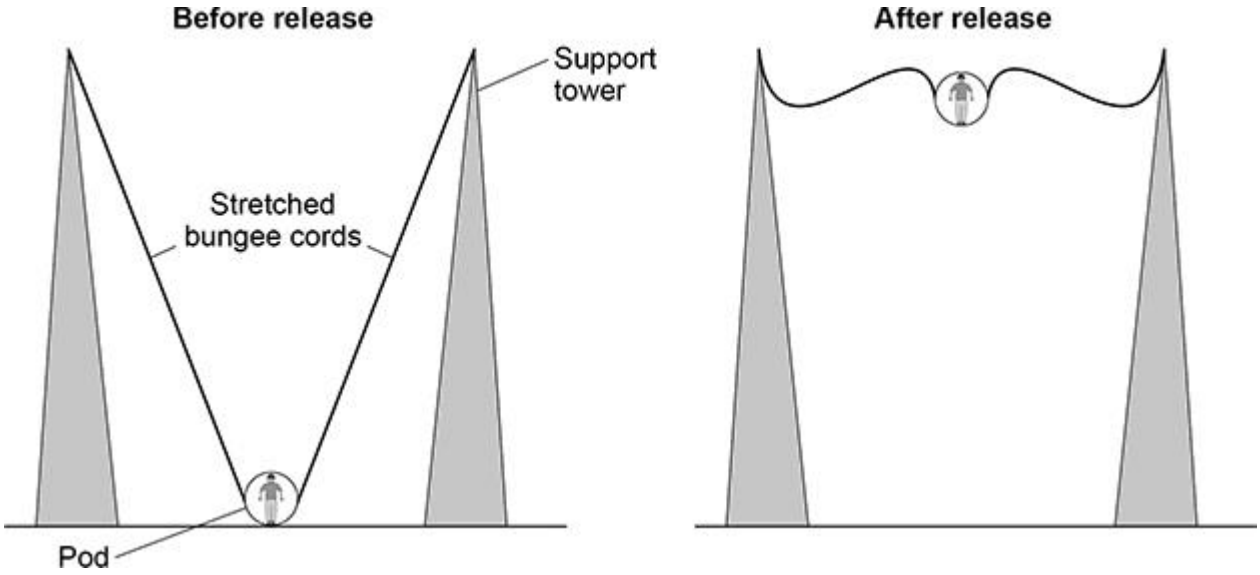
**Questions are for both separate science and combined science students unless indicated in the question**

## Q1.

In a ride at a theme park, a person is strapped into a pod that is attached to two stretched bungee cords.

The bungee cords behave like springs.

The figure below shows a person using the ride.




(a) Which energy store increases as the bungee cords are stretched?

_____

**(1)**

(b) When the pod is released, the pod accelerates upwards.

Before the pod is released the extension of **each** of the two bungee cords is 8.0 m.

The spring constant of each bungee cord is 735 N/m.

The mass of the pod is 240 kg.

gravitational field strength = 9.8 N/kg

Calculate the maximum height reached by the pod.

Use the Physics Equations Sheet. **(Physics only)**

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Maximum height = _____ m

**(6)**

(c) The actual maximum height reached by the pod will be lower than the correct answer to part (b).

Explain why.

_____

_____

_____

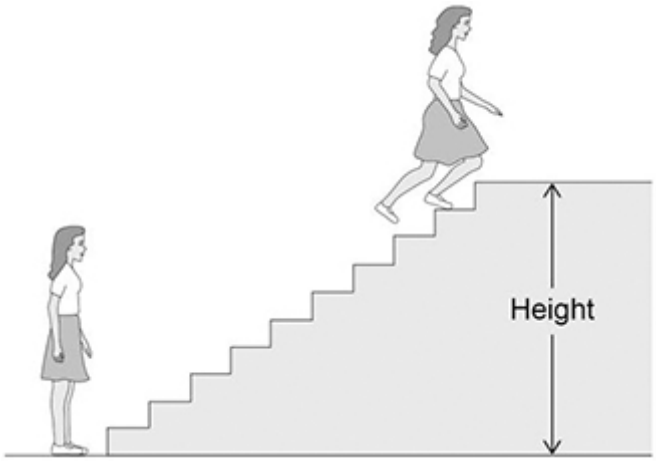
_____

**(2)**

**(Total 9 marks)**

## Q4.

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)**

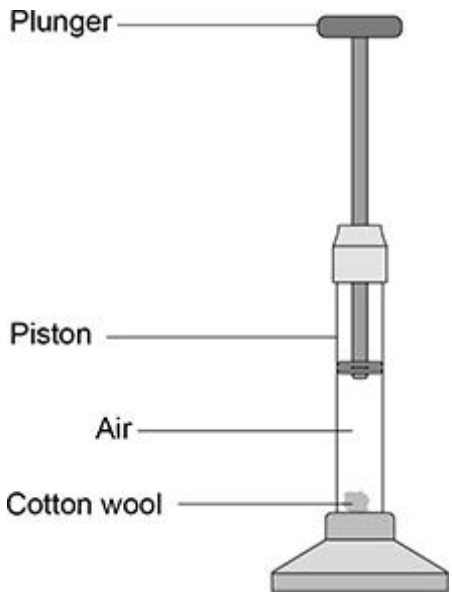
**(Total 8 marks)**

## Q2.

A fire piston is a special type of syringe that can be used to start fires. **(Physics only)**

**Figure 2** shows a fire piston.

**Figure 2**




The plunger is pushed quickly downwards and compresses the air.

When the air is compressed quickly, the temperature of the air increases.

(a) How does an increase in temperature affect the air particles inside the piston?

Tick (✓) **one** box.

The mean kinetic energy of the particles increases. ☐

The mean potential energy of the particles increases. ☐

The mean separation of the particles increases. ☐

**(1)**

(b) When the air is hot enough, a small piece of cotton wool in the piston catches fire.

The energy transferred to the air in the piston is 0.0130 J.

The mass of air in the piston is $2.60 \times 10^{-8}$ kg.

specific heat capacity of air = 1.01 kJ/kg °C

Calculate the temperature change of the air.

Use the Physics Equations Sheet.

Temperature change = _____ °C

**(4)**

**(Total 5 marks)**

## Q3.

A remote village in the UK uses a hydroelectric generator to provide electricity.

(a) In one day, 2 500 000 kg of water passes through the hydroelectric generator.

The change in gravitational potential energy of the water is 367.5 MJ.

gravitational field strength = 9.8 N/kg

Calculate the mean change in vertical height of the water as it moves through the hydroelectric generator.

Use the Physics Equations Sheet.

_____

_____

_____

_____

_____

Mean change in vertical height = _____ m

**(4)**

(b) The generator transfers 3.0 kW of electrical power.

Calculate the time taken for the generator to transfer $2.16 \times 10^7$ J of energy.

Use the Physics Equations Sheet.

Give your answer in standard form.

_____

_____

_____

_____

_____

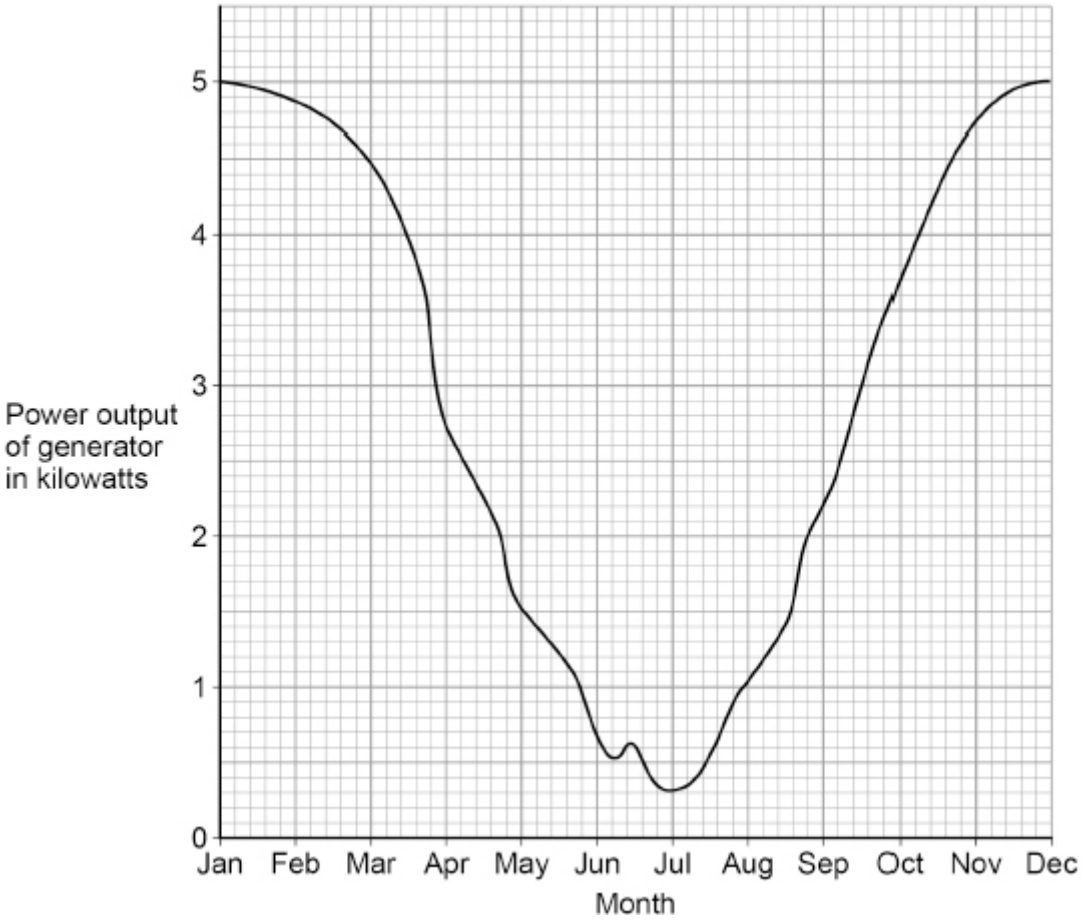
_____

_____

Time taken (in standard form) = _____ s

**(5)**

(c) The figure below shows how the power output of the generator varied during one year.




A solar power system is installed in the remote village in addition to the hydroelectric generator.

Explain why this improves the reliability of the electricity supply to the village.

Use information from the figure above.

_____

_____

_____

_____

_____

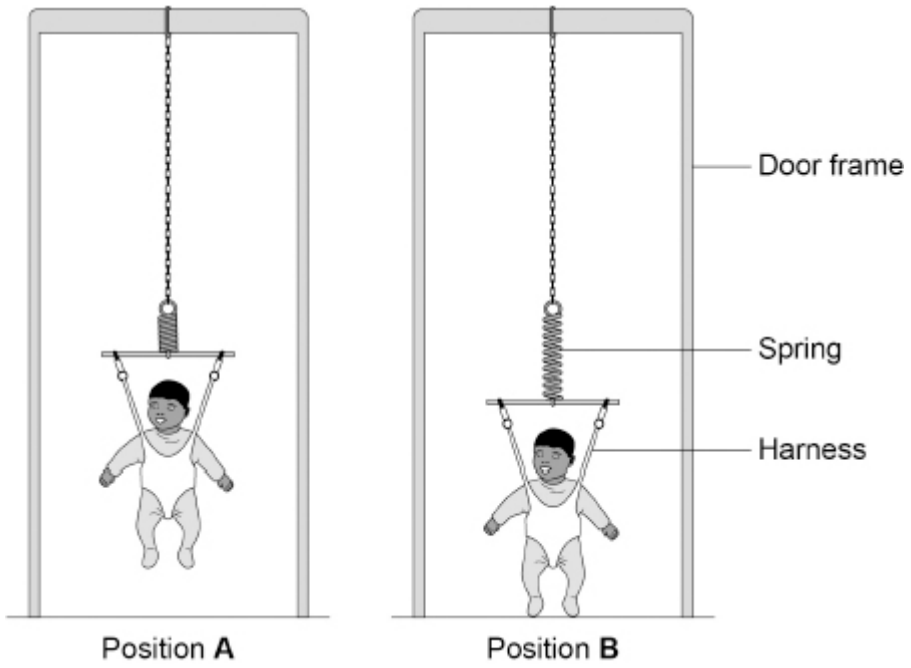
**(2)**

**(Total 11 marks)**

## Q4.

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)**

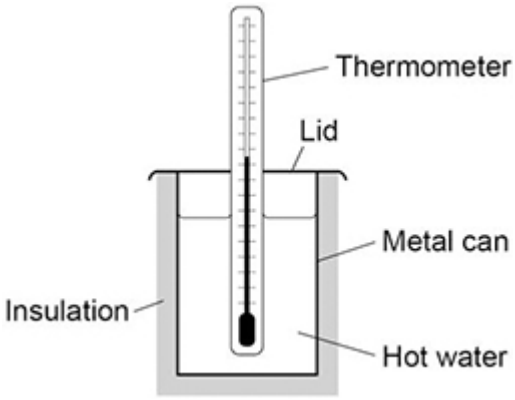
**(Total 8 marks)**

## Q5.

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.

_____

_____

_____

_____

_____

_____

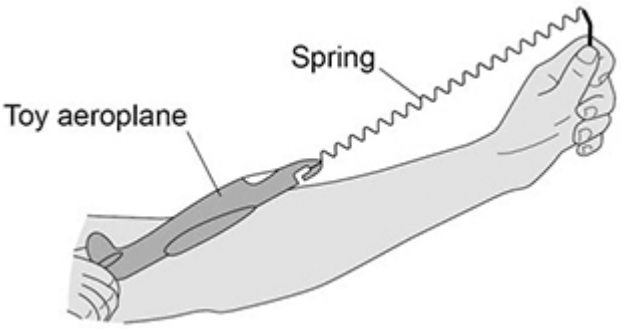
**(2)**

**(Total 9 marks)**

## Q7.

The figure below shows a student launching a toy aeroplane.

To launch the aeroplane, the student pulls on it to stretch the spring and then releases it.




(a) Just before the toy aeroplane is released, the spring has an extension of 0.12 m.

mass of aeroplane = 0.020 kg

spring constant of the spring = 50 N/m

Calculate the maximum speed of the toy aeroplane just after it is launched.

Use the Physics Equations Sheet.

Give the unit.

Speed = _____ Unit _____

**(6)**

(b) Complete the sentence.

As the aeroplane moves upwards through the air there is a decrease

in the _____ energy of the aeroplane.

**(1)**

(c) Give **one** factor which would increase the distance the toy aeroplane travels horizontally before hitting the ground.

_____

_____

**(1)**

**(Total 8 marks)**

**Questions are for both separate science and combined science students unless indicated in the question**

## Q1.

The figure below shows a wind turbine.

Wind turbines may generate electricity when the electricity is not needed.

Two methods that can be used to store the energy from the turbine are:

**Method A**: Heating water to a high temperature.

**Method B**: Pumping water uphill into a reservoir.

(a) Which energy store increases when water is heated?

_____

**(1)**

(b) Which energy store increases when water is pumped uphill into a reservoir?

_____

**(1)**

(c) The table below shows information about the two methods of storing energy.

| **Method** | **Energy stored per 100 kg of water in kJ** | **Percentage of stored energy wasted** | **Installation** |
|---|---|---|---|
| **A**: Increasing water temperature by 80 °C | 33 600 | 40% | Anywhere |
| **B**: Pumping water uphill to a height of 500 m | 490 | 25% | High mountains |

Compare the advantages and disadvantages of the two methods of storing energy.

Include calculations in your answer.

**(4)**

(d) Decreasing the amount of carbon dioxide released by different activities will help slow down climate change.

Transport and generating electricity are the two activities that released the largest amounts of carbon dioxide in the UK in 2018.

Explain **one** change that would reduce the amount of carbon dioxide released by **each** activity.

Transport _____

_____

_____

_____

_____

Generating electricity _____

_____

_____

_____

_____

**(4)**

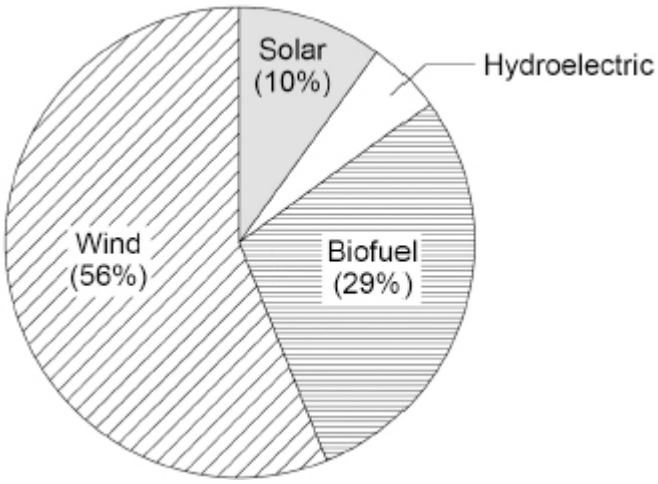
**(Total 10 marks)**

## Q2.

The UK uses renewable energy resources to generate some of its electricity.

**Figure 1** shows the proportion of electricity generated by different renewable energy resources in the UK in 2020.

**Figure 1**




(a) Calculate the percentage of electricity generated using hydroelectric power.

_____

_____

_____

Percentage = _____ %

**(2)**

A remote village in the UK uses a hydroelectric generator to provide electricity.

(b) The mass of water that passes through the hydroelectric generator each day is 2 500 000 kg.

The change in vertical height of the water is 15.0 m.

gravitational field strength = 9.8 N/kg

Calculate the decrease in gravitational potential energy of the water.

Use the equation:

gravitational potential energy = mass × gravitational field strength × height

_____

_____

_____

_____

Decrease in gravitational potential energy = _____ J

**(2)**

Use the Physics Equations Sheet to answer parts (c) and (d).

(c) Write down the equation which links energy (*E*), power (*P*) and time (*t*).

_____

**(1)**

(d) The hydroelectric generator transfers electrical power of 3000 W to the village.

Calculate the energy transferred to the village in 60 minutes.

_____

_____

_____

_____

_____

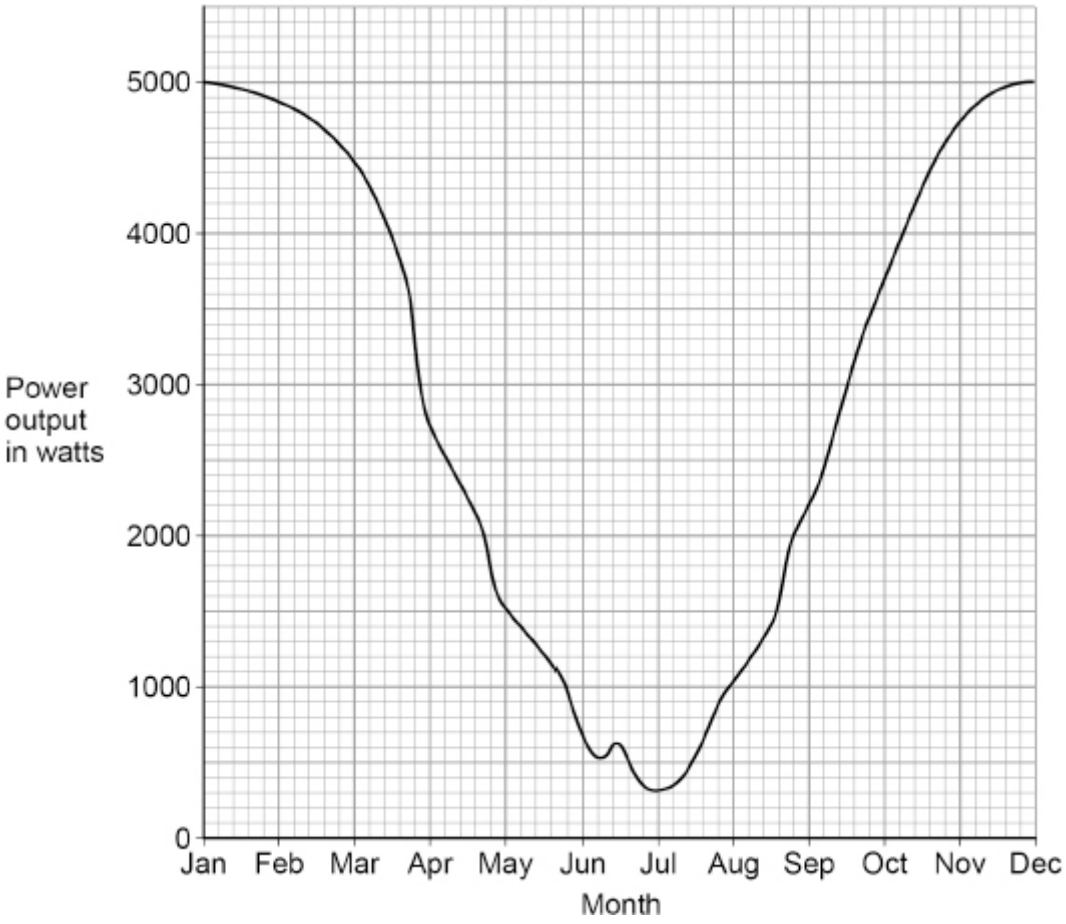
Energy transferred = _____ J

**(3)**

(e) The hydroelectric generator is turned by falling river water.

**Figure 2** shows how the power output of the hydroelectric generator varied during one year.

**Figure 2**




Explain **one** reason why the power output varied.

_____

_____

_____

_____

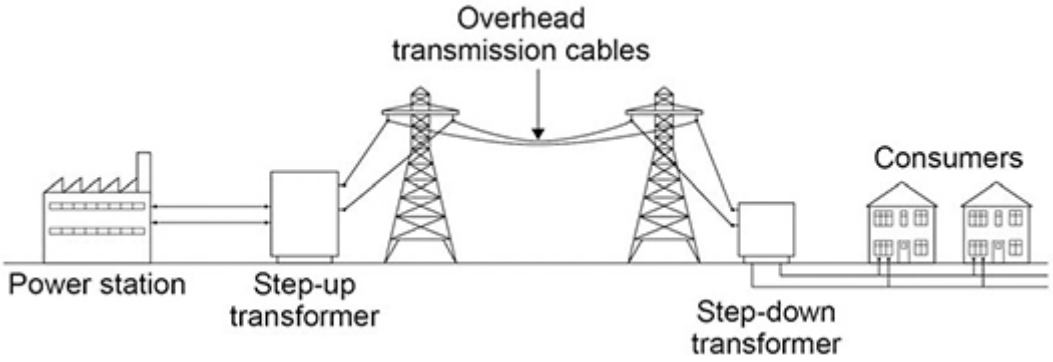
_____

**(2)**

**(Total 10 marks)**

## Q3.

The figure below shows how electricity is supplied to consumers. **(Physics only)**




(a) Electricity from the power station can be generated using renewable or non-renewable energy resources.

Complete table below to show which energy resources are renewable and which are non-renewable.

Tick (✓) **one** box in **each** row.

| **Energy resource** | **Renewable** | **Non-renewable** |
|---|---|---|
| biofuel | | |
| coal | | |
| nuclear | | |
| tides | | |

**(2)**

**(Total 2 marks)**

**Q4.**

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)**