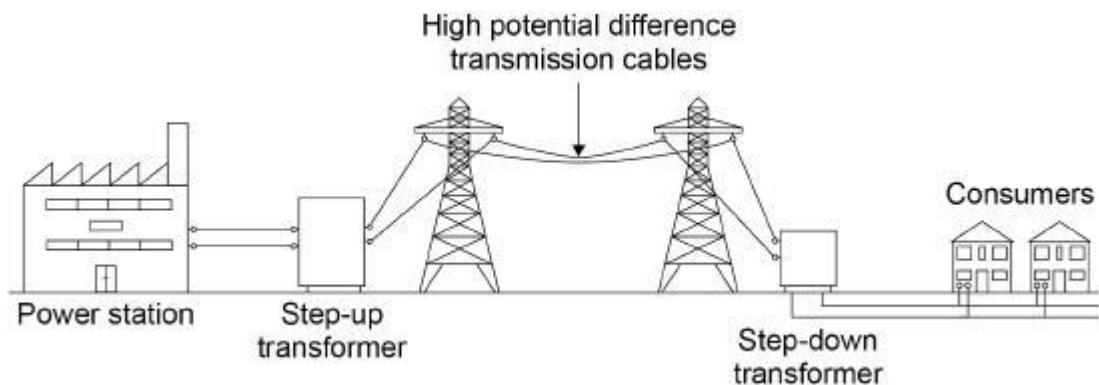


P1 Energy transfers and resources Homework Task 3

Q1. The diagram below shows how a power station supplies electricity to consumers.



- (a) The National Grid is a system of cables and transformers linking power stations to consumers.

Complete the sentences.

Choose answers from the box.

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

decrease	increase	remain the same
----------	----------	-----------------

The step-up transformer causes the potential difference to increase and the current to _____.

The use of the step-up transformer causes the energy transferred by heating of the cables to _____.

The step-down transformer causes the potential difference to decrease and the current to _____.

(3)

- (b) A nuclear power station has a power output of 350 000 000 W

Calculate the energy transferred by the power station in 60 seconds.

Use the equation:

$$\text{energy transferred} = \text{power} \times \text{time}$$

Energy transferred = _____ J (2)

The table below shows some of the waste products produced by three different types of power station.

Type of power station	Carbon dioxide produced in kg/MJ	Other waste products
Coal	0.08	sulfur dioxide
Geothermal	0.03	none
Nuclear	0.00	radioactive waste

(c) Which type of power station contributes least to global warming?

Give a reason for your answer.

Power station _____

Reason _____

(2)

(d) Which type of power station produces waste products that cause acid rain?

Give a reason for your answer.

Power station _____

Reason _____

(2)

(Total 9 marks)

Q2.

A small community of people live in an area in the mountains.
The houses are not connected to the National Grid.

The people plan to buy an electricity generating system that uses either the wind or the flowing water in a nearby river.

Figure 1 shows where these people live.

Figure 1



© Brian Lawrence/Getty Images

- (a) It would not be economical to connect the houses to the National Grid.
Give **one** reason why.

(1)

- (b) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Information about the two electricity generation systems is given in **Figure 2**.

Figure 2

<p>The wind turbine costs £50 000 to buy and install.</p> <p>The hydroelectric generator costs £20 000 to buy and install.</p> <p>The average power output from the wind turbine is 10 kW.</p> <p>The hydroelectric generator will produce a constant power output of 8 kW.</p>

Compare the advantages and disadvantages of the two methods of generating electricity.

Use your knowledge of energy sources as well as information from **Figure 2**.

(6)
(Total 7 marks)

Higher Tier Questions

Q3.

A hybrid car has an electric motor and a petrol engine.

- (a) Petrol is a non-renewable energy resource.

What is meant by a non-renewable energy resource?

(1)

- (b) The electric motor in the car is powered by a battery.

To charge the battery, the car is plugged into the mains supply at 230 V

The power used to charge the battery is 6.9 kW

Calculate the current used to charge the battery.

Current = _____ A

(4)

- (c) Mains electricity is an ac supply.

Explain the difference between direct and alternating potential difference.

(2)

- (d) The cable used to connect the car to the mains electricity supply has a low resistance.

Explain why it is better to use a cable with a low resistance than to use a cable with a high resistance.

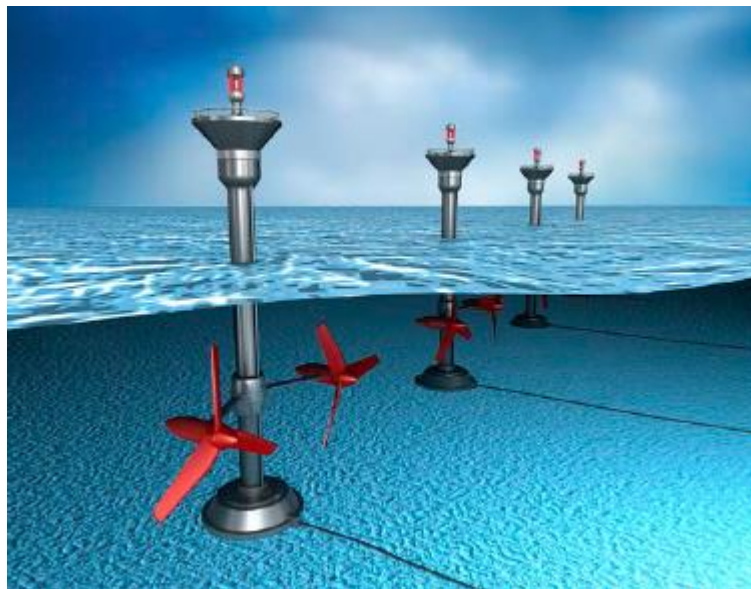
(2)
(Total 9 marks)

Q4.

Electricity in the UK is generated in many ways.

The figure below shows an undersea turbine.

The undersea turbine uses tidal energy to generate electricity.



© alex-mit/iStock/Thinkstock

- (a) What is the original source of energy for tidal power schemes?

(1)

- (b) Explain **two** advantages of using undersea tidal turbines to generate electricity rather than burning fossil fuels.

(4)

- (c) Some power stations burn wood instead of fossil fuels to generate electricity.

A coal-burning power station burns 6 million tonnes of coal per year.

Coal has an average energy value of 29.25 MJ per kg.

Wood chip from willow trees has an energy value of 13 MJ per kg.

A hectare of agricultural land can produce 9 tonnes of dry willow wood per year.

If this power station burned dry willow wood instead of coal, how much agricultural land would be needed to grow the willow?

Amount of land needed = _____ hectares

(3)

- (d) The table below shows the carbon dioxide emissions of four fuels used to generate electricity.

Fuel	Direct CO ₂ emissions in kg per MWh	Lifecycle CO ₂ emissions in kg per MWh
Coal	460	540
Natural gas	185	215
Oil	264	313
Wood	2 100	58

Direct CO₂ emissions are the amounts of carbon dioxide released when the fuel is burned.

Lifecycle CO₂ emissions is the total amount of carbon dioxide released during all stages from fuel extraction to when the fuel has been used.

Use the data from the table above to explain why wood is considered to be a low carbon dioxide emitting fuel.

(2)
(Total 10 marks)

Mark schemes

Q1.

- (a) decrease 1
- decrease 1
- increase 1
- (b) $E = 350\,000\,000 \times 60$ 1
- $E = 2.1 \times 10^{10}$ (J)
or
21 000 000 000 (J) 1
- (c) nuclear 1
- no carbon dioxide emitted 1
- (d) coal 1
- produces sulfur dioxide
ignore produces carbon dioxide 1

[9]

Q2.

- (a) any **one** from:
- high cost of installing overhead power lines or underground cables or pylons
 - high cost as (very) long cables needed
 - amount of electricity required is too low
allow not enough (surplus) electricity would be generated
- 1
- (b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should apply a 'best-fit' approach to the marking.
- Level 3 (5 – 6 marks):**
clear comparison of advantages **and** disadvantages of **each** method
- Level 2 (3 – 4 marks):**
at least **one** advantage **and one** disadvantage is stated for **one** method **and** a different advantage **or** disadvantage is stated for the other method
- Level 1 (1 – 2 marks):**
at least **one** advantage **or one** disadvantage of either method

Level 0 (0 marks):

No relevant information

examples of physics points made in the response

Advantages of both methods:

- both renewable sources of energy
- both have no fuel (cost)
- both have very small (allow 'no') running costs
- no carbon dioxide produced
 - accept carbon neutral*
 - accept no greenhouse gases*
 - accept doesn't contribute to global warming*

Advantages of wind:

- higher average power output
 - produces more energy is insufficient*

Advantages of hydroelectric:

- constant / reliable power (output)
- lower (installation) cost

Disadvantages of wind:

- higher (installation) cost
- variable / unreliable power output
- (may) kill birds / bats

Disadvantages of hydroelectric:

- lower power output
- (may) kill fish or (may) damage habitats
- more difficult to set up (within river)

Disadvantages of both methods:

- (may be) noisy
- visual pollution
 - ignore payback time unless no other relevant points made*
 - ignore time to build for both*

6

[7]

Q3.

- (a) an energy resource that cannot be replenished as it is used

allow an energy resource that will run out
ignore cannot be re-used

1

- (b)

an answer of 30 (A) scores 4 marks

$$6.9 \text{ k(W)} = 6900 \text{ (W)}$$

1

$$6900 = 230 \times I$$

allow correct substitution of an incorrectly/not converted value for power

$$6900 = 230 \times I$$

allow correct substitution of an incorrectly/not converted value for power

$$I = \frac{6900}{230}$$

allow a correct transformation using an incorrectly/not converted value for power

$$I = 30 \text{ (A)}$$

allow a correct calculation using an incorrectly/not converted value for power

- (c) direct potential difference is always in the same direction

allow direct current is always in the same direction

alternating potential difference changes direction

allow alternating current changes direction

- (d) lower potential difference across the cable

allow lower power/energy dissipation

it is more efficient

allow it won't get as hot

OR

(lower resistance gives) a greater current (for the same potential difference)

(1)

so the car battery can charge faster (1)

[9]

Q4.

- (a) gravity (of moon and sun)

- (b) any **two** from:

1 mark for statement, 1 mark for correctly linked reason

- tidal energy is renewable (1)
- so won't run out like fossil fuels (1)

or

- doesn't emit carbon dioxide
- so won't contribute to global warming / climate change

1

1

1

1

1

1

1

1

or

- doesn't emit oxides of sulfur or nitrogen
- so doesn't cause acid rain

or

- doesn't use fossil fuels
- so less impact on environment of extraction / transport

or

- doesn't produce particulates
- so less effect on health / environment

Max. 4

(c) coal consumption per year = $29.25 \times 1000 \times 6$ million = 175 500 000 000 MJ

1

1 hectare of willow will produce $9 \times 13 \times 1000 = 117\,000$ MJ per year

1

so need $175\,500\,000\,000 \div 117\,000 = 1\,500\,000$ (hectares)

1

allow 1 500 000 with no working shown for 3 marks

(d) although has higher direct emissions than other fuels

1

it has much lower lifetime emissions

1

[10]