



Energy Resources and Energy Transfers

FREE Online Physics GCSE Course

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Name _____ Date _____

TIME ALLOWED

55 minutes

TOTAL MARKS

42 DOUBLE AWARD · **56** PHYSICS

YOU WILL NEED

a ruler, a pencil, a black or blue pen and a calculator

Instructions

- **Physics:** answer **all** questions (55 minutes).
- **Double Award (Science):** answer Questions 1–5 (40 minutes). Skip Questions 6 and 7.
- Write your answers in the spaces provided, in black or blue ink. Draw diagrams in pencil.
- In calculations, show clearly how you work out your answer. Use $g = 10 \text{ N/kg}$.

Information

- The marks for each question are shown in brackets.
- Physics is out of 56 marks. Double Award (Science) is out of 42 marks.
- Questions 6 and 7 (generating electricity) are **Physics only**.

Your score

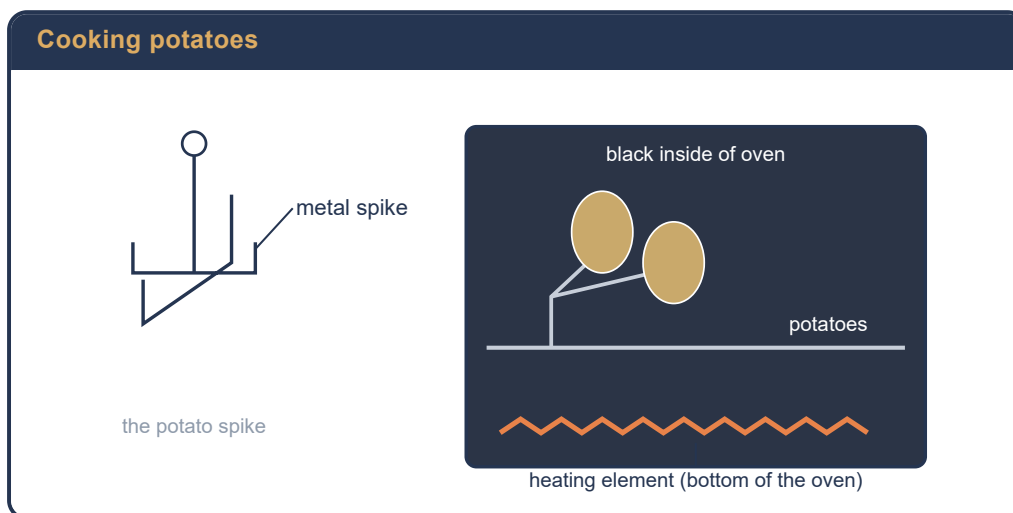
Question	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Total	%
Out of	6	8	12	10	6	6	8	42 / 56	100
Your mark									

Marking your test

The full mark scheme is at the back of this booklet. Try every question first, then mark your answers in a different colour.

1 Question 1**6 marks**

The diagram shows a metal device for cooking potatoes. Potatoes are pushed onto the metal spikes. Two potatoes are cooked on the device in an electric oven. The inside of the oven is black. The heating element is at the bottom of the oven.



Describe the different ways in which energy is transferred to cook the potatoes.

(6)**Total for this question: 6 marks**

2 Question 2**8 marks**

Four electrical appliances are: **A** a food mixer, **B** a kettle, **C** a lamp and **D** a radio.

- (a) (i) Which appliance is designed to transfer electrical energy to thermal energy?

Tick (✓) **one** box.

A food mixer ☐	B kettle ☐	C lamp ☐	D radio ☐
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(1)

- (ii) Which appliance is designed to transfer electrical energy to kinetic energy?

Tick (✓) **one** box.

A food mixer ☐	B kettle ☐	C lamp ☐	D radio ☐
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(1)

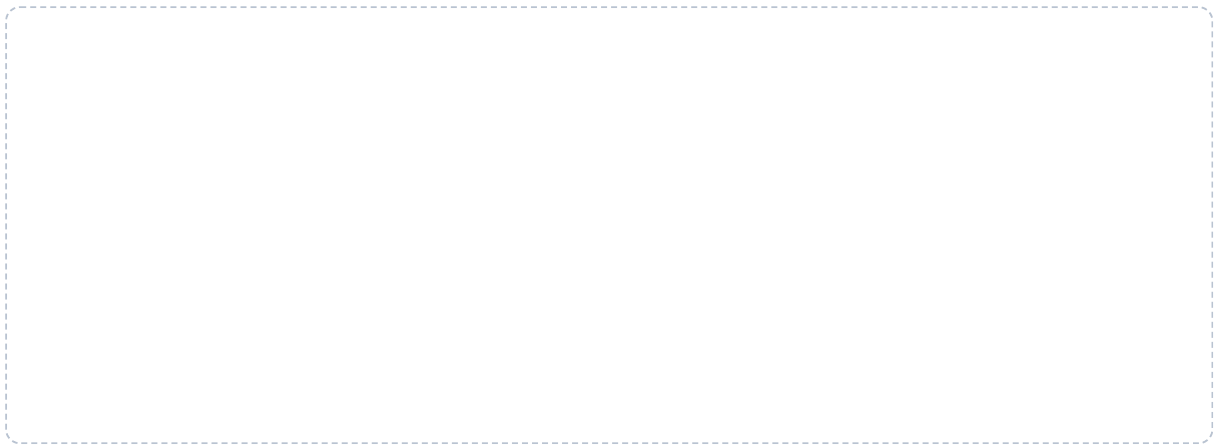
- (b) In all the appliances, energy is conserved. What is meant by the phrase **energy is conserved**?

(1)

- (c) (i) The lamp has an efficiency of 20%. Explain what this means.

(2)

- (ii) Draw a labelled Sankey diagram for the lamp.



(3)

Total for this question: 8 marks

3 Question 3

12 marks

A student investigates how the surface area of water affects how quickly it cools down. He puts warm water into different shaped containers.

This is the student's plan.

I will use four different containers and work out the surface area of water in each one.

I will heat some water and pour the same volume into each container.

I will put a thermometer into each container and measure the water temperatures.

After 15 minutes I will measure the temperatures again.

- (a) State the independent variable in this investigation.

(1)

- (b) (i) State **one** variable that the student plans to control.

(1)

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- (ii) Explain why it is important to control this variable.

(2)

- (c) Suggest a safety precaution for this investigation.

(1)

- (d) The table shows the student's results.

Surface area in cm ²	Starting temperature in °C	Temperature after 15 minutes in °C	Temperature difference in °C
600	85	54	
400	95	55	
300	88	60	
150	85	60	

- (i) Complete the table by inserting the missing temperature differences.

(2)

- (ii) The student wants to display the data on a graph. Give suitable labels for the axes of his graph.

x-axis _____

y-axis _____

(3)

- (iii) The student realises that it was a mistake to have different starting temperatures. Suggest how he could change his method to correct this mistake.

(2)

Total for this question: 12 marks

4 Question 4

10 marks

A flying squirrel is an animal that can glide through the air. It spreads out its limbs to stretch a membrane that helps it to glide.

- (a) The mass of a flying squirrel is 0.19 kg. It climbs 17 m up a tree.

- (i) State the equation linking gravitational potential energy (GPE), mass, g and height.

(1)

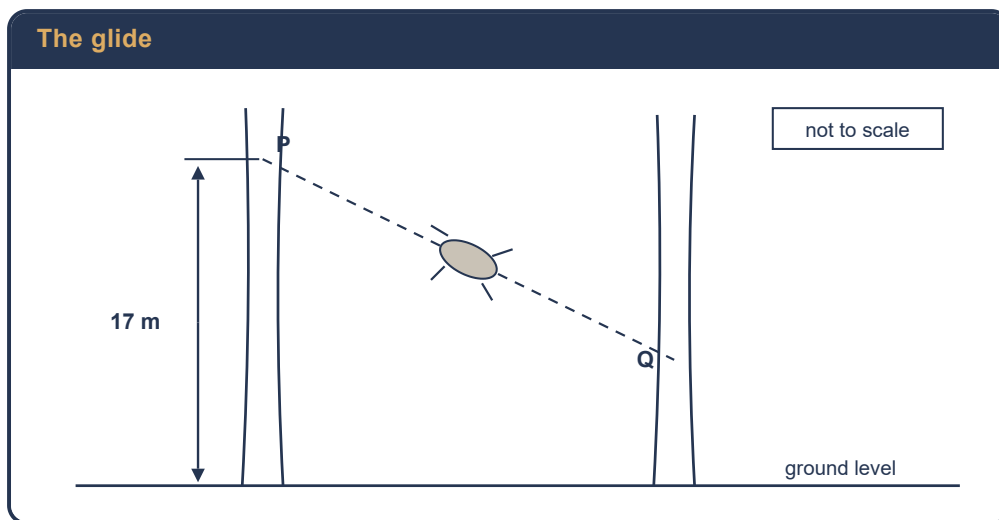
- (ii) Calculate the GPE gained by the squirrel during this climb.

GPE = _____ J
(2)

- (iii) State the amount of work done against the force of gravity by the squirrel during this climb.

Work done = _____ J
(1)

- (b) The flying squirrel glides from P to Q with a constant velocity of 13 m/s.



- (i) Add labelled arrows to the diagram to show the directions of the forces of weight and drag acting on the squirrel.

(2)

- (ii) State the equation linking kinetic energy (KE), mass and velocity.

_____ (1)

- (iii) Calculate the KE of the squirrel as it glides.

KE = _____ J (2)

- (iv) The velocity of the squirrel decreases to zero when it reaches the second tree because

Tick (✓) **one** box.

A an unbalanced force acts on the squirrel ☐

B no force acts on the squirrel ☐

C the GPE of the squirrel increases ☐

D the KE of the squirrel increases ☐

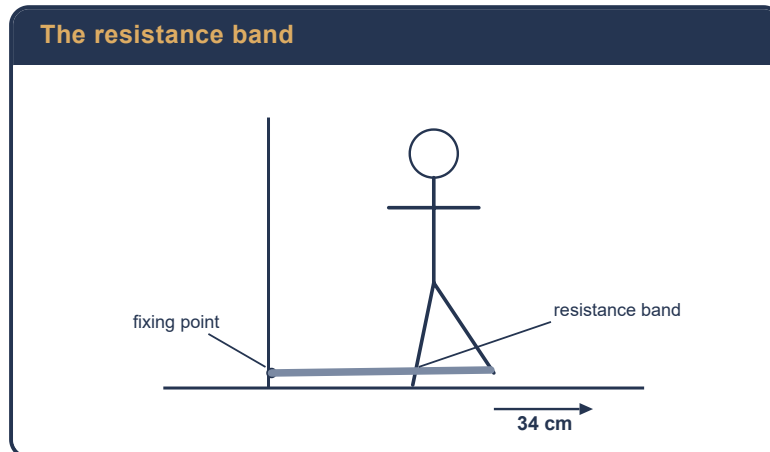
(1)

Total for this question: 10 marks

5 Question 5
6 marks

A resistance band is a stretchy plastic band that is used when doing exercises. The diagram shows a student exercising his leg by stretching a resistance band fixed to a wall.

The student moves his leg 34 cm sideways as shown. The average resistance force is 23 N.



- (a) (i) State the relationship between work done, force and distance moved.

_____ (1)

- (ii) Calculate the work done when the student moves his leg sideways once.

Work done = _____ J
(2)

- (b) The student repeats this movement 15 times in 1 minute. Calculate the average power of the student during this exercise.

Power = _____ W
(3)

Total for this question: 6 marks

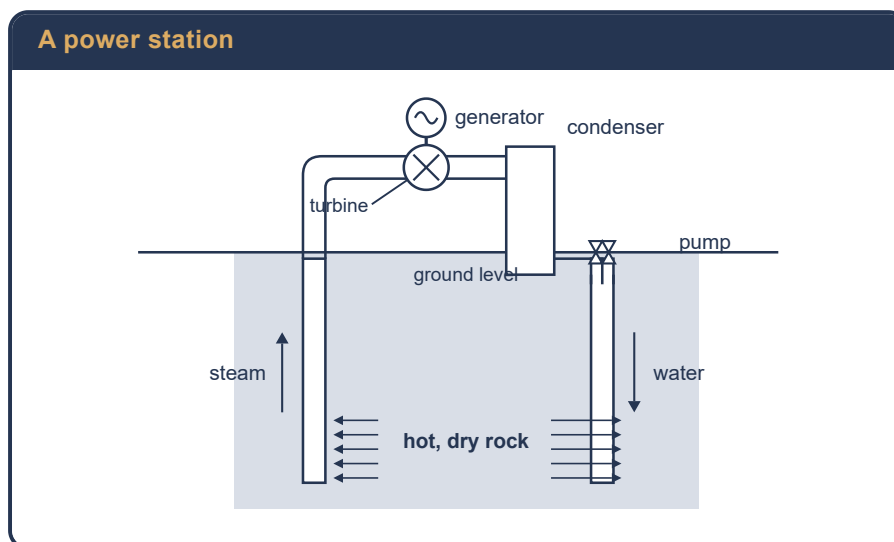
6 Question 6

Physics only

6 marks

Physics only. Double Award (Science) students: skip Questions 6 and 7.

The diagram shows a type of power station used to generate electricity.



- (a) (i) What type of renewable resource does this power station use?

(1)

- (ii) Name another renewable resource.

(1)

- (b) Cold water is pumped down into the hot, dry rock. Describe the energy transfers at each stage of electricity generation from this resource.

(4)

Total for this question: 6 marks

7 Question 7

Physics only

8 marks

Physics only.

A small building has a wind turbine and a panel of solar cells, used for generating electricity from renewable sources.

- (a) Complete the sentences using words from the box.

chemical

heat

kinetic

light

sound

- (i) The panel of solar cells transforms energy into electrical energy.

(1)

- (ii) The wind turbine transforms energy into electrical energy.

(1)

- (b) On a windy day, the wind turbine transfers 78 W of power.

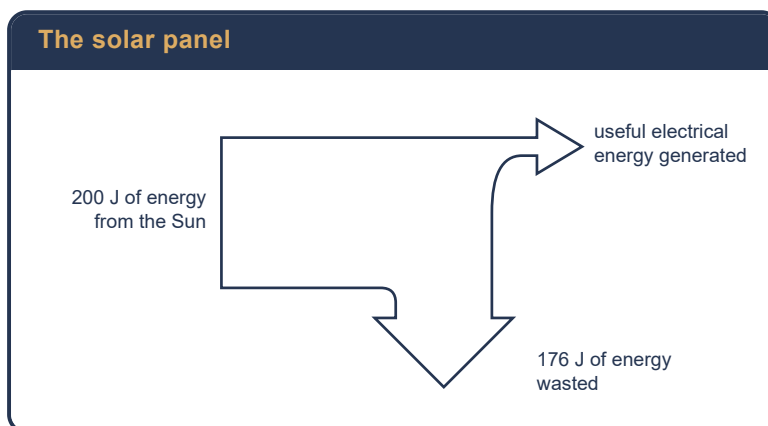
- (i) State the equation linking power, energy transferred and time.

(1)

- (ii) Calculate the amount of energy the turbine transfers in 10 s.

Energy transferred = _____ J
(3)

- (c) The Sankey diagram shows the energy transferred by the panel of solar cells.



Show that the efficiency of the panel of solar cells is 12%.

(2)

Total for this question: 8 marks

END OF TEST

Now mark your answers using the mark scheme that follows.

MARK SCHEME

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[1] in the Mark column means one mark for that line.

accept / allow notes (gold) are other answers that also score.

reject / do not accept notes (red) are answers that do not.

1 Question 1 — mark scheme

Spec 4.6, 4.7, 4.8

6 marks

PART	ANSWER	MARK
	any six of:	6
	● conduction: the metal spike conducts thermal energy (<i>metal is a good conductor</i>) ● conduction: thermal energy is conducted into the middle of the potato (<i>it is cooked from the inside</i>) ● convection: convection currents form in the oven ● convection: because the air expands / its density decreases (so it rises) ● convection: the potatoes receive hotter air near the top of the oven ● radiation: thermal energy is radiated / emitted from the black surfaces ● radiation: the potatoes absorb thermal energy from all sides (<i>cooked from the outside</i>) ● general: electrical energy is transferred to thermal energy in the heating element	
	allow "heat" for thermal energy throughout	
	ignore references to absorption by the oven walls	

Total: 6 marks

2 Question 2 — mark scheme

Spec 4.2, 4.3, 4.4, 4.5

8 marks

PART	ANSWER	MARK
(a)(i)	B kettle	1
(a)(ii)	A food mixer	1
(b)	any one of: the total energy always stays the same; energy cannot be created or destroyed; energy input = energy output	1
	allow "none is lost, it is just transferred"	

(c)(i) 20% of the energy input **and** is transferred usefully / as light

2

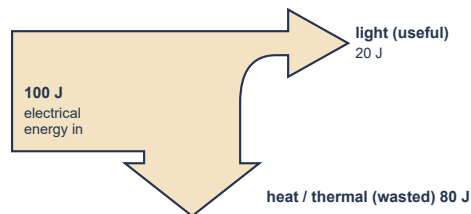
or: 80% of the energy input (1) is wasted / transferred as heat (1)

"20%" or "80%" alone is not enough: energy input / energy used must be mentioned

allow 1 mark for a definition of efficiency; condone power for energy

(c)(ii) one input arrow and **only** two output arrows

1



the outputs may point either way, or the same way

roughly correct proportions: light about $\frac{1}{4}$ of the width of heat, and outputs add up to the input

1

there must be no size difference between the input and the two outputs together

two correct labels from: input / electrical / total; useful / light; wasted / heat / thermal

1

ignore % on labels and "sound"

Total: 8 marks

3

Question 3 — mark scheme

Spec 4.9, 4.10

12 marks

PART	ANSWER	MARK
(a)	(surface) area	1
(b)(i)	any one of: volume of water; timing period (15 minutes) ignore the conditions of the room	1
(b)(ii)	any two of: - this variable would affect the heat loss - otherwise you would not know which variable mattered - otherwise it is not a fair test / the results would not be valid allow a description of how the variable would affect the heat loss	2
(c)	any suitable, e.g. take care with hot water; keep containers away from the edge of the bench; stand up while doing it allow gloves, goggles	1

(d)(i) 31, 40, 28, 25

2

Surface area in cm ²	Starting temperature in °C	Temperature after 15 minutes in °C	Temperature difference in °C
600	85	54	31
400	95	55	40
300	88	60	28
150	85	60	25

all four correct = 2 marks; -1 for each mistake; minimum 0

(d)(ii) temperature (difference)

1

which axis is which does not matter

(surface) area **or** time

1

relevant units on both, e.g. °C and cm²

1

(d)(iii) any **two** of:

2

- use water at the same starting temperature
- pour it in and wait until that temperature is reached before timing
- a method to keep the gap between pouring and starting small, e.g. do one at a time, use helpers
- put the containers (with the same volume) in a water bath

accept other sensible workable methods; allow two different methods

Total: 12 marks

4

Question 4 — mark scheme

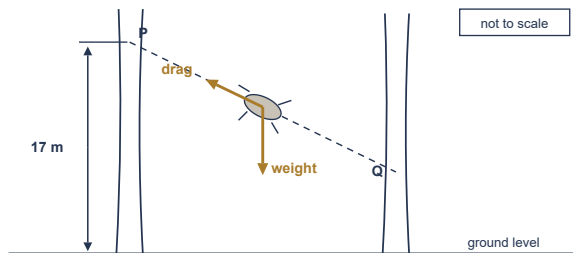
Spec 4.12, 4.13, 4.14, 4.15

10 marks

PART	ANSWER	MARK
(a)(i)	GPE = mass × g × height allow GPE = mgh; reject "gravity" for g	1
(a)(ii)	substitution: GPE = 0.19 × 10 × 17 32 J accept 32.3 J (31.6 J with g = 9.8) allow 32 300 for 1 mark	1 1
(a)(iii)	the same value as (a)(ii): 32 J allow "the same"	1

(b)(i) weight arrow acting vertically downwards

1

no label = no mark; allow W or mg ; ignore "gravity"

drag arrow acting backwards along the line of motion (opposite to the glide)

1

(b)(ii) $KE = \frac{1}{2} \times \text{mass} \times \text{velocity}^2$

1

allow $KE = \frac{1}{2}mv^2$ (b)(iii) substitution: $KE = \frac{1}{2} \times 0.19 \times 13^2$

1

16 J

1

16.055; 16 055 gets 1 mark

(b)(iv) A an unbalanced force acts on the squirrel

1

Total: 10 marks

5

Question 5 — mark scheme

Spec 4.11, 4.16, 4.17

6 marks

PART	ANSWER	MARK
(a)(i)	work done = force $\times$ distance moved accept standard symbols and rearrangements	1
(a)(ii)	substitution: 23×0.34 a power-of-ten error (cm not converted) loses 1 mark	1
	7.8 J accept 7.82 J	1
(b)	time for one movement: 15 times in 60 s, so 4 s or total work done = $15 \times 7.82 = 117$ J, divided by 60 s	1
	substitution: $P = 7.8 \div 4$ allow error carried forward from (a)(ii)	1
	2.0 W accept 1.955 W, 2 W allow 1 mark only for $7.82 \div 60$ or $782 \div 60$	1

Total: 6 marks

6

Question 6 — mark scheme

Physics only · Spec 4.18P

6 marks

PART	ANSWER	MARK
(a)(i)	geothermal	1
(a)(ii)	any suitable renewable resource, e.g. wind, hydroelectric, waves, tidal, solar, biofuels / biomass allow photovoltaic cells, (sun)light, wood ignore nuclear; ignore "water" on its own	1
(b)	any four of: - thermal energy is transferred from the hot rock to the cold water / the water heats up - the water molecules gain kinetic energy (as they are heated) / the water turns into steam - the steam gains kinetic energy as it is heated by the rock - the GPE of the steam increases as it rises - the turbine gains kinetic energy from the steam - the generator transfers kinetic energy (from the turbine) to electrical energy - the pump transfers electrical energy to GPE / KE of the water allow "mechanical energy" for KE and "heat" for thermal energy throughout	4

Total: 6 marks

7

Question 7 — mark scheme

Physics only · Spec 4.4, 4.17, 4.18P

8 marks

PART	ANSWER	MARK
(a)(i)	light	1
(a)(ii)	kinetic	1
(b)(i)	power = energy (transferred) ÷ time (taken) accept energy = power × time, $P = E \div t$	1
(b)(ii)	substitution: $78 = \text{energy} \div 10$ substitution and rearrangement in either order	1
	rearrangement: energy = 78×10	1
	780 J the correct answer scores all 3 marks, whatever the working	1
(c)	useful energy = $200 - 176 = 24 \text{ J}$ or: wasted = $176 \div 200 = 88 \%$	1

$$\text{efficiency} = 24 \div 200 (\times 100) = 12 \%$$

or: $\text{useful} = 100 - 88 = 12 \%$

the second line of working scores both marks

1

Total: 8 marks

END OF MARK SCHEME
