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Student number

Name _____

Date _____

Attempt/Time taken _____

GCSE
PHYSICS

Topic Paper: 3.1 & 3.2 Change of state, internal energy and energy transfers Part 2

Time allowed: 40 minutes

Materials

For this paper you must have:

- the Periodic Table/Data Sheet, provided as an insert (enclosed)
- a ruler with millimetre measurements
- a calculator, which you are expected to use where appropriate.

Instructions

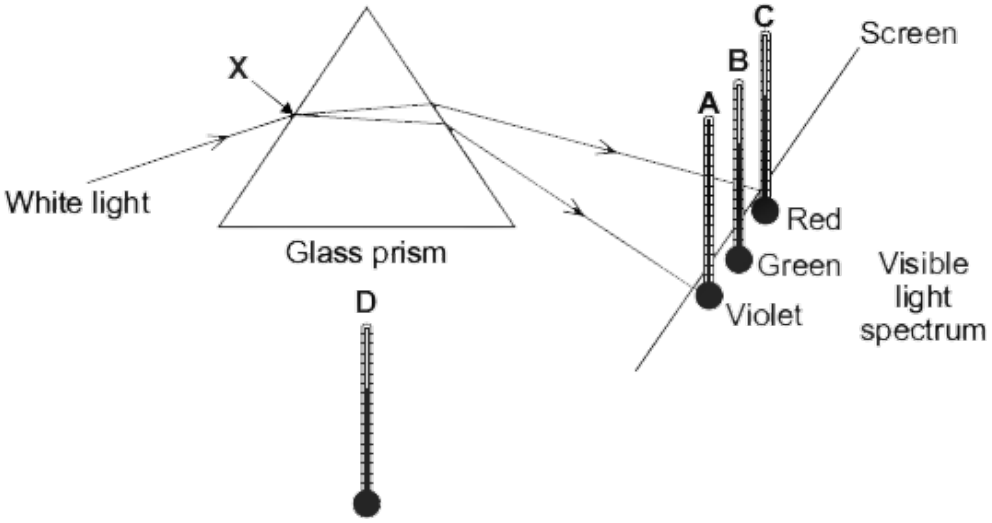
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The Periodic Table/Data Sheet is provided as in insert.
- You are reminded of the need for good English and clear presentation in your answers.
- When answering questions you need to make sure that your answer:
  - is clear, logical, sensibly structured
  - fully meets the requirements of the question
  - shows that each separate point or step supports the overall answer.

37 Marks

Q7. The diagram shows the apparatus that a student used to investigate the heating effect of different wavelengths of light.



(a) (i) What process happens at the point labelled **X** on the diagram?

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(1)

(ii) The student put thermometer **D** outside of the light spectrum.

Suggest why.

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(1)

(iii) The table gives the position and reading of each thermometer 10 minutes after the investigation started.

Thermometer	Position of thermometer	Temperature in ℃
A	in violet light	21
B	in green light	22
C	in red light	24
D	outside the spectrum	20

What should the student conclude from the data in the table?

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(2)

(b) A similar investigation completed in 1800 by the scientist Sir William Herschel led to the discovery of infrared radiation.

Suggest how the student could show that the spectrum produced by the glass prism has an infrared region.

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(2)

(c) A person emits infrared radiation at a frequency of 3.2×10^{13} Hz.

Calculate the wavelength of the infrared radiation that a person emits.

Take the speed of infrared radiation to be 3.0×10^{8} m/s.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

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Wavelength = ... m

(2)

(d) A thermal imaging camera detects infrared radiation. Electronic circuits inside the camera produce a visible image of the object emitting the infrared radiation.

At night, police officers use thermal imaging cameras to track criminals running away from crime scenes.

Thermal imaging cameras work better at night than during the day.

Explain why.

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(2)
(Total 10 marks)

Q8. Warm air inside a house contains water in the form of a gas. The water condenses onto cold surfaces such as windows. This leaves liquid water on the inside of the glass.

(a) Explain what happens to the particles when water changes from a gas to a liquid.

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(2)

(b) Many houses in the UK have double-glazed windows.

Section through double-glazed window

U-value = 2.8 W/m^2 °C

Section through single-glazed window

U-value = 5.0 W/m^2 °C

Photograph supplied by iStockphoto/Thinkstock

If the window is double-glazed rather than single-glazed there is less condensation on the inside of the glass.

Explain why.

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(2)

(c) Double glazing can be made using two pieces of normal glass with an air gap between them. Better insulating glass (Superglaze or G-type) can be used instead of normal glass. The size of the air gap can also be increased to improve insulation.

A company making double glazing provides some information about their products.

U-values for different types of double glazing

	Normal glass	**Superglaze**	**G-type**
6 mm air gap	3.1	2.7	2.6
12 mm air gap	2.8	2.2	2.0
16 mm air gap	2.7	2.0	1.8

For the same size window, under the same temperature conditions, the energy loss halves if the U-value is halved.

Cost of double glazing in £ per m^2

	Normal glass	Superglaze	G-type
6 mm air gap	90	110	160
12 mm air gap	100	130	185
16 mm air gap	110	155	210

(i) The data the double glazing company produced is checked and confirmed independently by other scientists.

Suggest why it is important to confirm the data independently.

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(1)

(ii) A homeowner is going to replace his old single-glazed windows with new double-glazed windows.

Discuss the cost of fitting double glazing using better insulating glass compared with double glazing using normal glass.

Use the information given in the tables.

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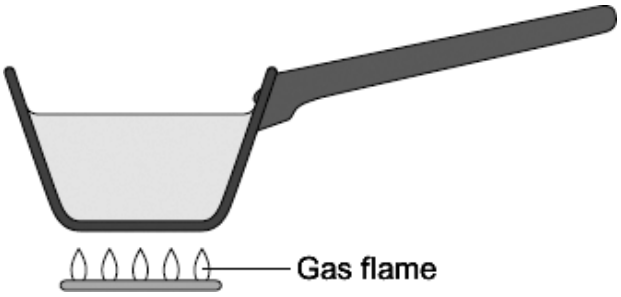
(3)
(Total 8 marks)

Q9. The diagram shows a metal pan being used to heat water.



Energy from the gas flame is transferred through the metal pan by conduction.

Explain the process of conduction through metals.

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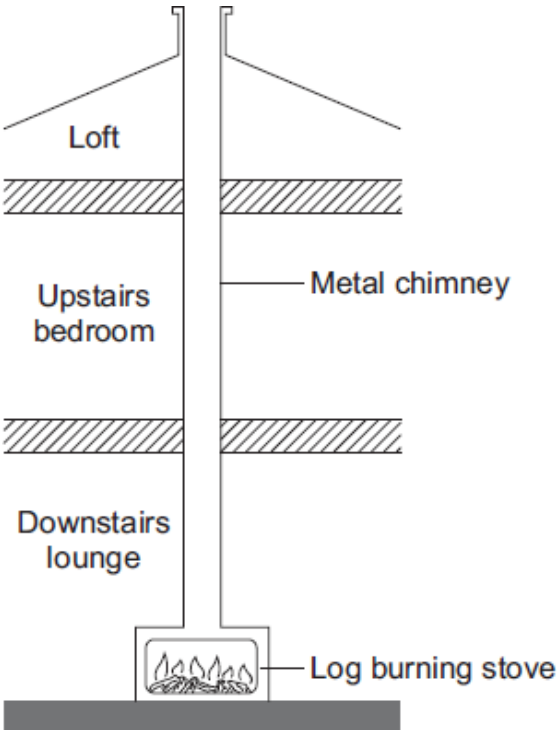
(4)
(Total 4 marks)

Q10. The diagram shows how the metal chimney from a log-burning stove passes through the inside of a house.



(a) Explain how heat is transferred by the process of convection from the inside of the stove to the top of the chimney.

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(2)

(b) Although the outside of the chimney becomes very hot, there is no insulating material around the chimney.

(i) Explain, in terms of the particles in a metal, how heat is transferred by conduction from the inside to the outside of the metal chimney.

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(2)

(ii) Suggest **one** advantage of having no insulation around the chimney.

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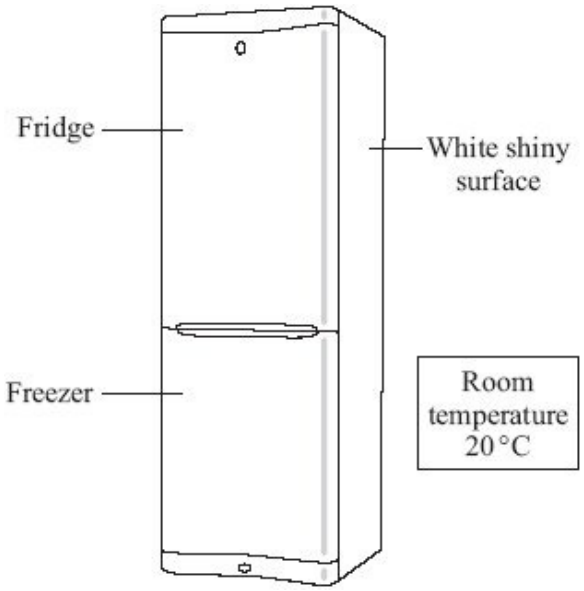
(1)

(Total 5 marks)

Q11. The diagram shows a fridge-freezer.



(a) By which method is heat transferred through the walls of the fridge-freezer?

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(1)

(b) The inside of the fridge is at 4 °C. The inside of the freezer is at −18 °C.

Into which part of the fridge-freezer will the rate of heat transfer be greater?

Draw a ring around your answer.

the fridge **the freezer**

Give a reason for your answer.

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(1)

(c) The outside surface of the fridge-freezer is white and shiny.

Give **two** reasons why this type of surface is suitable for a fridge-freezer.

1 .....

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2 .....

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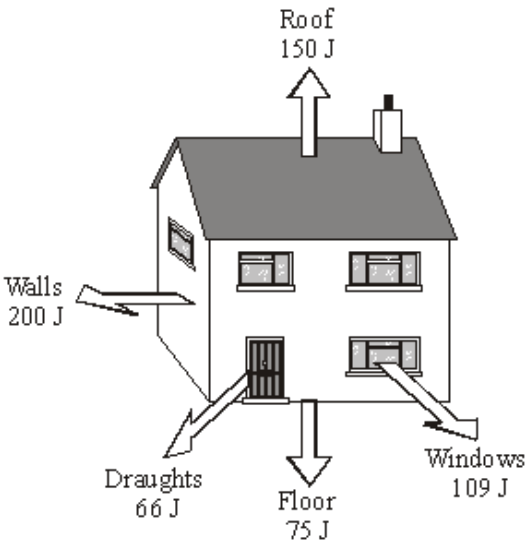
(2)

(Total 4 marks)

Q12. (a) The diagram shows how much heat is lost each second from different parts of an uninsulated house.



(i) Each year, the house costs £760 to heat.

How much money is being wasted because of heat lost through the roof?

Show clearly how you work out your answer.

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(2)

(ii) Insulating the loft would cut the heat lost through the roof by 50 %.

The loft insulation has a payback time of $1\frac{1}{2}$ years.

How much did the loft insulation cost to buy?

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Cost of loft insulation = £ .....

(1)

(b) What happens to the wasted energy?

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(1)

(Total 4 marks)