



Energy

FREE Online Physics GCSE Course

physicswithkate.com

Name _____ Date _____

TIME ALLOWED

40 minutes

TOTAL MARKS

41

YOU WILL NEED

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

Instructions

- Answer **all** questions.
- Write your answers in the spaces provided.
- Use black or blue ink.
- In calculations, show clearly how you work out your answer.

Information

- The marks for each question are shown in brackets.
- The maximum mark for this test is 41.
- You are reminded of the need for good English and clear presentation in your answers.

Your score

Question	Q1	Q2	Q3	Q4	Q5	Q6	Total	%
Out of	5	8	7	8	8	5	41	100
Your mark								

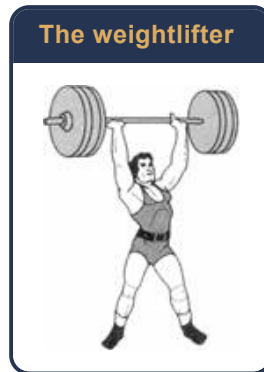
Marking your test

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

5 marks

A weightlifter picks up a barbell.



- (a) Which type of energy is stored in the barbell when it is held above the weightlifter's head?

Tick (✓) **one** box.

A Chemical potential

☐

B Elastic potential

☐

C Gravitational potential

☐

D Kinetic

☐

(1)

- (b) The weightlifter drops the barbell. Which energy store of the barbell increases as the barbell falls?

Tick (✓) **one** box.

A Chemical potential

☐

B Elastic potential

☐

C Gravitational potential

☐

D Kinetic

☐

(1)

- (c) Use the data in the table to draw a line between each calculation and the energy change it is calculating. Draw **two** lines only.

Quantity	Value
mass of barbell	50 kg
gravitational field strength	9.8 N/kg
height the barbell drops	2 m
maximum speed of the barbell as it drops	6.2 m/s

Calculation

Increase / decrease in

$$50 \times 9.8 \times 2$$

Chemical potential energy

Elastic potential energy

Gravitational potential energy

$$\frac{1}{2} \times 50 \times 6.2 \times 6.2$$

Kinetic energy

(1)

- (d) Explain why the weightlifter's chemical store of energy decreased more when he lifted the bar than the bar's gravitational potential store of energy gained.

(2)

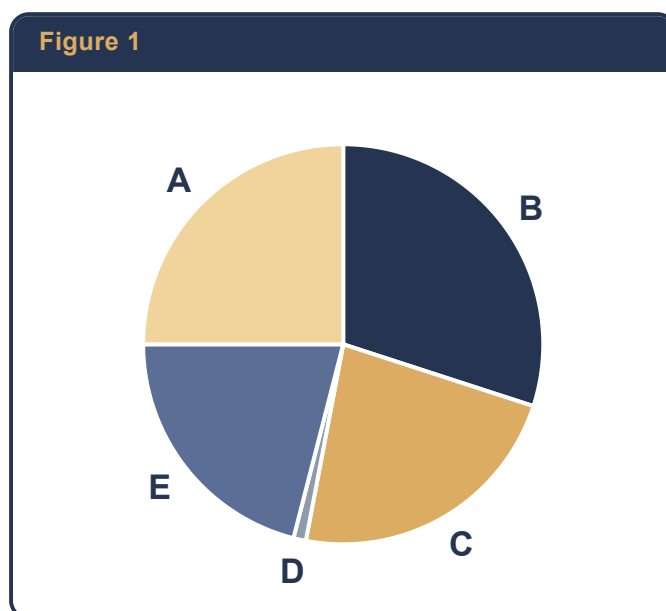
Total for this question: 5 marks

2 Question 2

8 marks

Electricity in the UK is produced from a number of energy resources.

Figure 1 shows the proportion of each energy resource used in 2015. The labels have been removed from the pie chart.



(a) Complete the table by writing the segment label (A–E) for each energy resource.

Energy resource	Percentage of UK electricity production	Segment label
Coal	23	
Natural gas	30	
Nuclear power	21	
Oil	1	
Renewable fuels	25	

(2)

- (b)** Over the next 10 years, many of the UK's nuclear power stations are expected to close. Suggest how this may affect the future balance of energy resources used for electricity production in the UK.

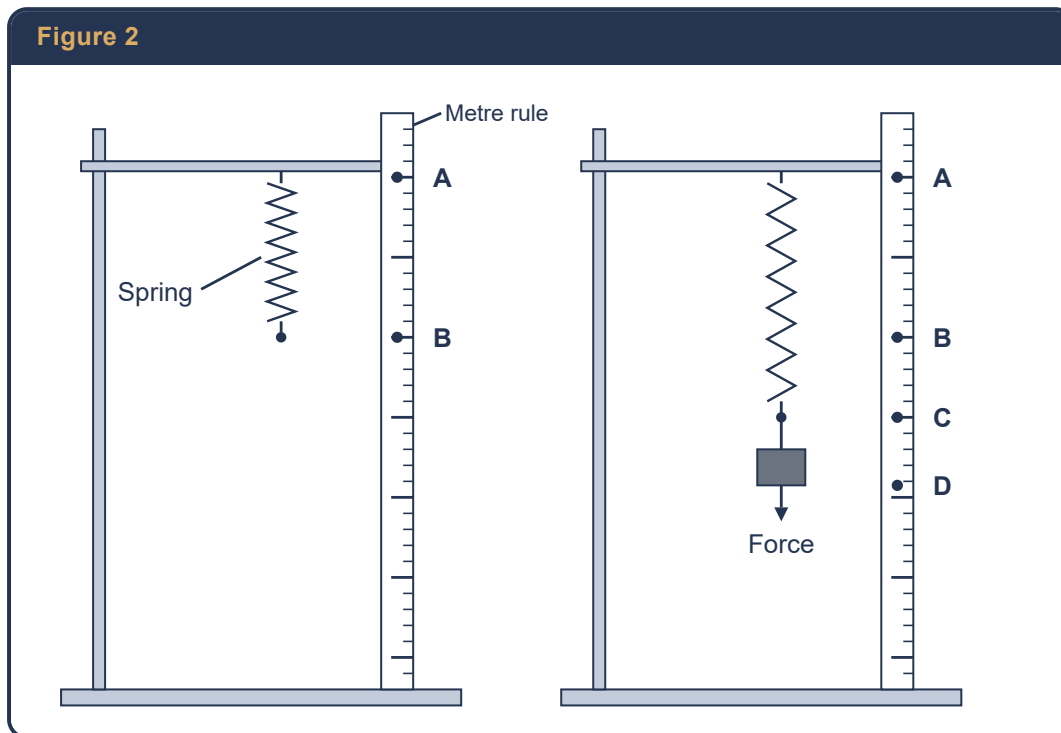
(6)

Total for this question: 8 marks

3 Question 3

7 marks

A student investigated how the extension of a spring depends on the force applied to the spring. **Figure 2** shows the spring before and after a force has been applied.



- (a) The distance between each large mark on the rule is 10 cm. Point **A** is on a large mark. State the unstretched length of the spring. Then state the extension after the force is applied.

Unstretched length = _____ cm

Extension = _____ cm
(1)

- (b) The stretched spring stores elastic potential energy, given by the equation:

$$\text{elastic potential energy} = 0.5 \times \text{spring constant} \times (\text{extension})^2$$

A particular spring has a spring constant of 25 N/m. Calculate the energy stored when the spring is extended by 15 mm.

Give your answer in standard form, to 3 significant figures.

Energy stored = _____ J
(3)

- (c) Another student calculated that the energy stored in her spring was twice the amount in part (b), for half the extension.

Calculate the spring constant of this spring.

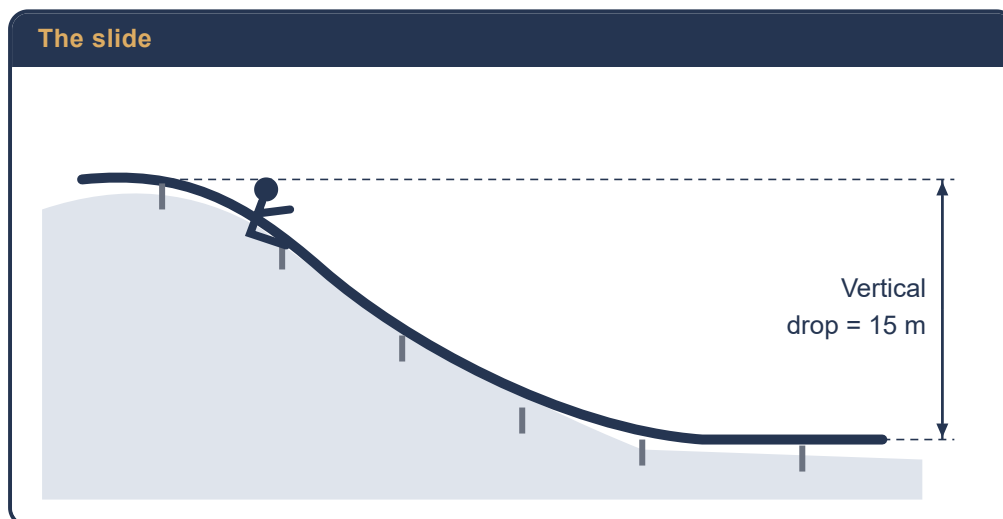
Spring constant = _____ N/m
(3)

Total for this question: 7 marks

4 Question 4

8 marks

The miners working in a salt mine use smooth wooden slides to move quickly from one level to another.



- (a) A miner of mass 90 kg travels down the slide. Calculate the change in gravitational potential energy of the miner when he moves 15 m vertically downwards.

gravitational field strength = 9.8 N/kg

Show clearly how you work out your answer.

Change in gravitational potential energy = _____ J
(2)

- (b) Calculate the **maximum** possible speed that the miner could reach at the bottom of the slide.
Show clearly how you work out your answer. Give your answer to an appropriate number of significant figures.

Maximum possible speed = _____ m/s
(3)

- (c) The speed of the miner at the bottom of the slide is much less than the calculated maximum possible speed. Explain why.

(3)

Total for this question: 8 marks

5 Question 5

8 marks

A wood burning stove is used to heat a room. The fire in the stove uses wood as a fuel. The fire heats the matt black metal case of the stove.

- (a) Burning 1 kg of wood transfers 15 MJ of energy to the stove. The stove then transfers 13.5 MJ of energy to the room.

Calculate the efficiency of the stove. Show clearly how you work out your answer.

Efficiency = _____
(2)

- (b) Some of the energy from the burning wood is transferred wastefully as the hot gases leave the chimney and warm the air outside the house.

Name **one** other way energy is wasted by the stove.

(1)

- (c) Some people heat their homes using electric heaters. Other people heat their homes using a wood burning stove.

Give **two** environmental advantages of using a wood burning stove to heat a home rather than heaters that use electricity generated from fossil fuels.

1

2

(2)

- (d) The metal case of the stove gets hot when the fire is lit. Here is some information about the stove.

Quantity	Value
Mass of metal case	100 kg
Starting temperature of metal case	20 °C
Final temperature of metal case	70 °C
Specific heat capacity of metal case	510 J/kg °C

Calculate the energy required to raise the temperature of the metal case to 70 °C. Show clearly how you work out your answer and give the unit.

Energy required = _____

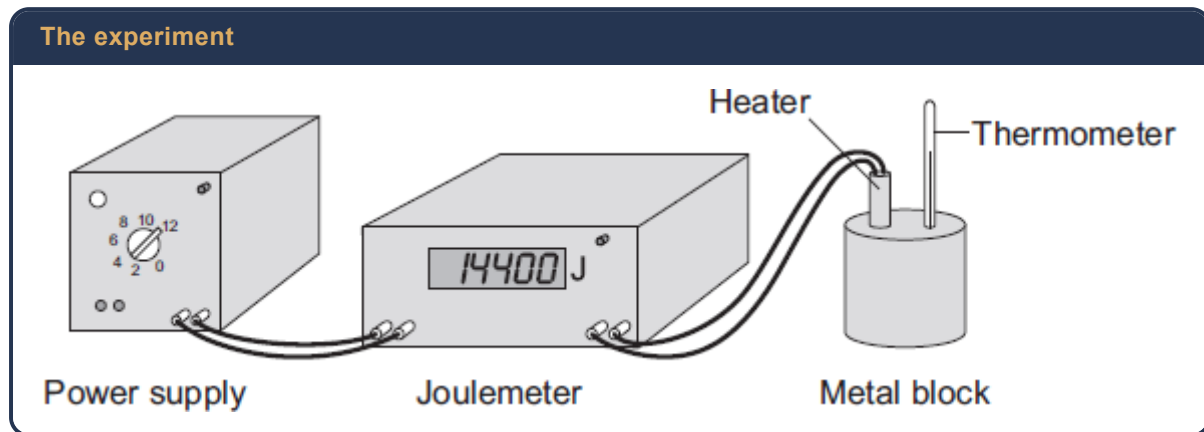
(3)

Total for this question: 8 marks

6 Question 6

5 marks

A student used an electric heater to heat a metal block. The student measured the energy input to the heater with a joulemeter.



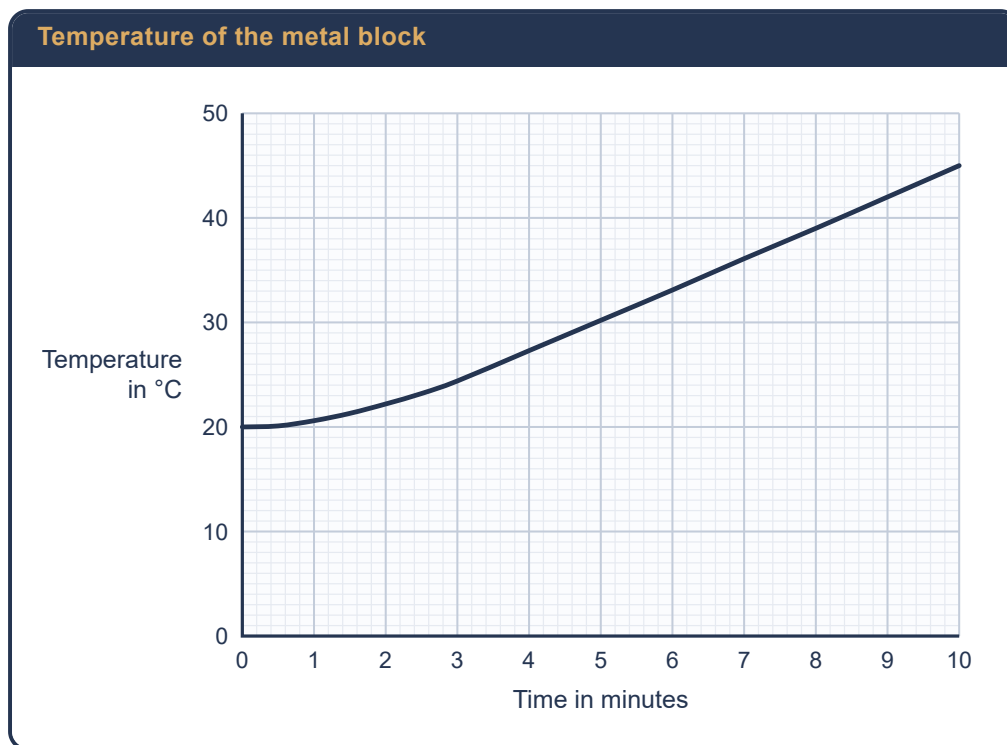
- (a) Before starting the experiment, the student reset the joulemeter to zero. The student switched the power supply on for exactly 10 minutes. During this time, the reading on the joulemeter increased to 14 400.
- (i) Calculate the energy transferred each second from the power supply to the heater. Show clearly how you work out your answer.

Energy transferred each second = _____ J/s
(2)

- (ii) What is the power of the heater?

(1)

- (b) The student measured the temperature of the metal block every minute. The data obtained by the student is displayed in the graph.



- (i) What range of temperatures did the student measure?
From _____ °C to _____ °C (1)

- (ii) Before starting the experiment, the student had calculated that the temperature of the block would go up by 36 °C. The student's data shows a smaller increase.

Which **one** of the following statements gives the most likely reason for this?

Tick (✓) **one** box.

A The student does not read the thermometer accurately.

☐

B The block transfers energy to the surroundings.

☐

C The power supply is not connected correctly to the joulemeter.

☐

(1)

Total for this question: 5 marks

END OF TEST

Now mark your answers using the mark scheme that follows.

MARK SCHEME

Energy · Topic Test

[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

5 marks

PART	ANSWER	MARK
(a)	gravitational potential	1
(b)	kinetic	1
(c)	$50 \times 9.8 \times 2 \rightarrow$ gravitational potential energy $\frac{1}{2} \times 50 \times 6.2 \times 6.2 \rightarrow$ kinetic energy <i>both required for the mark</i>	1
(d)	energy is transferred to the surroundings <i>do not accept "energy lost" on its own</i> <i>accept energy lost to the surroundings</i>	1
	a named example, e.g. the air (or his body) is heated / gains internal energy <i>accept heat / the air got warmer / sound</i>	1

Total: 5 marks

2 Question 2 — mark scheme

8 marks

PART	ANSWER	MARK
(a)	natural gas B , nuclear power E , oil D <i>all three needed for the mark</i>	1
	coal C , renewable fuels A <i>both needed for the mark</i>	1
(b) Marks awarded for this answer will be determined by the quality of communication as well as the standard of the scientific response. Apply a 'best-fit' approach.		
0	No relevant content.	0
L1	Limited structure. Some discussion of a number of resources, with a limited link to the country's overall energy needs.	1–2
L2	Some structure. Some discussion of the country's overall energy needs. Discusses a range of resources, giving advantages and disadvantages, although these may not be coherently linked.	3–4

- L3** Clear, coherently organised answer. Clear understanding of the country's overall energy needs and of the need for a range of resources. Discusses both renewable and non-renewable resources, making clear points about each.

5–6

Indicative content

- the same or greater overall energy will be required, and / or efficiency savings could mean less is needed
- fossil fuels are plentiful in supply
- fossil fuels contribute to global warming
- there is unlikely to be time to build new nuclear power stations
- renewable energy resources are expensive to set up
- renewable energy resources can be unreliable / inefficient
- wave, hydro and / or wind are likely to be useful for the UK
- solar power is less likely to be useful
- biomass has negatives: land use, fertilisers, etc.

Ignore discussion of nuclear waste etc.

Model answer

- The UK needs the same amount of electricity or more, so the 21% that nuclear provides will have to come from other resources.
- Electricity can be generated from fossil fuels such as gas, which are reliable.
- However, burning fossil fuels releases carbon dioxide, which contributes to global warming.
- Fossil fuels are non-renewable, so this energy resource will run out.
- Gas power stations are cheap to install because the infrastructure already exists. However, they are expensive to run, as fuel prices are now high.
- Renewables could fill the gap. For example, wind is renewable, so it will not run out.
- However, wind is not reliable, as it is not always windy.
- Wind farms are expensive to set up. However, they are then cheap to run, as the wind is free.

Conclusion

- The solution could be a mix of resources, with gas power stations used when it is not windy and offshore wind farms providing most of the UK's energy.

Total: 8 marks**3 Question 3 — mark scheme****7 marks**

PART	ANSWER	MARK
(a)	unstretched length = 20 cm; extension = 10 cm <i>both required for the mark</i>	1

(b)	$0.5 \times 25 \times (15 \times 10^{-3})^2$ if an extension of 15 is used, do not allow this mark	1
	$= 0.0028125$	1
	$= 2.81 \times 10^{-3} \text{ J}$ allow ECF from an extension of 15: $2812.5 = 2.81 \times 10^3 \text{ J}$ scores 2	1
(c)	rearrange: $k = E \div (0.5 \times x^2)$	1
	substitute: $k = (2 \times 2.81 \times 10^{-3}) \div (0.5 \times (7.5 \times 10^{-3})^2)$ allow ECF from (b) or algebra: $k = 2E \div (0.5 \times (x/2)^2) = 8 \times$ the original spring constant	1
	$k = 200 \text{ N/m}$ allow rounding errors	1

Total: 7 marks

4

Question 4 — mark scheme

8 marks

PART	ANSWER	MARK
(a)	13 230 (J) allow 1 mark for correct substitution, i.e. $90 \times 9.8 \times 15$, provided no subsequent step is shown	2
(b)	17 (m/s), correctly calculated and given to 2 or 3 significant figures accept 17.1 allow 2 marks for an answer with 4 or more significant figures, i.e. 17.15 or allow 2 marks for correct substitution, i.e. $13\,230$ (or their (a)) $= \frac{1}{2} \times 90 \times v^2$ or allow 1 mark for a statement or figures showing $KE = GPE$	3
(c)	work is done	1
	(against) friction (between the miner and the slide) accept air resistance or drag for friction	1
	(due to the) slide not being perfectly smooth or causing (kinetic) energy to be transferred as heat / internal energy of the surroundings accept the miner's clothing is rough accept lost / transformed for transferred accept air for internal energy of the surroundings	1

Total: 8 marks

5

Question 5 — mark scheme

8 marks

PART	ANSWER	MARK
(a)	90% or 0.9(0) allow 1 mark for correct substitution, i.e. $13.5 \div 15$, provided no subsequent step is shown an answer of 90 scores 1 mark an answer of 90 / 0.90 with a unit scores 1 mark	2
(b)	(producing) light allow (producing) sound	1
(c)	any two from: ● wood is renewable ● (using wood) conserves fossil fuels ● wood is carbon neutral accept wood grows again / can be replanted accept doesn't use fossil fuels accept a description of carbon neutral reject cheaper / saves money: insufficient	2
(d)	$E = m \times c \times \theta = 2\,550\,000$ allow 1 mark for correct substitution, i.e. $100 \times 510 \times 50$, provided no subsequent step is shown answers of 1 020 000 or 3 570 000 gain 1 mark	2
	joules / J accept kJ / MJ for full credit the unit and numerical answer must be consistent	1

Total: 8 marks

6

Question 6 — mark scheme

5 marks

PART	ANSWER	MARK
(a)(i)	24 allow 1 mark for converting the time to 600 seconds or for showing the method, i.e. $14\,400 \div 600$ provided no further steps are shown	2
(a)(ii)	24 (W) or their (a)(i) ignore any unit	1
(b)(i)	20 (°C) and 45 (°C) both required, either order	1

(b)(ii) The block transfers energy to the surroundings.

1

Total: 5 marks

END OF MARK SCHEME