Candidate Name	Centre Number					Candidate Number				

GCSE PHYSICS

COMPONENT 2

Applications in Physics

HIGHER TIER

SAMPLE PAPER

(1 hour 15 minutes)

	For Examiner's use only		
	Question	**Maximum Mark**	**Mark Awarded**
Section A	**1.**	**15**	
Section B	**2.**	**9**	
	3.	**13**	
	4.	**5**	
	5.	**18**	
	Total	**60**	

ADDITIONAL MATERIALS

In addition to this examination paper you will need a calculator, a ruler and a resource booklet.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

This paper is in 2 sections, **A** and **B**.
Section **A**: 15 marks. Read the article in the resource booklet carefully then answer **all** questions. You are advised to spend about 25 minutes on this section.
Section **B**: 45 marks. Answer **all** questions. You are advised to spend about 50 minutes on this section.

The number of marks is given in brackets at the end of each question or part-question.
The assessment of the quality of extended response (QER) will take place in question **5(a).**

EQUATION LIST

final velocity = initial velocity + acceleration × time	$v = u + at$
distance = ½ (initial velocity + final velocity) × time	$x = \frac{1}{2}(u + v)t$
(final velocity)^2 = (initial velocity)^2 + 2 × acceleration × distance	$v^2 = u^2 + 2ax$
distance = initial velocity × time + ½ × acceleration × time^2	$x = ut + \frac{1}{2}at^2$
change in thermal energy = mass × specific heat capacity × change in temperature	$\Delta Q = mc\Delta\theta$
thermal energy for a change of state = mass × specific latent heat	$Q = mL$
energy transferred in stretching = 0.5 × spring constant × (extension)^2	$E = \frac{1}{2}kx^2$
force on a conductor (at right angles to a magnetic field) carrying a current = magnetic field strength × current × length	$F = BIl$
potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil	$V_1I_1 = V_2I_2$
$\frac{\text{potential difference across primary coil}}{\text{potential difference across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$	$\frac{V_1}{V_2} = \frac{N_1}{N_2}$
for gases: pressure × volume = constant (for a given mass of gas at a constant temperature)	pV = constant
pressure due to a column of liquid = height of column × density of liquid × gravitational field strength	$p = h\rho g$

SECTION A

Read the article in the resource booklet carefully and answer **all** *the questions that follow.*

1. (a) Explain how the shape of the blades creates a force on the wind turbine blades. [2]

....

....

(b) A wind turbine of blade diameter 80 m is placed at an altitude of 160 m.

(i) Calculate the swept area of the blades. [2]

swept area = ... m^2

(ii) Calculate the mean kinetic energy/second delivered to the turbine. [3]
(Use wind speed^3 = 1 300 m^3/s^3)

mean kinetic energy/second = ... J/s

(c) (i) Use the information in **Table 1** to answer the questions below.

I Describe how the annual mean wind speed varies with altitude. [1]

....

....

II Explain why altitude will affect the maximum power output of a wind turbine. [2]

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....

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(ii) Use the information in **Table 2** to explain why the power output of the wind turbine will be different in summer and winter. [2]

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(d) Describe the benefits and drawbacks of meeting more of the demand for electricity with wind power in the future. [3]

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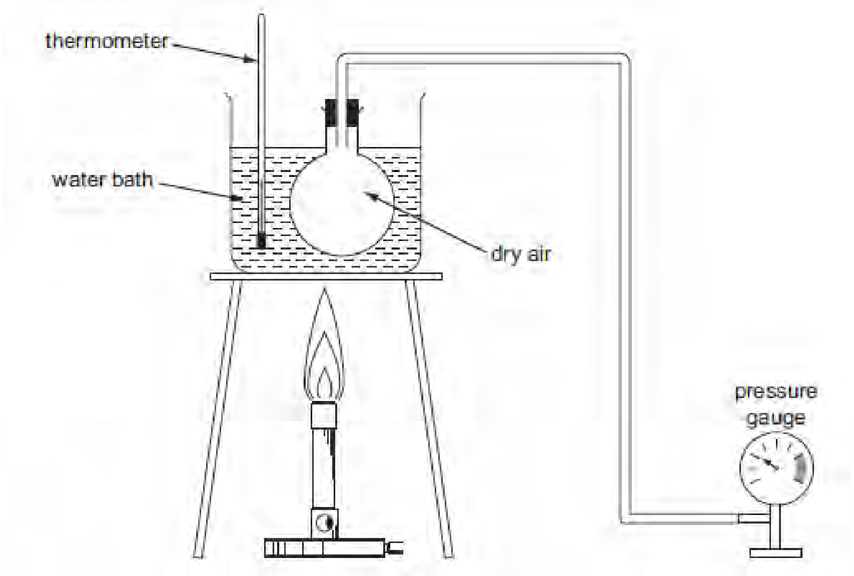
15

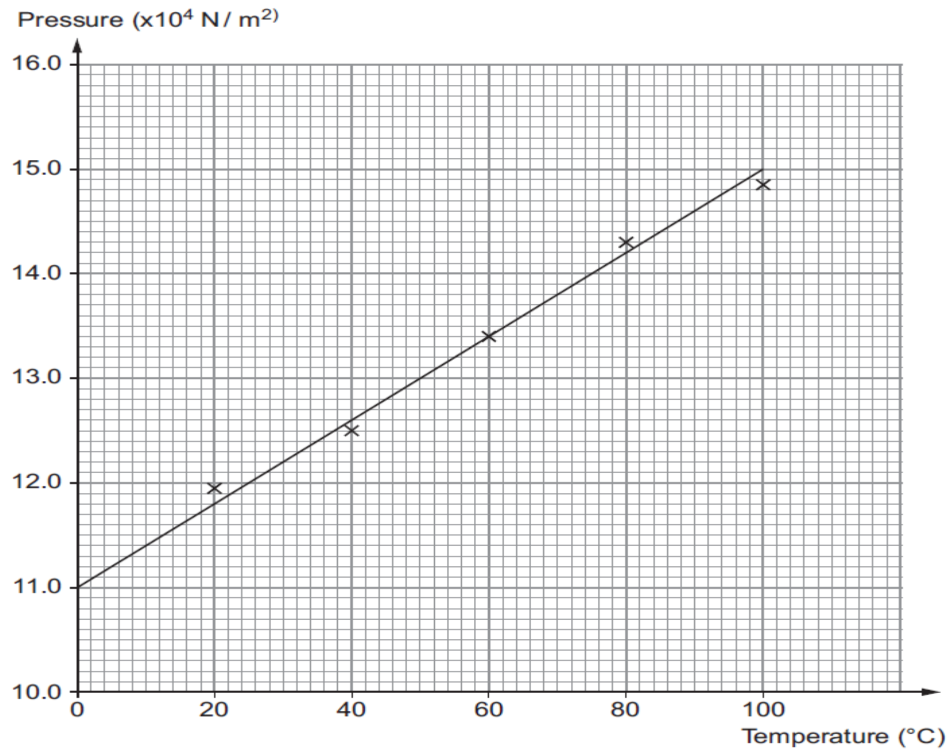
SECTION B

Answer **all** *questions*

2. A teacher uses the apparatus below to demonstrate how the pressure of a mass of air changes as it is heated. The mass of air is held in a closed flask. The experiment was carried out during a 10 minute period during a lesson.



The change of pressure was noted as the temperature was increased.
The results are shown on the graph below.



(a) Explain, **in terms of the motion of molecules**, why the pressure on the walls of the container changes as the temperature is increased. [3]

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(b) Explain why there is no change in density of the air in this experiment. [2]

....

....

(c) The graph shows that the pressure falls by 4×10^4 N/m^2 when the temperature decreases by 100 °C. Use this information to calculate the negative temperature at which the pressure would become zero. [2]

temperature = ... °C

(d) Explain one improvement to the way the experiment was conducted that would make the results more accurate. [2]

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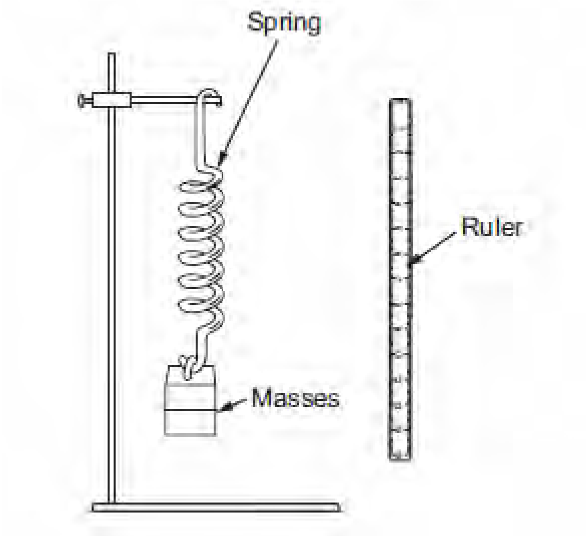
3. An experiment was carried out to investigate the elastic behaviour of a spring. The students added slotted masses to the spring and measured how much it stretched.



Mass applied to spring (g)	Force (N)	Extension of the spring (cm)		Mean extension (cm)
		Loading	Unloading	
100	1	2.0	1.9	2.0
200	2	4.0	4.0	4.0
300	3	6.2	5.8	6.0
400	4	8.2	7.8	8.0
500	5	9.9	10.0	10.0

(a) Suggest how the students could modify the apparatus to get more accurate results. [1]

....

(b) (i) Use the data in the table and a suitable equation to calculate a value for the spring constant and give its unit. [3]

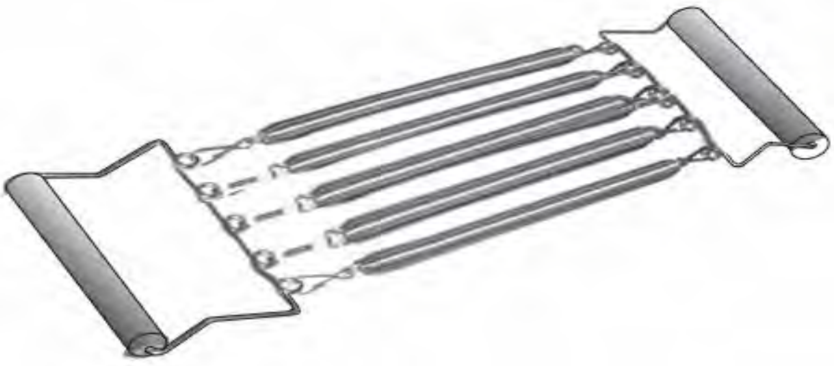
spring constant = ...
unit = ...

(ii) The elastic limit for this spring occurs for a load of 500 g. Describe what happens when loads bigger than this value are added to the spring. [1]

....

....

(c) (i) Springs are used in chest expanders that are used as an exercise machine to strengthen the arms.



An expander consists of 5 springs in parallel held between two handles.
They each have a spring constant of 400 N/m.

Calculate the force that must be applied to the handles to stretch the expander by 50 cm. [4]

force = ... N

(ii) Give one change that could be made to the expander to decrease the force needed to stretch it by 50 cm. [1]

....

....

(iii) Select an equation from page 2 and use it to calculate the extra energy stored in the expander when it is stretched from 30 cm to 50 cm. [3]

energy = ... J

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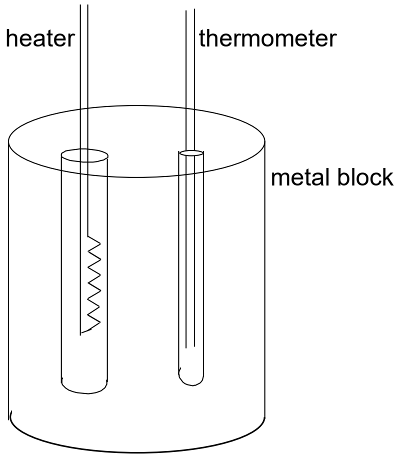
4. A metal's specific heat capacity can be measured by heating a block of it electrically and measuring the temperature rise, $\Delta\theta$ after a period of time, t.



The voltage, V, applied to the heater and the current, I, through it are measured. The temperature rise is related to the other quantities by the following equation, providing no heat is lost to the surroundings.

$$I \times V \times t = m \times c \times \Delta\theta$$

where: m = mass of the metal block
c = specific heat capacity of the metal

(a) Define the term "specific heat capacity" of a substance. [1]

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(b) In an experiment, a lead block (c = 0.13 J/g °C) was heated and after 4 minutes **the temperature rise was 15 °C.**
Complete the table below to show the effect on the temperature rise ($\Delta\theta$) when each of the changes is made separately. [4]

Change made	**New value of $\Delta\theta$**
The heating time is doubled	…………
The current and the voltage are both doubled	…………
The lead block is changed for copper (c = 0.39 J/g °C) of the same mass	…………
The mass of the lead block was changed from 30 g to 40 g and was also heated for double the time	…………

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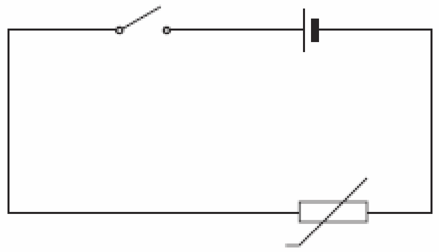
5. (a) The aim of a Physics lesson is to identify whether a thermistor is an ohmic device. Pupils are given the following circuit and some additional components to carry out the experiment.

Describe how this experiment is carried out and how the results should be processed to determine whether it is an ohmic device. [6 QER]



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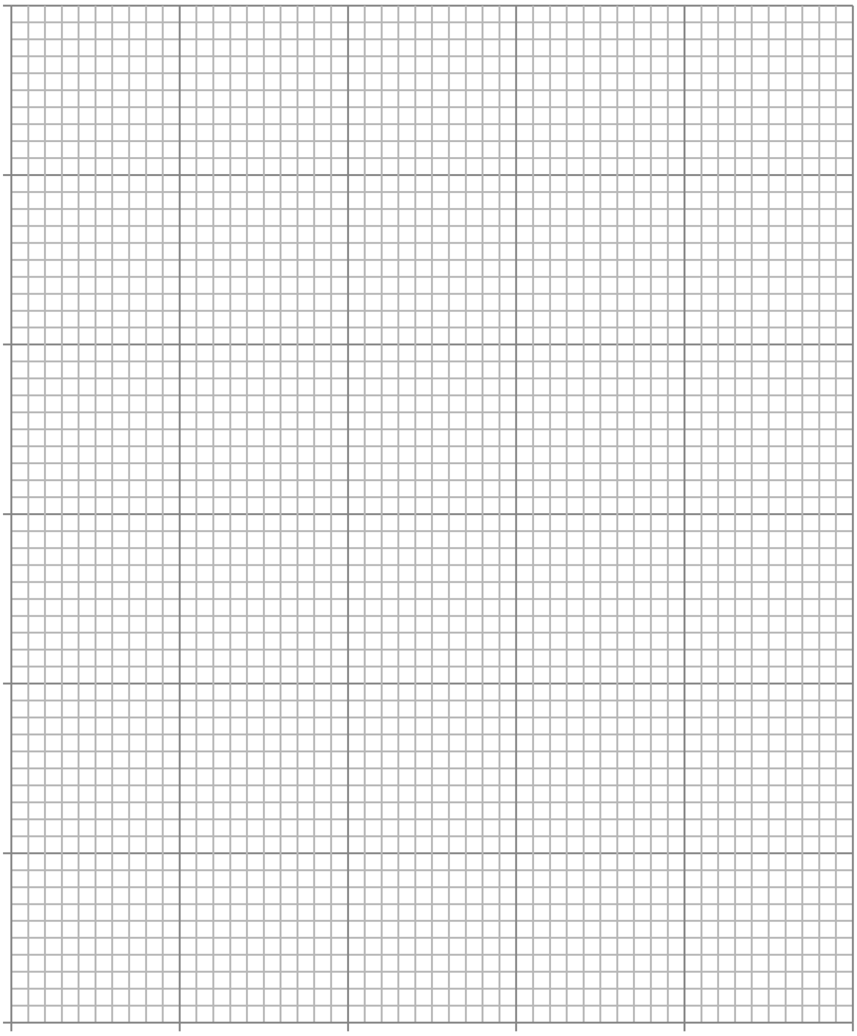
(b) In another experiment, the temperature of the thermistor is varied to investigate its change in resistance.

The table below shows the results of the experiment.

Temperature (°C)	10	20	30	40	60	80
Resistance (Ω)	25	17	12	6	4	3

(i) Plot the data on the grid below.
Circle any anomalous points and draw a suitable line. [4]



(ii) Describe how the resistance of the thermistor changes as the temperature rises. [2]

....

....

(iii) Calculate the potential difference applied to the thermistor that would produce a current of **0.5 A** at **50 °C.** [4]

potential difference = ... V

(iv) Helen suggests that these results show that resistance is inversely proportional to the Celsius temperature. Comment on her suggestion. [2]

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