

## GCSE BITESIZE Examinations

General Certificate of Secondary Education

**AQA SCIENCE A            PHY1A**

Unit Physics P1a    (Energy and Electricity)

**AQA Physics**

Unit Physics P1a    (Energy and Electricity)

HIGHER TIER

**Specimen Paper**

**Time allowed: 30 minutes**

**Maximum marks: 36**

### **Instructions**

- Answer **all** of the questions for the Tier you are attempting.
- Record your answers on a separate answer sheet only.
- Do all rough work in this book - **not** on your answer sheet.

### **Advice**

- Do **not** choose more responses than you are asked to. You will lose marks if you do.

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**HIGHER TIER**

**SECTION ONE**

Questions **ONE** and **TWO**

In these questions, match the letters **A**, **B**, **C** and **D** with the numbers **1-4**.

Use **each** answer only **once**.

Mark your choice on the answer sheet.

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**QUESTION ONE**

Coal-fired power stations are connected to the national grid.

Match the words **A**, **B**, **C** and **D** with the numbers **1-4** in the table.

- A** Transformer
- B** Turbine
- C** Generator
- D** Boiler

	Description
<b>1</b>	Changes current and voltage for transmission
<b>2</b>	Transforms chemical energy into thermal energy
<b>3</b>	Its blades are rotated by steam
<b>4</b>	Transforms kinetic energy into electrical energy

Turn over ►

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## QUESTION TWO

Read the article below:

### The quest for nuclear fusion

Nuclear fusion is a nuclear reaction which occurs in the Sun, producing huge amounts of energy with virtually no pollution. In 2002, a team from Oak Ridge National Laboratory in the US claimed to have achieved nuclear fusion in a table-top device. Fusion creates tiny particles called neutrons, which the scientists measured as evidence that nuclear fusion had occurred.

However, many scientists were sceptical, as they were unable to reproduce the results. Another team of scientists used a piece of equipment with a smaller scale to measure a different indicator of nuclear fusion. They found that nuclear fusion had not occurred, and that it was likely the original team measured neutrons in the background.

Match words **A**, **B**, **C** and **D** with the numbers **1-4** in the sentences.

- A** precise
- B** valid
- C** controlled
- D** reliable

To make the test fair, the first team of scientists made sure that all of the other variables in their experiment were ...**1**....

However, when other scientists could not reproduce the results of the original experiment, this meant the data was not ...**2**....

Another team of scientists used a piece of equipment with a smaller scale, making their measurements more ...**3**.... than those of the original team.

The technique the second team of scientists used to measure whether nuclear fusion had taken place answered the original question, making it more ...**4**....

Turn over ►

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## SECTION TWO

### Questions THREE to NINE

Each of these questions has four parts.

In each part, choose only **one** answer.

Mark your choices on the answer sheet.

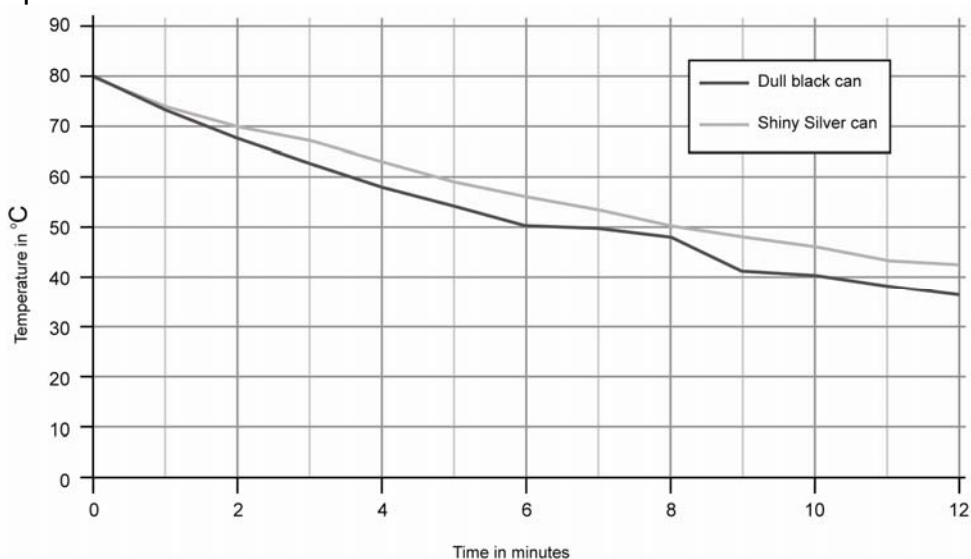
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### QUESTION THREE

A group of students investigated thermal energy transfer. They took two cans, painting one in shiny silver conductive paint, and the other in matt black conductive paint.

They later added  $300\text{cm}^3$  of hot water to each can, then measured the temperature of each can every minute using a thermometer.

The graph below shows their results:



- 3A** The students needed to control key variables in order to make it a fair test. Which row of the table shows the variables which should be controlled and changed?

	Time cans were left for	Type of surface paint
1	same	different
2	different	different
3	different	same
4	same	same

**3B** Which result/results should the group repeat?

- 1 Ten minutes for the shiny silver can
- 2 Six and seven minutes for the dull black can
- 3 Eight minutes for the dull black can
- 4 Seven and eight minutes for the dull black can

**3C** Which conclusion can be drawn from the data?

- 1 Dull black surfaces are best at conducting thermal radiation.
- 2 Dull black surfaces are best at emitting thermal radiation.
- 3 Shiny silver surfaces are best at absorbing thermal radiation.
- 4 Shiny silver surfaces are best at conducting thermal radiation.

**3D** The rate of heat loss for both cans is at its greatest early in the experiment, then it starts to decrease.

The most likely reason for this is that...

- 1 the group measured the temperatures inaccurately.
- 2 the air surrounding the can acted as an insulator.
- 3 the temperature difference between the can and the surroundings became less.
- 4 the room became hotter and transferred heat into the can.

Turn over ►

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## QUESTION FOUR

A study by calculated the savings which could be made if an average three-bedroom detached house was made more energy efficient.

Energy-saving item	Installation cost in £	Annual saving in £ per year	Carbon dioxide reduction in kg per year
Cavity wall insulation	500	90	750
Loft insulation	180	30	250
Insulating pipes	10	10	65
Hot water tank insulation	12	20	65
Double-glazing	3000	90	740
Energy-saving light bulbs	1.50	7	26
Draught-proofing	90	20	150
Floor insulation	90	45	370

**4A** Pay back time is the time it takes for a product to save more money than it originally cost. Using the information in the table, which **insulating** product has the quickest pay back time?

- 1 Draught-proofing
- 2 Insulating pipes
- 3 Hot water tank insulation
- 4 Floor insulation

Turn over ►

**4B** Approximately how greater is the reduction in carbon dioxide emissions as a result of installing double-glazing compared with loft insulation?

- 1 Three times more
- 2 Four times more
- 3 Five times more
- 4 Six times more

**4C** The study found that the use of energy-saving light bulbs actually meant the boiler required more gas to heat the house.

The most likely explanation for this is that...

- 1 less energy was being transferred by the boiler.
- 2 energy-saving bulbs were absorbing heat energy.
- 3 the energy-saving bulbs were wasting less heat.
- 4 the boiler had become less efficient.

**4D** The savings shown in the study would not be correct for most houses. Terraced houses would make fewer savings by installing these products.

Why would terraced houses make fewer savings?

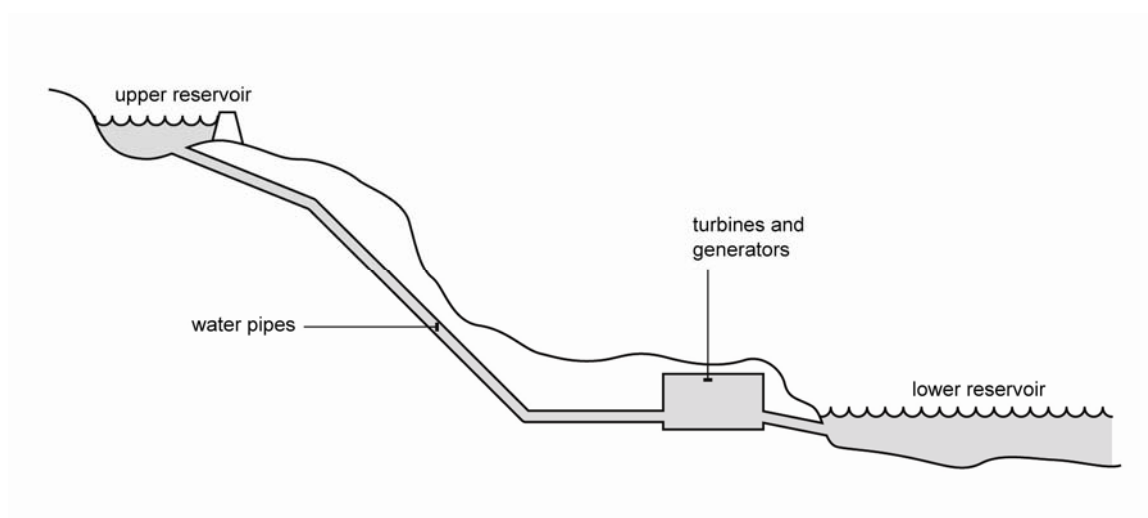
- 1 They are often already well insulated.
- 2 They have fewer external walls through which to lose heat.
- 3 The people who live there often use energy-efficient appliances already.
- 4 Terraced houses are always smaller than detached houses.

Turn over ►

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## QUESTION FIVE

The diagram below shows a cross-section through a hydroelectric power station.



**5A** In a hydroelectric power station, the main energy transformations that take place are...

- 1 chemical → kinetic → electrical
- 2 gravitational potential → kinetic → electrical
- 3 gravitational potential → kinetic → heat → electrical
- 4 chemical → heat → kinetic → electrical

**5B** Hydroelectric power stations can respond very quickly to short surges in the demand for electricity in the UK.

Another source of energy in the UK that can respond very quickly to short surges in the demand for electricity is...

- 1 tidal.
- 2 wave.
- 3 wind.
- 4 geothermal.



**5C** One disadvantage of hydroelectric power stations is that they...

- 1 cause the large-scale loss of animal and plant habitats.
- 2 produce sulfur dioxide gas.
- 3 generate a lot of heat and noise pollution.
- 4 are unreliable during heavy rain or stormy conditions.

**5D** Hydroelectric power stations often use surplus electricity to pump water from the lower reservoir up to the upper reservoir.

This is done because...

- 1 it supplies homes near the upper reservoir with water.
- 2 it prevents flooding around the lower reservoir.
- 3 it stores the water for use again during periods of high demand.
- 4 the water is important for cooling the steam in the turbines.

Turn over ►

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## QUESTION SIX

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

$$\text{total cost} = \text{number of kilowatt-hours} \times \text{cost per kilowatt-hour}$$

This question is about energy-saving light bulbs.

- 6A** A 100W traditional filament bulb that is on for 20 minutes will transfer 120 kJ of energy.

The efficiency of a filament bulb is 5 per cent.

Calculate the amount of useful energy that will be transferred by the bulb.

- 1 6 kJ
- 2 24 kJ
- 3 60 kJ
- 4 600 kJ

Turn over ►

**6B** An energy-saving bulb gives out 3.5 kJ of light over a 20-minute period.

The electrical energy input to the bulb will be...

- 1 less than 2 kJ
- 2 less than 3.5 kJ
- 3 3.5 kJ
- 4 more than 3.5 kJ

**6C** What will happen eventually to the useful energy transferred by the bulb?

- 1 It will be destroyed.
- 2 It will be transformed into potential energy.
- 3 It will be transferred to the surroundings as heat.
- 4 It will be recycled back into electrical energy.

**6D** An average 60W bulb has a lifetime of 1,000 hours, during which time it will use 60 kWh of electricity. A comparable energy-saving bulb will only use 11 kWh if used for the same amount of time.

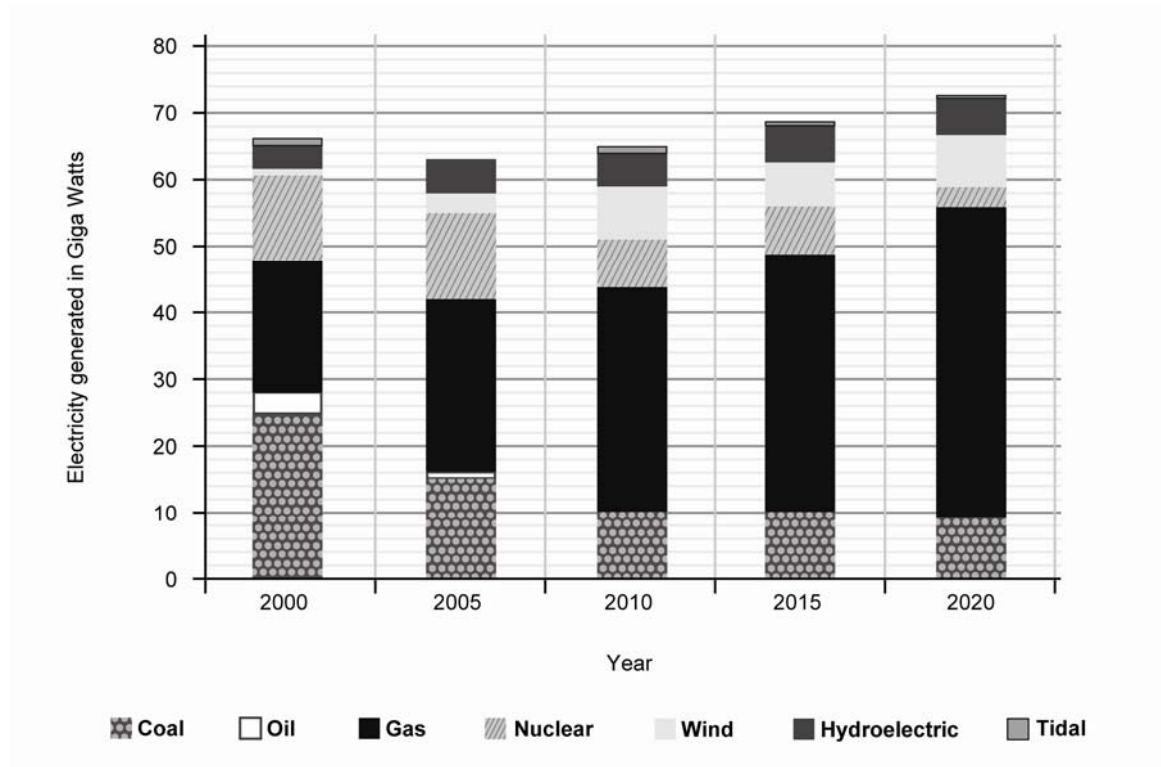
Let's say electricity costs 10p per kilowatt-hour.  
Calculate the amount of money that the person would save (on their electricity bill) by using energy-saving bulbs.

- 1 £ 1.10
- 2 £ 4.90
- 3 £ 110.00
- 4 £ 490.00

Turn over ►

## QUESTION SEVEN

The graph below shows the energy sources used to generate electricity in 2000 and 2005. It also shows projections for future sourcing.



**7A** Which of the following is the correct order, starting with the largest energy source, for electricity generation in 2005?

- 1 Gas, nuclear, coal, wind
- 2 Gas, coal, hydroelectric, nuclear
- 3 Gas, nuclear, coal, hydroelectric
- 4 Gas, coal, nuclear, hydroelectric

Turn over ►

**7B** Using the data from the graph, approximately how much of the UK's electricity was generated from non-renewable sources in 2005?

- 1 15 gigawatts
- 2 25 gigawatts
- 3 42 gigawatts
- 4 55 gigawatts

**7C** Based on the predictions in the graph, approximately how much electricity will be generated from gas in the UK by 2020?

- 1 Eight gigawatts
- 2 26 gigawatts
- 3 47 gigawatts
- 4 56 gigawatts

**7D** By 2020, it is projected that the amount of electricity generated from renewable sources will have doubled from 2005 levels.

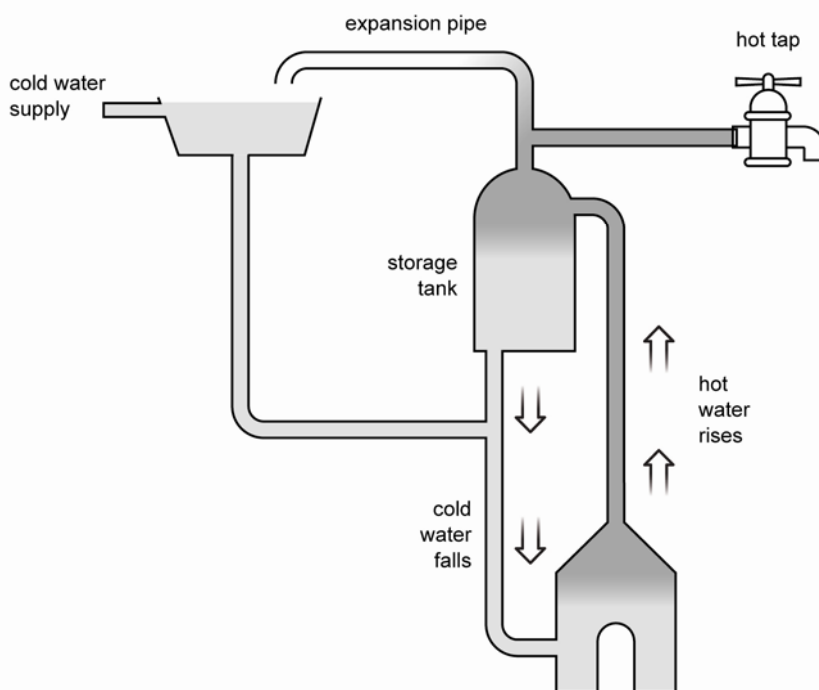
The advantage of using more renewable sources of energy is...

- 1 they do not damage the environment.
- 2 they generate less atmospheric pollution.
- 3 they generate cheaper electricity.
- 4 they are more reliable than non-renewable sources.

Turn over ►

## QUESTION EIGHT

Some houses have hot water systems in which water is heated in a boiler and then transferred to a storage tank. Switching on hot water taps drains the storage tank, and it must then be filled up again before more hot water becomes available.



**8A** Read the statements in the box below:

- i) All hot objects emit infrared radiation.
- ii) Polishing the pipes will reduce the heat loss due to radiation.
- iii) Putting fibreglass insulation around the tank reduces heat loss from the surface of the tank due to radiation.

Which of the statements in the box are correct?

- 1 Statements **i)**, **ii)** and **iii)**
- 2 Statements **i)** and **ii)**
- 3 Statements **i)** and **iii)**
- 4 Statements **ii)** and **iii)**

- 8B** In the boiler, thermal energy is transferred to the water. Which of these statements explains how the heat energy is spread by convection?
- 1 Water molecules expand, become less dense and rise, carrying the heat energy with them.
  - 2 The water molecules gain kinetic energy and move apart, causing the region of water above the flame to expand and rise, carrying the heat with it.
  - 3 Water molecules gain kinetic energy and vibrate against one another, passing the heat energy along throughout the water.
  - 4 Free electrons from the water molecules gain kinetic energy and move, colliding with other free electrons and spreading the energy.

**8C** The pipes and storage tanks are made of metal. In addition to heat loss from radiation, heat is also lost through the metal due to conduction.

Which of these statements describes heat energy conduction in metals?

- 1 The thermal energy provides the atoms with additional kinetic energy, enabling them to move through the metal more quickly.
  - 2 The vibration of the atoms creates waves of energy which travel through the metal.
  - 3 Free electrons gain kinetic energy, enabling them to move faster and collide with other free electrons, transferring the energy through the metal.
  - 4 Free electrons gain kinetic energy and expand, becoming less dense and rising through the metal.
- 8D** The heat from a boiler can sometimes be supplemented using an electric immersion heater. If the immersion heater is put on for 20 minutes, 1.98 kWh of electrical energy is transferred to it.

$$\begin{array}{ccccc} \text{energy transferred} & = & \text{power} & \times & \text{time} \\ \text{(kilowatt-hour. kWh)} & & \text{(kilowatt. kW)} & & \text{(hour. h)} \end{array}$$

Using the equation above, calculate the power of the immersion heater.

- 1 0.65 kW
- 2 0.099 kW
- 3 5.94 kW
- 4 39.6 kW

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## QUESTION NINE

The table below shows the estimated cost, per kilowatt-hour, of generating electricity from some of the main sources available in the UK.

Energy source	Building cost	Fuel cost	Running cost	Decommissioning cost
Coal	1.1p	1.5p	0.3p	0.1p
Gas	0.4p	2.5p	0.5p	0.1p
Nuclear	1.5p	0.5p	0.5p	2.5p
Wind	4.2p	zero	0.9p	0.2p
Tidal	4.9p	zero	1.7p	0.2p
Biomass	2.7p	0.9p	3.3p	0.1p

**9A** Ignoring building and decommissioning costs, which method of generating electricity is the cheapest per kWh?

- 1 Coal
- 2 Gas
- 3 Nuclear
- 4 Wind

**9B** The government is seeking to generate 20 per cent of the electricity we use from renewable sources by 2020.

Considering the running cost only, how much more would it cost to generate 1,000 kilowatt-hours of electricity from the **cheapest** renewable source compared with a gas-fired power station?

- 1 £4
- 2 £9
- 3 £90
- 4 £400



- 9C** Which of these statements is supported by the data in the table?
- 1 Taking into account the total cost, tidal is the most expensive method of generating electricity.
  - 2 The total cost of generating electricity from nuclear is twice as much as it is from coal.
  - 3 The cost of generating electricity from some renewable sources is cheaper than from some non-renewable sources.
  - 4 The total cost of generating electricity from biomass is twice as much as it is from gas.

- 9D** Despite high fuel costs, it is still cheaper to generate electricity from fossil fuels or nuclear than it is from wind.

This is mainly because...

- 1 the cost of restoring the landscape when wind farms are decommissioned is far greater than the decommissioning costs of nuclear, gas or coal.
- 2 the energy in wind is more dilute, so there is a greater cost associated with buying more land and building hundreds of windmills to harness enough of it.
- 3 the infrastructure for delivering nuclear and fossil fuels to the power stations is well established.
- 4 there are more energy transformations involved in the electricity-generation process in a wind turbine, so it is less efficient.

**END OF QUESTIONS**