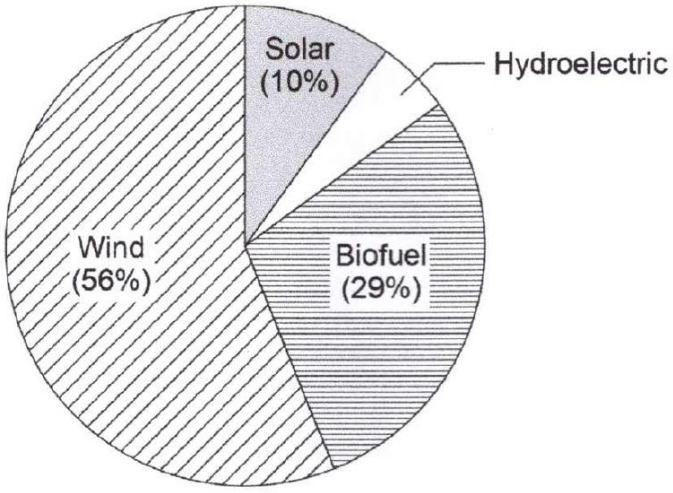
Energy and Power – GCSE Physics Paper 1

1. No.4

0 4 The UK uses renewable energy resources to generate some of its electricity.

Figure 4 shows the proportion of electricity generated by different renewable energy resources in the UK in 2020.

Figure 4



0 4 . 1 Calculate the percentage of electricity generated using hydroelectric power.

[2 marks]

$= 100 - (56 + 10 + 29)$

$= 100 - 95$

$= 5\%$

Percentage = 5 %

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

0 4 . 2 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

[2 marks]

GPE = 2,500,000 × 9·8 × 15

= 367,500,000 Joules

Decrease in gravitational potential energy = 367,500,000 J

Use the Physics Equations Sheet to answer questions **04.3** and **04.4**.

0 4 . 3 Write down the equation which links energy (E), power (P) and time (t).

[1 mark]

$P = \frac{E}{t}$

0 4 . 4 The hydroelectric generator transfers electrical power of 3000 W to the village.

Calculate the energy transferred to the village in 60 minutes.

[3 marks]

$E = P \times t$ ← Must be in minutes

$E = 3000\text{W} \times (60 \times 60)$

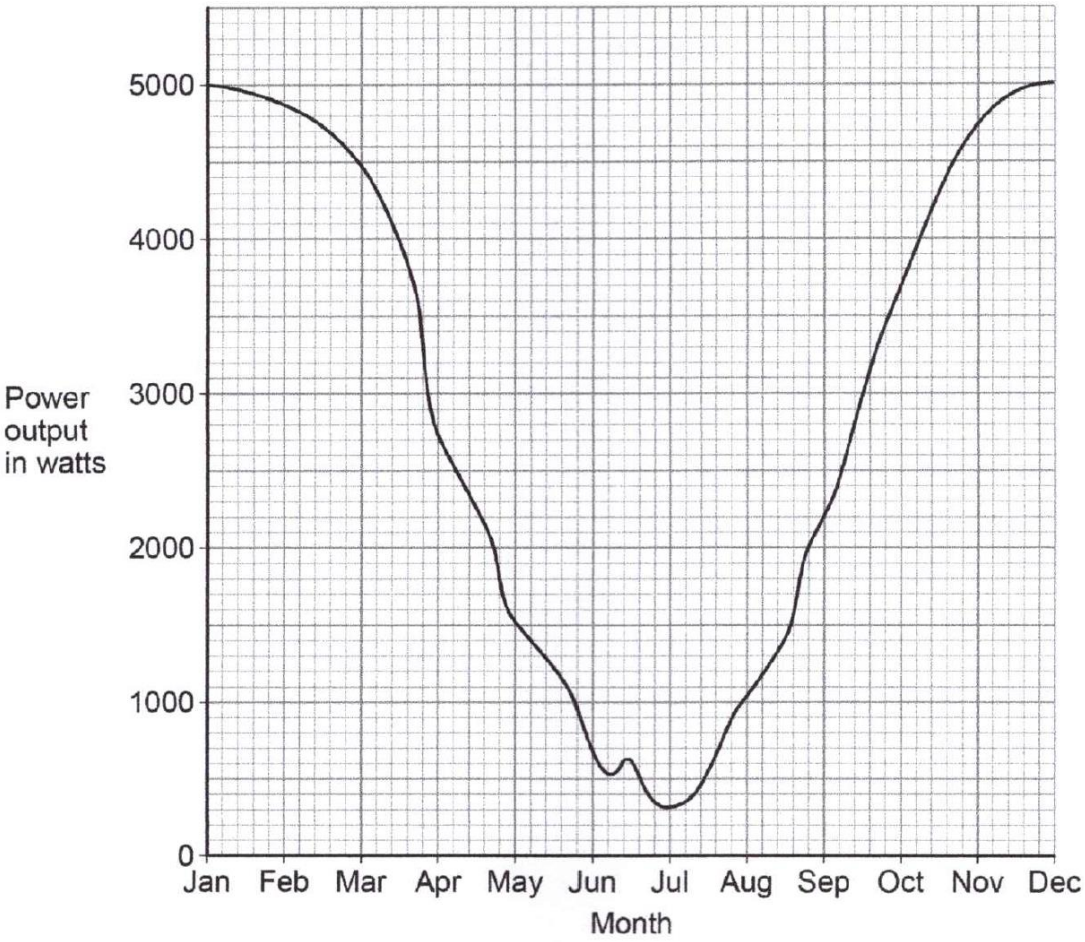
$E = 10,800,000$ Joules

Energy transferred = 10,800,000 J

0 4 . 5 The hydroelectric generator is turned by falling river water.

Figure 5 shows how the power output of the hydroelectric generator varied during one year.

Figure 5



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

[2 marks]

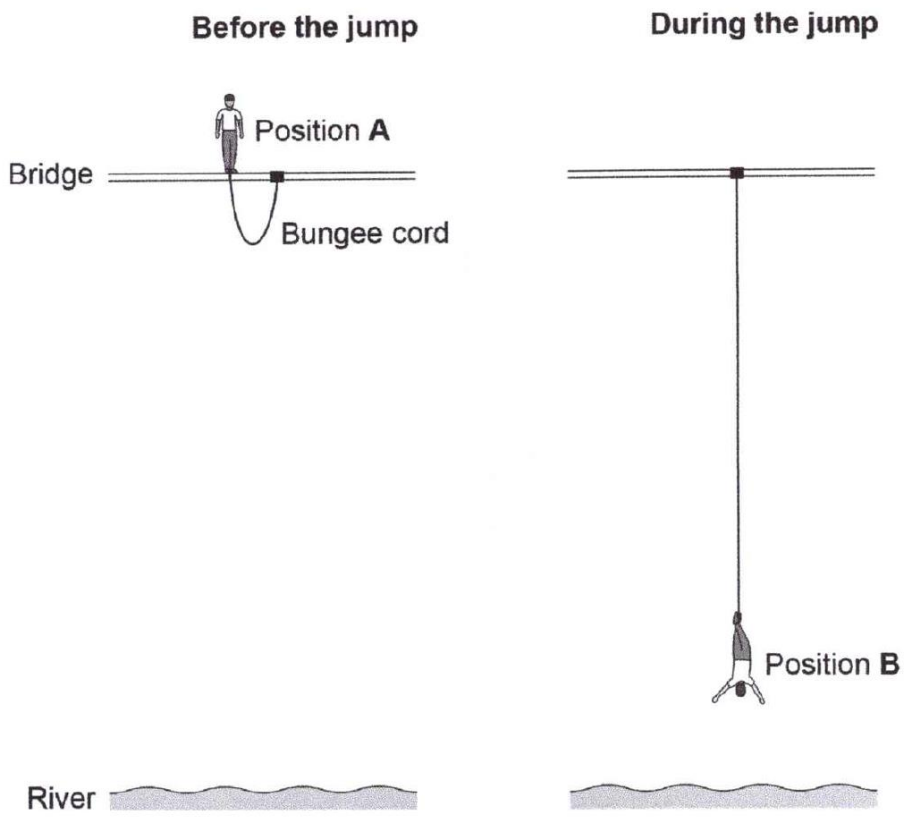
The amount of water in the river varies in the course of the year due to decrease in rains in the Summer.

2. No.6

0 6 **Figure 8** shows a student before and during a bungee jump.

The diagram is not to scale.

Figure 8



0 6 . 1 In position **B**, the student is moving towards the river and the bungee cord is stretching.

How do the energy stores in position **B** compare with the energy stores in position **A**?

[3 marks]

Tick (✓) **one** box in **each** row.

Energy store	Less than at A	The same as at A	More than at A
The student's gravitational potential energy	✓		
The student's kinetic energy			✓
The bungee cord's elastic potential energy			✓

0 6 . 2 The bungee cord behaves like a spring with a spring constant of 78.4 N/m.

At one point in the bungee jump, the extension of the bungee cord is 25 m.

Calculate the elastic potential energy stored by the bungee cord.

Use the equation:

elastic potential energy = 0.5 × spring constant × extension^2

[2 marks]

$E = 0.5 \times 78.4 \times 25^2$

$E = 24500$ J

Elastic potential energy = 24,500 J

Table 5 shows information about different bungee cords.

Table 5

Bungee cord	Spring constant in N/m	Maximum extension before snapping in metres
A	78.4	36
B	82.0	24
C	84.5	12

0 6 . 3 Bungee cord **C** will have a smaller extension than **A** or **B** for any bungee jumper.

Give the reason why.

[1 mark]

Has the greatest spring constant

0 6 . 4 Which bungee cord would be safest to use for a person with a large weight?

Give a reason for your answer.

[2 marks]

Bungee cord A

Reason it has the greatest extension before it snaps

3. No.4

0 4 A remote village in the UK uses a hydroelectric generator to provide electricity.

0 4 . 1 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.

[4 marks]

367.5×10^6

$GPE = mgh$

$h = \frac{E}{m \times g}$

$h = \frac{367500000}{2500000 \times 9.8}$

$h = 15m$

Mean change in vertical height = 15 m

0 4 . 2 The generator transfers 3.0 kW of electrical power.

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

Use the Physics Equations Sheet.

Give your answer in standard form.

[5 marks]

$P = \frac{E}{t} \Rightarrow t = \frac{E}{P}$

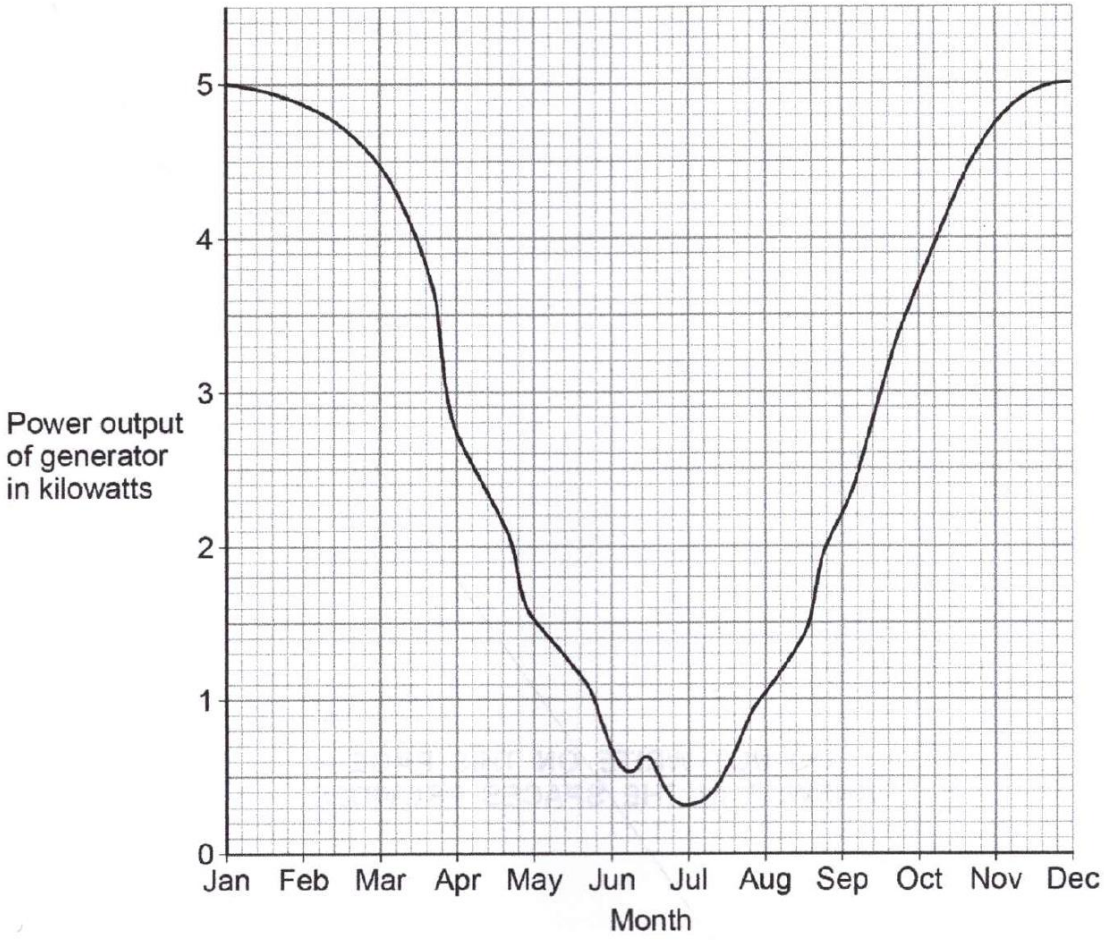
$t = \frac{2.16 \times 10^7}{3 \times 10^3}$

$t = 7200$ seconds

Time taken (in standard form) = 7.2×10^3 s

0 4 . 3 **Figure 5** shows how the power output of the generator varied during one year.

Figure 5



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 **Figure 5**.

[2 marks]

-In the Summer, the water levels are down so less power produced by hydroelectric generator.

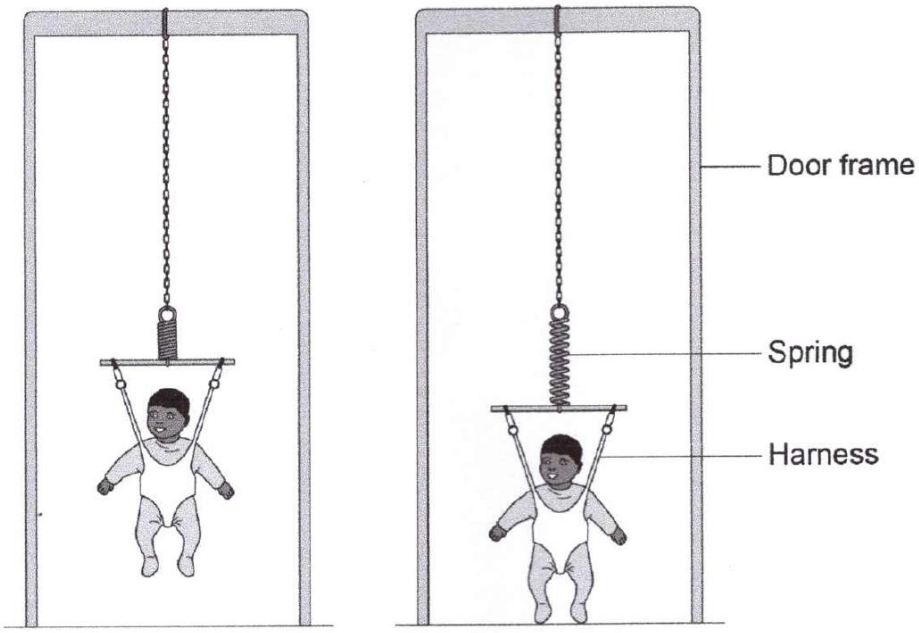
-Solar power helps cut that deficit since in the summer, there is alot of sunshine. This keeps the total power output same throughout the year.

4. No.7

0 7 A baby bouncer is a harness attached to a spring that hangs from a door frame.

Figure 7 shows a baby in a baby bouncer in two positions.

Figure 7



0 7 . 1 The baby bouncer should not be used with babies that have a mass greater than 12 kg.

Suggest **one** reason why.

[1 mark]

-The spring may be permanently damaged

-The extension may be too great, so that the baby's feet is always on the floor.

0 7 . 2 In positions **A** and **B** the baby is stationary.

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

[3 marks]

- At A the baby has Gravitational potential energy.
- As the baby moves down, GPE converts to KE and Elastic energy with the extension of the spring.
- At the bottom, all GPE and KE is converted into elastic energy.

0 7 . 3 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.

[4 marks]

Elastic Energy $= \frac{1}{2} k e^2$

$\frac{8\text{cm}}{100} = 0.08\text{m}$

$k = \frac{2E}{e^2}$

$k = \frac{2 \times 4}{0.08^2}$

$k = 1250\ \text{N/m}$

Spring constant = 1250 N/m