000 (W)

1

P = 1200 (W)

allow an answer consistent with their incorrectly / not converted value of P

1

(b) any **2** from:

- wind is unreliable

  allow it was not windy (on that day)

- wind turbines don't turn when the wind is too strong/weak
- there are not enough wind turbines (in the UK)

  allow some wind turbines may be offline for maintenance

  allow energy from wind may not be enough (to generate 34 000 MW)

  ignore weather conditions unqualified

2

(c) the efficiency would increase

1

because the percentage / proportion / amount of energy usefully transferred would increase

ignore more electricity generated

or

because the percentage / proportion / amount of energy wasted would decrease

allow less energy wasted

1

(because) less (work is done against) friction

1

(d) more efficient devices waste less energy

or

more efficient devices need a lower energy input (for the same energy output)

ignore use less electricity

1

which would minimise the electricity / energy demand

allow less electricity needs to be generated

allow lower energy / electricity bill

or

which would minimise the environmental impact from (fossil fuel) electricity generation

allow examples of environmental impact e.g. lower CO_2 emissions

ignore 'better for the environment' unless qualified

ignore answers that discuss 'saving energy' unless qualified

ignore answers that discuss alternative methods of generating electricity

1

[9]

5. (a) 0.1 °C

1

(b) a bigger

1

(c) identifies 75 (°C) **and** 62.5 (°C)

1

$\Delta\theta$ = 12.5 (°C)

allow a correct calculation of temperature change from misread values

1

E = 0.12 × 4200 × 12.5

allow a correct substitution using an incorrect temperature change

1

E = 6300 (J)

allow an answer consistent with an incorrect temperature change

1

(d) point at 7 minutes for material **X** ringed

1

(e) any **two** from:

- water wrapped in material X cooled more slowly

  allow water wrapped in material X transfers less energy to the surroundings (in 10 minutes)

  allow water wrapped in material X has a higher final temperature

- material X is a better insulator

  or

- the thermal conductivity of material X is lower

  allow material X is a worse (thermal) conductor

- the rate of cooling decreased with time (for both X and Y)

  allow temperature decreased with time (for both X and Y)

  allow converse answers for material Y

2

(f) the rate of cooling would be lower

1

(g) the temperature would be higher

1

[11]

6. (a) independent variable: (type of) insulation / material

do not accept thickness of material

1

dependent variable: time

1

(b) 0.1 (ºC)

1

(c) viewing angle affects measurement

or

parallax error

allow judgement needed in reading the position (of the liquid in the thermometer)

allow the level of the liquid may be between lines

allow number of lines may be miscounted

ignore harder to read

ignore lines are close together

ignore human error

1

(d) E = 10 500(J)

1

$$m = \frac{10\,500}{4200 \times (85\text{-}65)}$$

*allow a correct substitution **and** rearrangement using an incorrectly / not converted value of E*

1

m = 0.125 (kg)

allow a correct calculation using an incorrectly / not converted value of E

1

(e) (same) temperature decrease in a shorter time means a higher thermal conductivity

allow converse answer

1

(because) the rate of energy transfer is higher

1

[9]

7. (a) h = 1.75 (m)

1

$E_p = 60 \times 9.8 \times 1.75$

allow a correct substitution using an incorrectly / not converted value of h

1

E_p = 1029 (J)

allow a correct calculation using an incorrectly / not converted value of h

1

$$P = \frac{1029}{1.40}$$

allow a correct substitution using their calculated value of E_p

1

P = 735 (W)

allow an answer consistent with their value for E_p

1

(b) girl increases her kinetic energy (as well as increasing her gravitational potential energy)

1

some energy is wasted in her muscles
or
some energy transferred as thermal energy (to surroundings)

allow some energy transferred due to air resistance

ignore unqualified references to friction

ignore references to sound

1

(c) the boy's mass was greater than the girl's mass

1

[8]