Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
TOTAL	

General Certificate of Secondary Education
Higher Tier
January 2012

Science A 1

SCA1HP

Unit 5

H

Thursday 12 January 2012 9.00 am to 10.30 am

For this paper you must have:
- a ruler
- the Chemistry Data Sheet (enclosed)
- the Physics Equations Sheet (enclosed).

You may use a calculator.

Time allowed
- 1 hour 30 minutes

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.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 90.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 3 should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

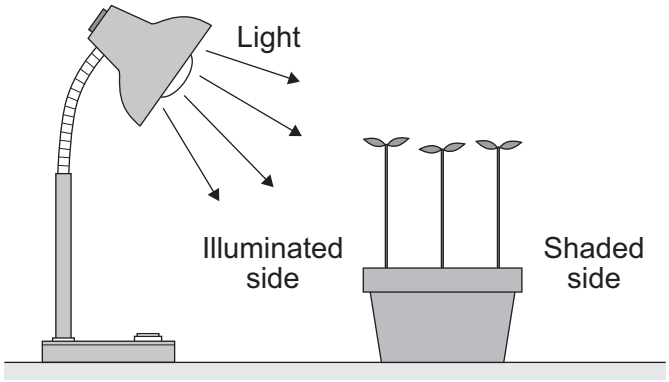
Advice
- In all calculations, show clearly how you work out your answer.

Answer **all** questions in the spaces provided.

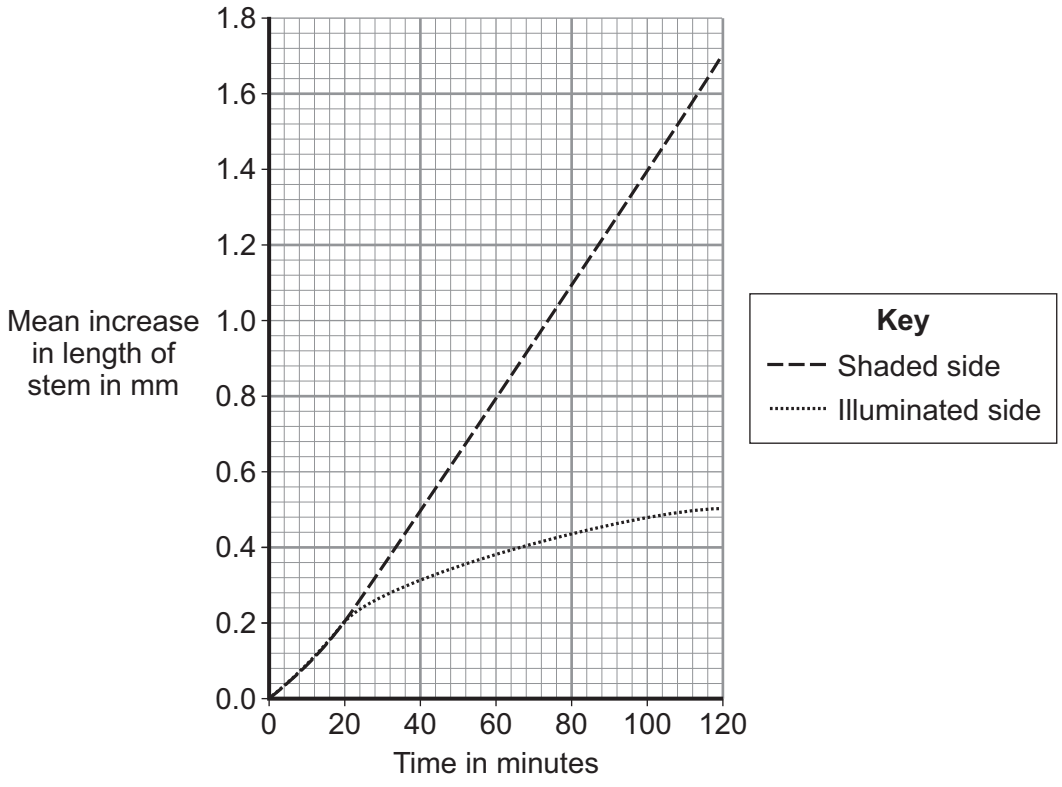
Biology Questions

1 Auxins control growth in plants.

In an investigation, scientists illuminated seedlings from one side. They measured the increase in the length of the stems of the seedlings on both the illuminated and the shaded sides.



The graph shows their results.



1 (a) Describe the difference between the growth of the illuminated side and the growth of the shaded side.

.....

.....

(1 mark)

1 (b) Explain the difference you have described in part **(a)** in terms of the distribution of auxins.

.....

.....

.....

.....

(2 marks)

1 (c) Give **two** different uses of plant growth hormones in horticulture.

1 .....

2 .....

(2 marks)

5

Turn over for the next question

2 In Vitro Fertilisation (IVF) treatment helps infertile women to become pregnant.

2 (a) Name the **two** hormones in a fertility drug.

1 .....

2 .....

(2 marks)

2 (b) The table shows the effectiveness of IVF treatment in one clinic in 2010.

Age of women in years	**Under 35**	**35–37**	**38–40**	**Over 40**
Number of IVF treatments	130.0	100.0	29.0	20.0
Average number of embryos transferred	2.6	2.8	3.3	3.6
Percentage of successful pregnancies	43.0	30.0	21.0	13.0

2 (b) (i) What is the relationship between the age of women and the success of IVF treatment?

.....

.....

(1 mark)

2 (b) (ii) Use information from the table to give **one** ethical problem with IVF.

.....

.....

(1 mark)

4

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

3 Total cholesterol in the blood contains 'good' and 'bad' cholesterol.
High levels of 'bad' cholesterol increase the risk of heart disease.
High levels of 'good' cholesterol reduce the risk of heart disease.

Scientists have suggested that chemicals called polyphenols in dark chocolate may help people with Type 2 diabetes.
Polyphenols may reduce high levels of 'bad' cholesterol in the blood.

The scientists investigated the effect of polyphenols on levels of cholesterol in the blood.

- 7 men and 5 women with Type 2 diabetes had the levels of cholesterol in their blood measured.
- They all ate 45 g of dark chocolate every day for 16 weeks.
- 6 of the people ate dark chocolate that contained polyphenols. The other 6 people ate dark chocolate that did not contain polyphenols.
- All 12 people were allowed to eat and drink anything else they wanted, but **no more** chocolate.
- The levels of cholesterol in their blood were measured again after 16 weeks.

The results showed that for the people who ate dark chocolate with polyphenols:

- there were decreases in total cholesterol and 'bad' cholesterol
- there was an increase in 'good' cholesterol.

A newspaper headline reported the research and wrote:
'Research shows that diabetics should eat dark chocolate.'

In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Was the newspaper's statement justified?

Include in your answer evidence that supports the newspaper's statement and evidence that does **not** support the newspaper's statement.

Remember to give a conclusion to your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6 marks)

6

Chemistry Questions

4 Solder is an alloy of lead and tin.

The table shows how the percentage of tin affects some of the properties of solder.

Percentage (%) of tin	Tensile strength in MPa	Melting point in ºC	Density in g per cm^3
0	12	347	11.35
20	33	257	10.40
40	37	187	9.28
60	52	153	8.52

Tensile strength is the ability to support a load without breaking.

Use information from the table to answer these questions.

4 (a) What is the density of pure lead?

Density = ... g per cm^3

(1 mark)

4 (b) How does increasing the percentage of tin affect the properties of solder?

.....

.....

.....

.....

.....

.....

(3 marks)

4 (c) Solder was used when plumbers joined lead pipes together.
Solder, not pure lead, was used to make the joints.

Suggest **one** reason why.

.....

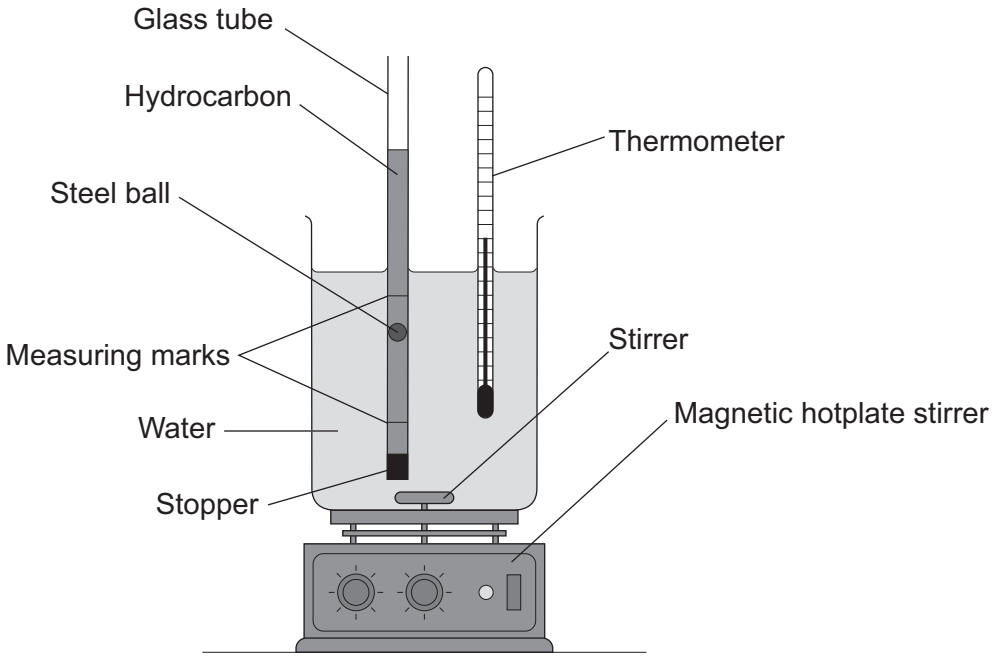
.....

(1 mark)

5

Turn over for the next question

5 The diagram shows apparatus used to measure the effect of temperature on the viscosity of two liquid hydrocarbons **A** and **B**.



The time taken for the steel ball to fall between the two measuring marks is recorded for each hydrocarbon at different temperatures.

5 (a) Using the stirrer improved the accuracy of the results.

Explain how.

.....

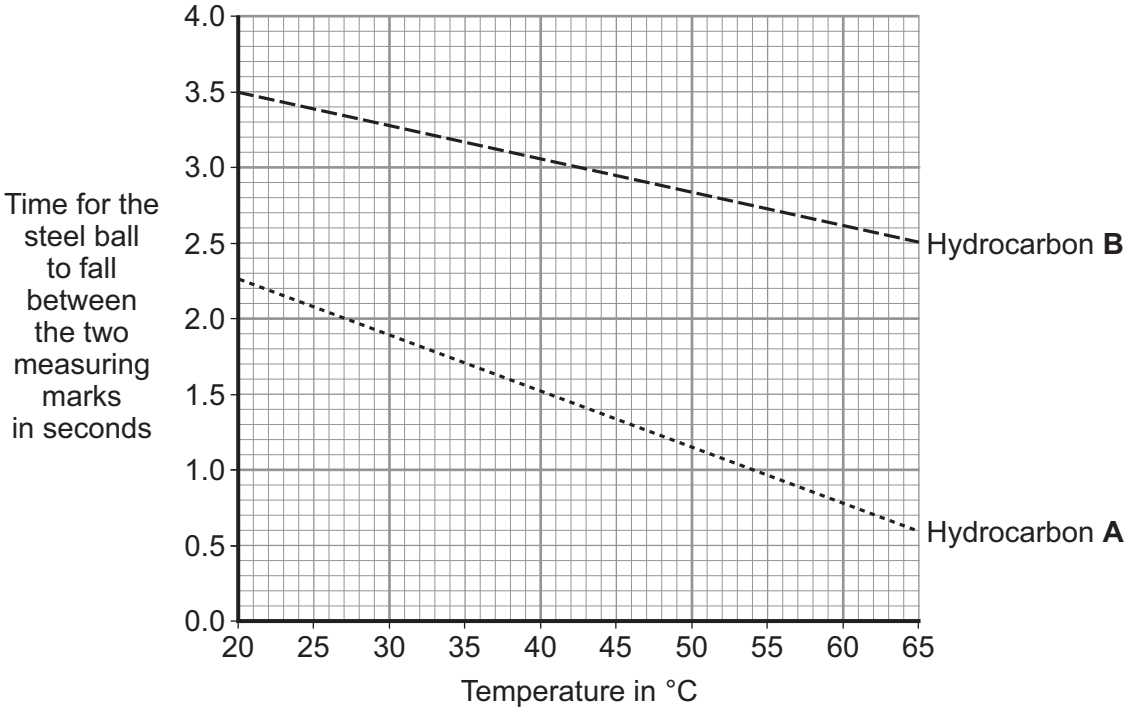
.....

.....

.....

(2 marks)

5 (b) The graph shows the results of the investigation.



5 (b) (i) What conclusions can be drawn from the data?

.....

.....

.....

.....

(2 marks)

5 (b) (ii) Give **one** reason for the difference in the viscosities of hydrocarbon **A** and hydrocarbon **B**.

.....

.....

(1 mark)

5

6 Iron is extracted from iron ore by heating the ore with coke in a blast furnace.

Iron ore contains iron oxide (Fe_2O_3).
Coke contains carbon (C).

6 (a) (i) Explain why carbon can be used to produce iron from iron oxide.

.....

.....

.....

.....

(2 marks)

6 (a) (ii) Balance the equation for the reaction of iron oxide with carbon.

..... Fe_2O_3 + ... C → ..... Fe + ... CO_2

(2 marks)

6 (b) Two methods of extracting copper are by smelting ores and by phytomining.

Which of these two methods is likely to be the more environmentally friendly?

Give reasons for your choice.

.....

.....

.....

.....

(2 marks)

6

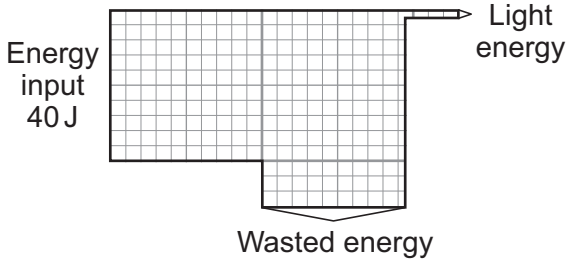
Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

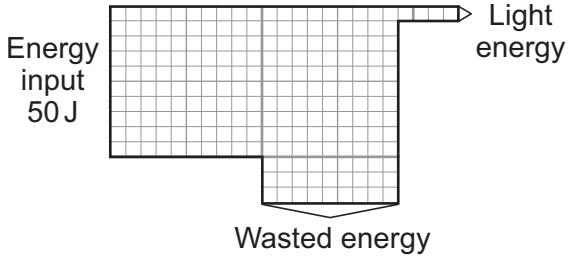
Physics Questions

7 The Sankey diagrams show the energy transferred to the surroundings each second by three different bulbs.

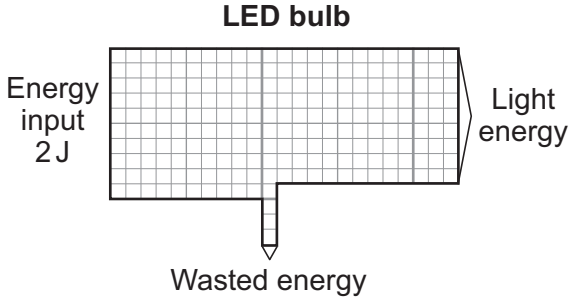
Filament bulb



Halogen bulb



LED bulb



7 (a) The filament bulb is the least efficient of the three bulbs.

Explain what *least efficient* means.

.....

.....

.....

.....

(2 marks)

7 (b) Calculate the percentage efficiency of the halogen bulb.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

.....

.....

Efficiency = ... %

(2 marks)

7 (c) What effect does the wasted energy from a bulb have on the surroundings?

.....

.....

(1 mark)

7 (d) Use the Sankey diagrams to give a reason why the overall cost of using an LED bulb is the lowest of the three bulbs.

.....

.....

(1 mark)

Question 7 continues on the next page

7 (e) The table gives further information about each type of bulb.

Bulb	Cost to buy in £	Average lifespan in hours
Filament	0.50	1000
Halogen	2.00	2500
LED	15.00	25 000

Use **only** the information in the table to answer the following questions.

7 (e) (i) Which type of bulb is the most cost-effective?

Give a reason for your answer.

Bulb .....

Reason .....

.....

(2 marks)

7 (e) (ii) Sales of LED bulbs are increasing.

Suggest **one** reason why.

.....

.....

(1 mark)

9

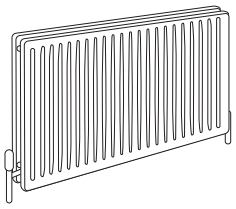
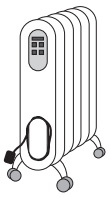
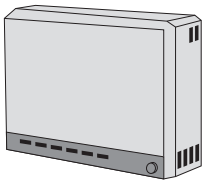
Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

8 Heaters contain materials that are good at storing and transferring energy to their surroundings.

Three heaters that use different materials are shown below.

The power output when the heaters are being used is shown below each picture.

Water-filled heater	**Oil-filled heater**	**Storage heater** (has concrete blocks inside)
		
3 kW	1500 W	1700 W

- Each heater is put in one of three identical rooms.
- Each room's temperature is 10 °C.
- Each heater is switched on for 5 hours.

8 (a) Which heater would cause the biggest temperature rise in the room?

Give a reason for your answer.

Heater .....

Reason .....

.....

(2 marks)

8 (b) The temperature of the room does not continue to rise due to energy transfer through the walls. It is important that the walls have a suitable *U-value*.

8 (b) (i) What is meant by the term *U-value*?

.....

.....

(1 mark)

8 (b) (ii) Draw a ring around the correct answer in the box to complete the sentence.

When constructing buildings, it is better to use a material with a U-value

that is

high.
medium.
low.

(1 mark)

8 (b) (iii) Different houses transfer energy at different rates depending on a number of factors. The U-value of the construction materials is one of these factors.

Name **two** other factors that affect the rate at which a house transfers energy.

Factor 1 .....

Factor 2 .....

(2 marks)

6

Turn over for the next question

Biology Questions

9 People can be immunised against a pathogen by injecting them with a vaccine.

9 (a) What does a vaccine contain?

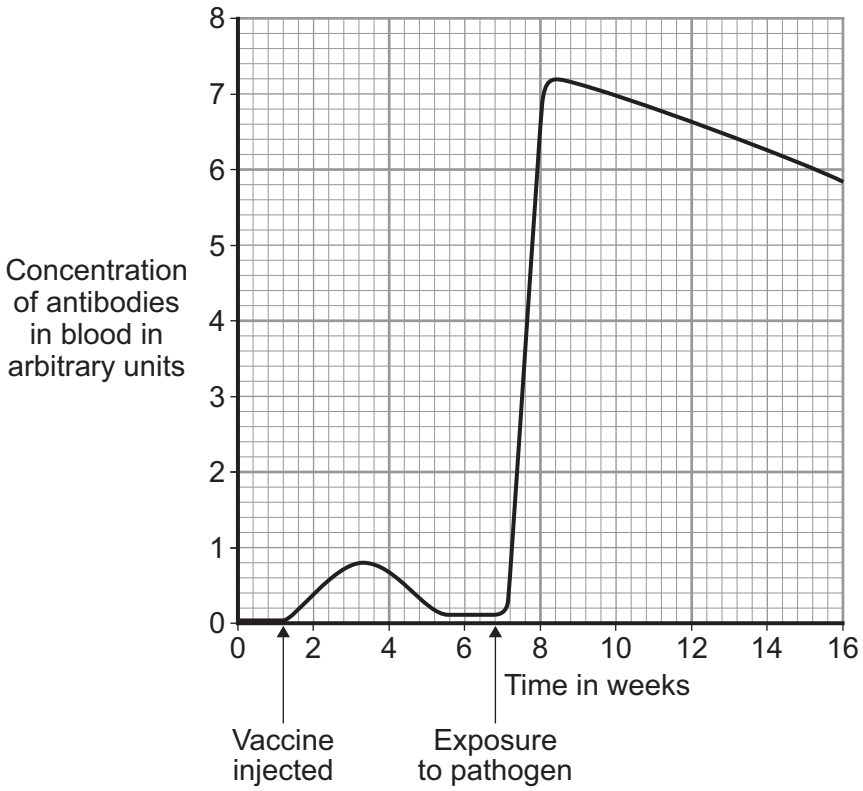
.....

.....

(1 mark)

9 (b) A person was injected with a vaccine. A few weeks later the person was exposed to the pathogen they had been immunised against.

The graph shows how the concentration of antibodies in the blood changed after injection of the vaccine and after exposure to the pathogen.



9 (b) (i) Describe in detail the differences between antibody production after the injection of the vaccine **and** after the person was exposed to the pathogen.

.....

.....

.....

.....

.....

.....

.....

.....

(3 marks)

9 (b) (ii) Suggest an explanation for the differences you have described in part **(b)(i)**.

.....

.....

.....

.....

.....

.....

.....

.....

(3 marks)

7

10 The use of performance-enhancing drugs in sport is banned.

Regular tests are done to check that the athletes have not been taking performance-enhancing drugs.

10 (a) (i) Name **one** type of performance-enhancing drug that some athletes may decide to take.

.....

(1 mark)

10 (a) (ii) Give **one** effect of this type of drug on the body.

.....

.....

(1 mark)

10 (a) (iii) How would the effect you have given in part **(a)(ii)** help the athlete to perform better?

.....

.....

(1 mark)

10 (b) A sports newspaper is campaigning for all athletes to be allowed to take legal performance-enhancing drugs.

Give **one** argument **for** and **one** argument **against** the newspaper campaign.

For .....

.....

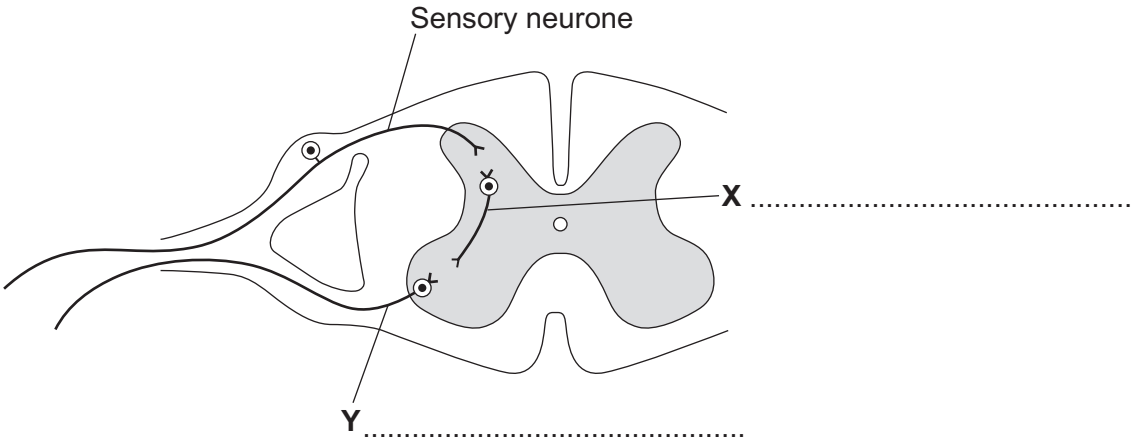
Against .....

.....

(2 marks)

5

11 The diagram shows some of the structures involved in a reflex action.



11 (a) On the diagram, name the neurones labelled **X** and **Y**.

(1 mark)

11 (b) Describe how information is transmitted from neurone **X** to neurone **Y**.

.....

.....

.....

.....

(2 marks)

3

Turn over for the next question

Chemistry Questions

12 The table gives some information about the first four alkanes.

			When one molecule of the alkane is completely burned	
Name	**Formula**	**Boiling point in °C**	**Number of CO_2 molecules formed**	**Number of H_2O molecules formed**
Methane	CH_4	−168	1	2
Ethane	C_2H_6	−89	2	3
Propane	C_3H_8	−42	3	4
Butane	C_4H_{10}	−0.5		

12 (a) The alkanes in crude oil can be separated using fractional distillation.

Explain why.

.....

.....

.....

.....

(2 marks)

12 (b) What is the general formula of the alkanes in the table?

.....

(1 mark)

12 (c) Draw the displayed (structural) formula of ethane.

(2 marks)

12 (d) Write a balanced symbol equation for the complete combustion of butane.

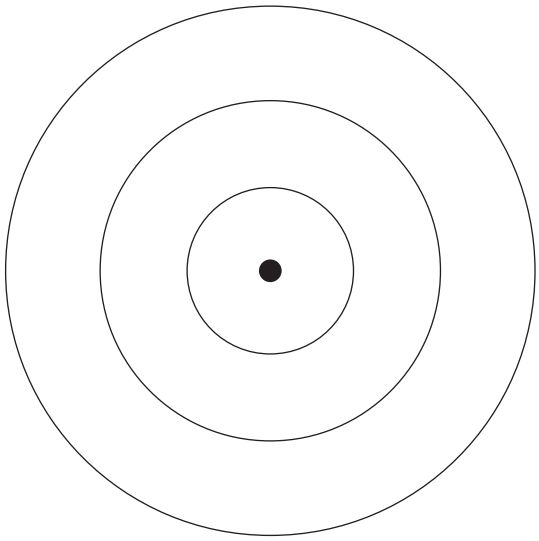
..... + ... → ..... + ...

(3 marks)

8

13 Sodium is a reactive element.

13 (a) Complete the diagram to show the electronic structure of a sodium atom.



(2 marks)

13 (b) Sodium reacts with chlorine to form sodium chloride.

Explain how in terms of electrons, atoms and ions.

.....

.....

.....

.....

.....

.....

.....

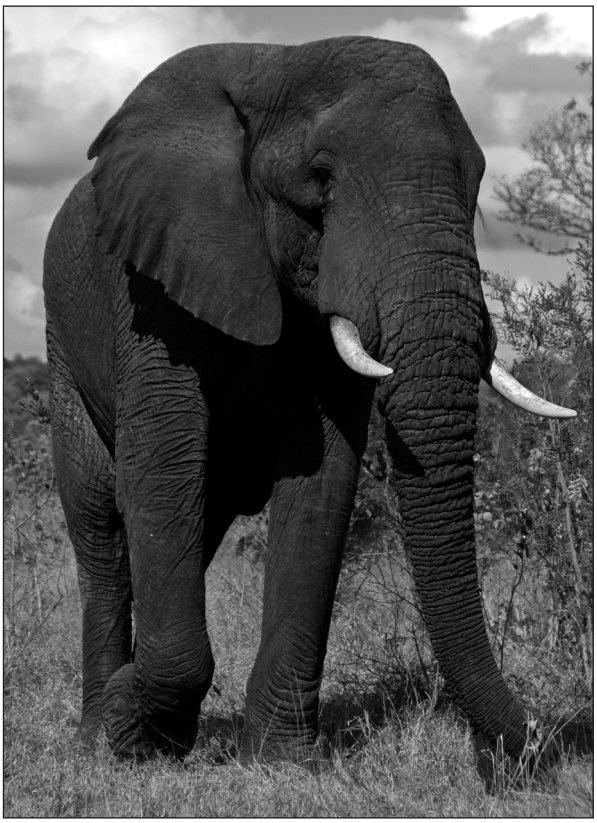
.....

(4 marks)

6

Physics Questions

14 Elephants are the largest animals that live on land.



14 (a) Elephants have much greater difficulty keeping cool compared with smaller mammals in the same environment.

Explain why.

Use ideas about energy transfer in your answer.

.....

.....

.....

.....

(2 marks)

14 (b) Elephants often spray themselves with cool water.

Explain, in terms of particles, how this helps to cool the elephant down.

.....

.....

.....

.....

.....

.....

.....

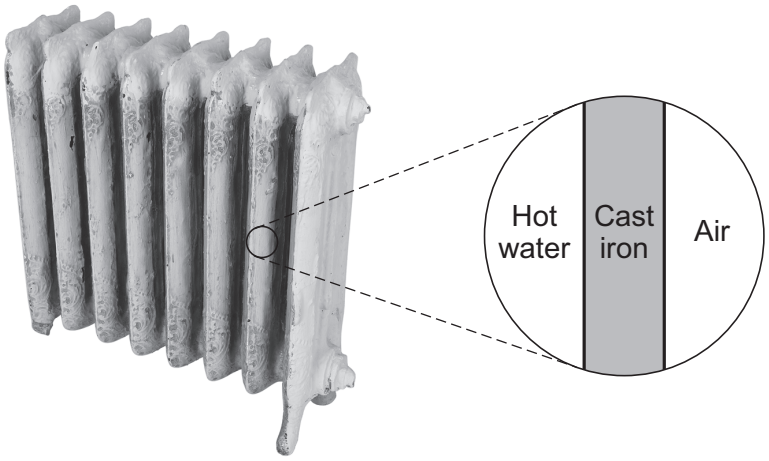
.....

(4 marks)

6

Turn over for the next question

15 An old house has a cast iron radiator. The radiator has hot water inside it.



15 (a) Energy is transferred through the cast iron.

Name the process involved and explain how this process transfers energy through the cast iron.

.....

.....

.....

.....

.....

.....

.....

.....

(4 marks)

15 (b) The table shows how the power output of the radiator varies with the temperature difference between the hot water and the air temperature of the room.

Temperature difference in ºC	10	20	30	40	50	60
Power output in W	400	900	1480	2200	3050	4000

15 (b) (i) Describe fully the relationship between temperature difference and power output.

.....

.....

(1 mark)

15 (b) (ii) The house owner wants to reduce their heating bills.

Use the data in the table to advise the house owner.

.....

.....

(1 mark)

15 (c) The air in a room is at a temperature of 12 °C.

The house owner switches the heating on until the temperature reaches 22 °C.
The amount of energy needed to raise the temperature of the air to 22 °C is 580 000 J.

The mass of air in the room is 58 kg.

Calculate the specific heat capacity of air and give the unit.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

.....

.....

.....

Specific heat capacity = ...

(3 marks)

9

END OF QUESTIONS

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

ACKNOWLEDGEMENT OF COPYRIGHT-HOLDERS AND PUBLISHERS

Question 14: Elephant photo © Thinkstock
Question 15: Cast iron radiator © Thinkstock