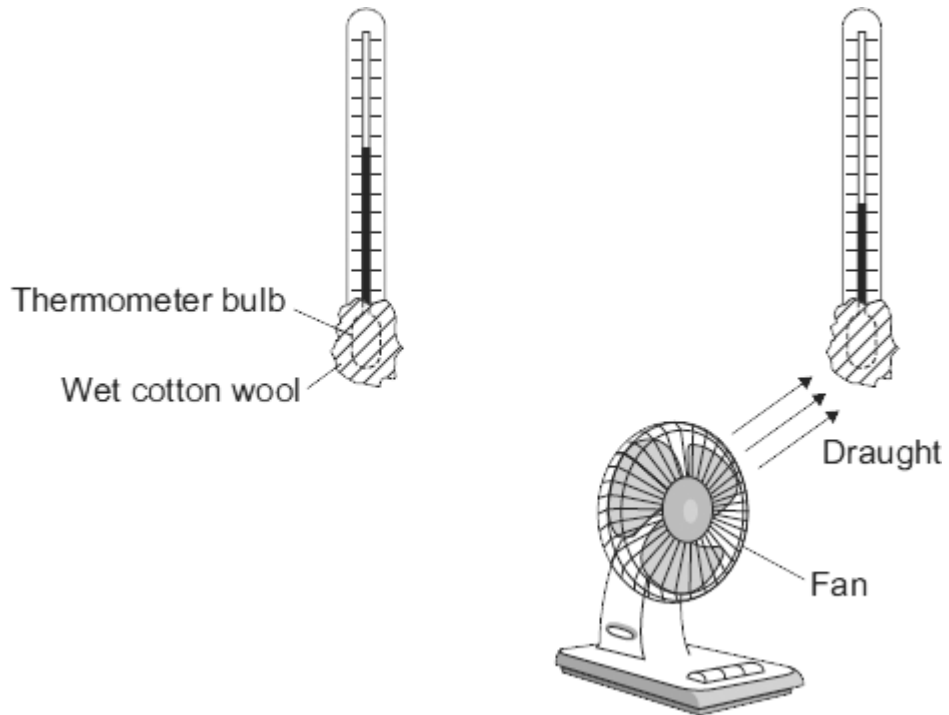
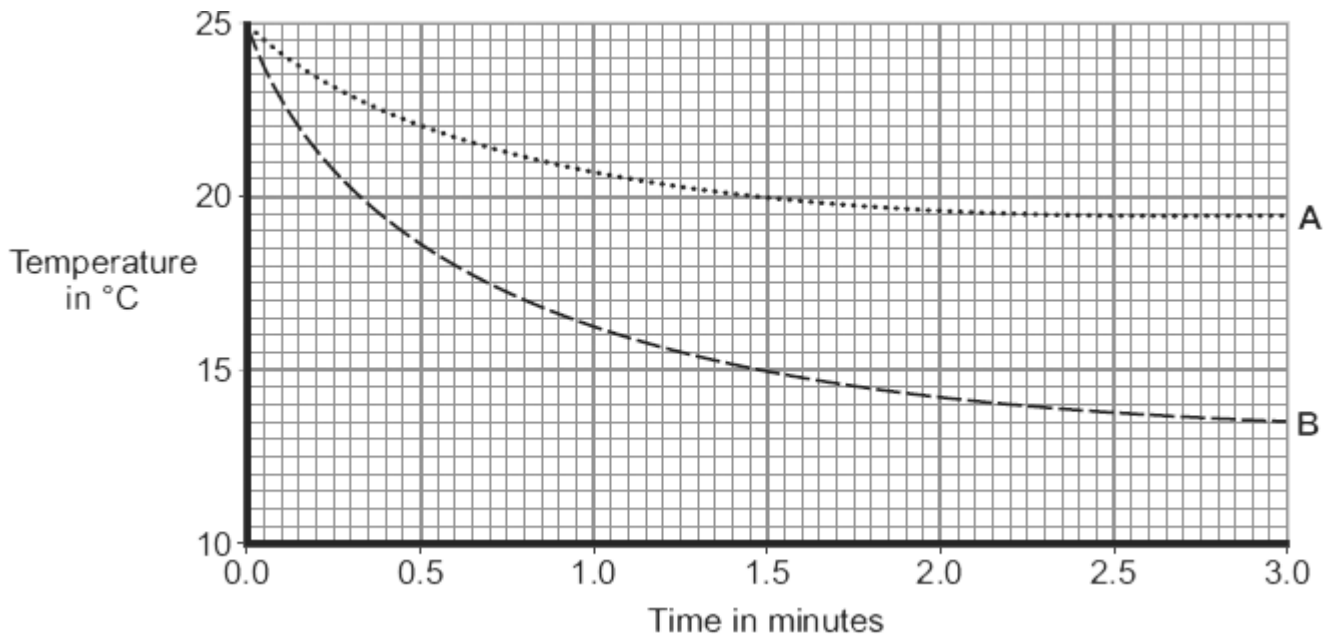


**Q1.**

The diagram shows two thermometers. The bulb of each thermometer is covered with a piece of wet cotton wool. One of the thermometers is placed in the draught from a fan.



The graph shows how the temperature of each thermometer changes with time.



- (a) Which of the graph lines, **A** or **B**, shows the temperature of the thermometer placed in the draught?

Write the correct answer in the box.

Explain, in terms of evaporation, the reason for your answer.

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(3)

- (b) A wet towel spread out and hung outside on a day without wind dries faster than an identical wet towel left rolled up in a plastic bag.

Explain why.

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(2)

(Total 5 marks)

**Q2.**

The picture shows a person taking a hot shower.



- (a) When a person uses the shower the mirror gets misty.

Why?

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(3)

(b) The homeowner installs an electrically heated mirror into the shower room.

When a person has a shower, the heated mirror does **not** become misty but stays clear.

Why does the mirror stay clear?

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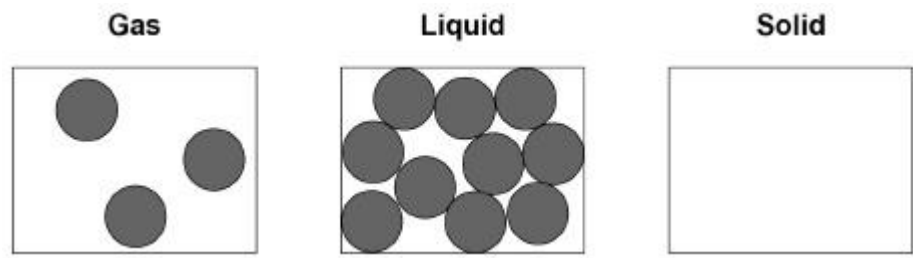
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(2)

(Total 5 marks)

**Q3.**

The diagram shows a model of the particles in a gas and in a liquid.



(a) Complete the diagram to show the arrangement of particles of the same substance as a solid.

(2)

(b) What is the name of the process when a substance changes from a gas to a liquid?

Tick **one** box.

Condensing	<input type="checkbox"/>
Evaporating	<input type="checkbox"/>
Freezing	<input type="checkbox"/>

Melting

(1)

(c) The substance in the diagram has a:

- melting point of 98 °C
- boiling point of 883 °C

What is the state of the substance at 20 °C?

Tick **one** box.

Gas       Liquid       Solid

(1)

(d) What type of change is a change of state?

Tick **one** box.

Chemical   
Kinetic   
Permanent   
Physical

(1)

(e) Which **two** statements are correct about the particles when a liquid turns into a gas?

Tick **two** boxes.

Particles are bigger   
Particles are lighter   
Particles have more chemical energy   
Particles have more kinetic energy   
Particles move faster

(2)

(f) Which **two** quantities are needed to calculate the energy required to turn a liquid into a gas with no change in temperature?

Tick **two** boxes.

Mass of the liquid	<input type="checkbox"/>
Specific heat capacity of the gas	<input type="checkbox"/>
Specific latent heat of vaporisation	<input type="checkbox"/>
Time the liquid is heated	<input type="checkbox"/>

(2)

(g) A mass of 2.0 kg of water is heated.

The temperature increase of the water is 80 °C

The specific heat capacity of water is 4200 J / kg °C

Calculate the change in thermal energy when the water is heated.

Use the equation:

change in thermal energy = mass × specific heat capacity × temperature change

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Change in thermal energy = \_\_\_\_\_ J

(2)

(Total 11 marks)

**Q4.**

Antibiotics are used to kill some types of pathogen.

(a) Which illness could be treated with an antibiotic?

Tick **one** box.

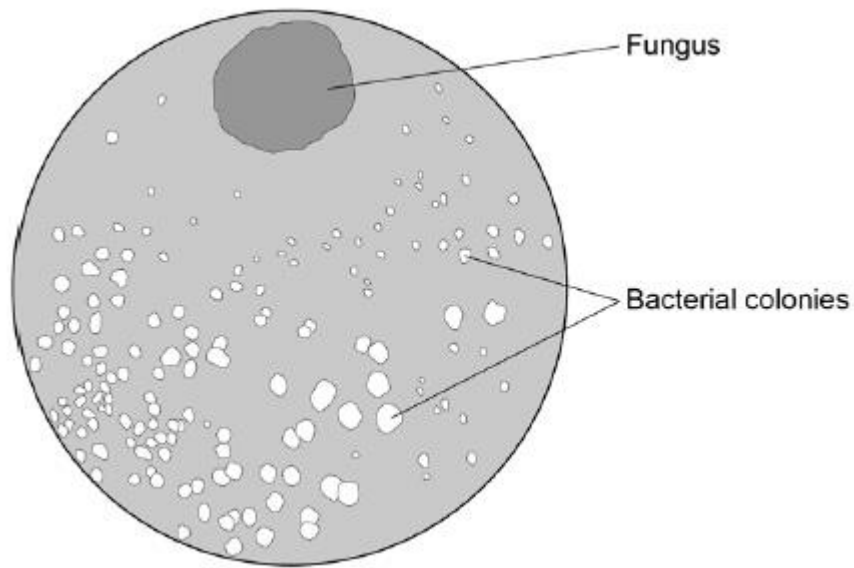
AIDS	<input type="checkbox"/>
Measles	<input type="checkbox"/>
Salmonella	<input type="checkbox"/>
Type 2 diabetes	<input type="checkbox"/>

(1)

Alexander Fleming discovered the antibiotic penicillin.

He noticed that one of his Petri dishes containing bacteria had become contaminated with a fungus.

The diagram shows the Petri dish.



(b) Read the information about the discovery of penicillin.

Draw **one** line from each piece of information to its description.

**Information**

**Description**

Fleming noticed that there were only a few bacterial colonies growing near the fungus.

Conclusion

Fleming thought the fungus must have produced a chemical (penicillin) that killed the bacteria around it.

Hypothesis

He injected 8 mice with bacteria and gave 4 of these mice an injection of penicillin.

Investigation

The 4 mice injected with penicillin survived. The 4 mice **not** given penicillin died.

Observation

Result

(4)

(c) Look at the diagram of the petri dish.

The greater the distance from the fungus the more bacteria grew.

Suggest **one** reason for this.

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(1)

(d) Give **two** reasons why Fleming's discovery was important.

1. \_\_\_\_\_

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2. \_\_\_\_\_

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(2)

(Total 8 marks)

### Q5.

Pathogens cause infectious diseases in animals and plants.

(a) Draw **one** line from each disease to the type of pathogen that causes the disease.

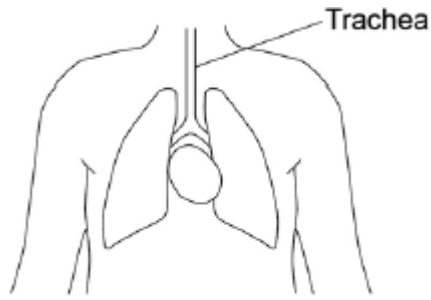
Disease	Type of pathogen
Gonorrhoea	Bacterium
Malaria	Fungus
Measles	Protist
	Virus

(3)

(b) Some parts of the human body have adaptations to reduce the entry of live pathogens.

Look at **Figure 1**.

**Figure 1**



Explain how the trachea is adapted to reduce the entry of live pathogens.

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(4)

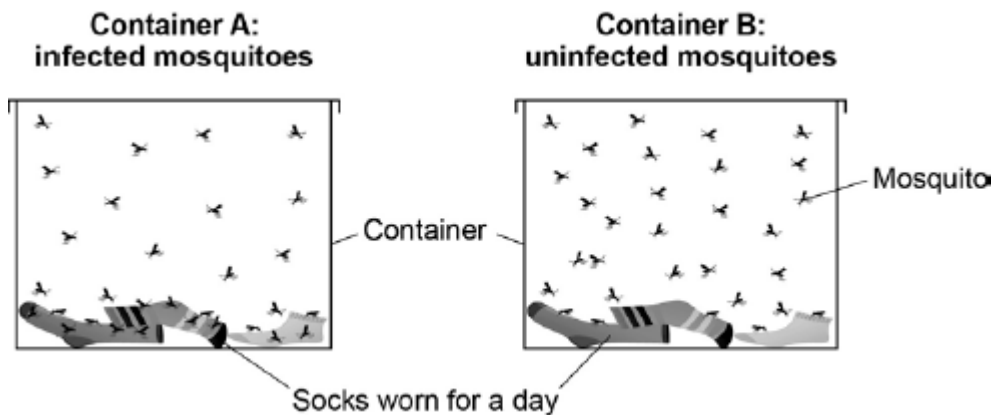
(c) Malaria is a serious disease that can be fatal.

Malaria is spread to humans by infected mosquitoes.

Scientists investigated the behaviour of mosquitoes to understand how the spread of malaria could be controlled.

**Figure 2** shows the equipment the scientists used.

**Figure 2**



This is the method used.

1. 30 mosquitoes **infected with malaria** were placed in Container **A**.



2. 30 **uninfected** mosquitoes were placed in Container **B**.
3. The total number of times the mosquitoes landed on the socks was recorded.

Name the dependent variable and suggest **one** control variable in this investigation.

Dependent variable \_\_\_\_\_

\_\_\_\_\_

Control variable \_\_\_\_\_

\_\_\_\_\_

(2)

- (d) Infected mosquitoes landed on the socks three times more often than uninfected mosquitoes.

Explain how this information can be used to reduce the spread of malaria.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

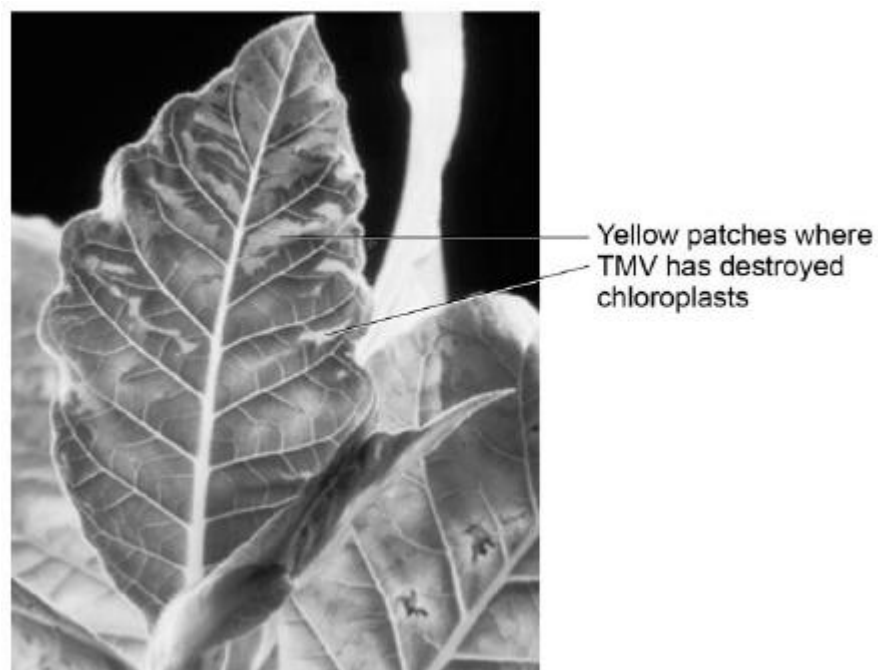
\_\_\_\_\_

(2)

- (e) Tobacco mosaic virus (TMV) affects many species of plant.

**Figure 3** shows a leaf infected with TMV.

**Figure 3**



© Nigel Cattlin/Getty Images

TMV destroys chloroplasts in the leaf.

Explain how this could affect the growth of the plant.

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(3)  
(Total 14 marks)

**Q6.**

Tobacco mosaic virus (TMV) can infect many species of plant.

TMV spreads throughout the whole plant, causing discolouration of the leaves.

(a) Suggest how TMV spreads within the plant from one part to another.

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(1)

(b) Describe how TMV can pass from one plant to another.

---

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(1)

Plants can be genetically modified (GM) to be resistant to TMV.

(c) What **two** ways is the process of genetic modification different from selective breeding?

Tick **two** boxes.

GM is faster.

GM is less dependent on chance at fertilisation.

GM is less likely to give the desired characteristics in the offspring.

GM is only used in plants, not animals.

GM requires less specialist equipment.



(2)

- (d) Describe the process of genetic modification that is used to produce a plant that is resistant to a disease.

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(4)

- (e) Fields planted with genetically modified (GM) crops may have lower biodiversity than fields planted with non-GM crops.

Why is a reduction in biodiversity more likely to result in the extinction of a species?

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(2)

- (f) Maintaining hedgerows around fields helps improve biodiversity.

Suggest **one** other reason why farmers maintain hedgerows around fields of crops.

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(1)

(Total 11 marks)

**Q7.**

Some infections are caused by bacteria.

- (a) The genetic material is arranged differently in the cells of bacteria compared with animal and plant cells.

Describe **two** differences.

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(2)

- (b) Tuberculosis (TB) is an infection caused by bacteria.

The table below shows the number of cases of TB in different regions of southern England from 2000–2011.

**Number of cases of TB per 100 000 people**

Year	London	South East	South West
2000	37	5	3
2001	36	6	4
2002	42	6	6
2003	42	7	4
2004	42	7	5
2005	49	8	5
2006	44	8	3
2007	43	8	5
2008	44	8	5
2009	44	9	6
2010	42	9	5
2011	45	10	5

- (i) How does the number of cases of TB for London compare with the rest of southern England?

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(1)

- (ii) Describe the pattern in the data for cases of TB in the South East.

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(1)

(iii) Describe the pattern in the data for cases of TB in the South West.

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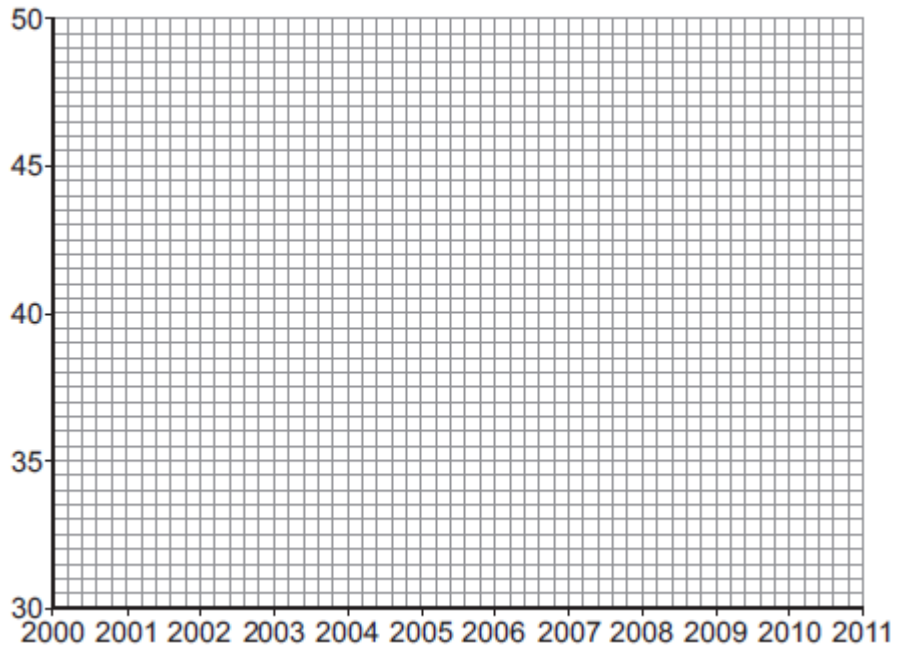
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(2)

(c) (i) On the graph paper below:

- plot the number of cases of TB in **London**
- label both the axes on the graph
- draw a line of best fit.



(4)

(ii) Suggest why a student thought the value for 2005 in London was anomalous.

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(1)

(d) People can be vaccinated against TB.

Suggest how a vaccination programme would reduce the number of people with TB.

Details of how a vaccine works are **not** required.

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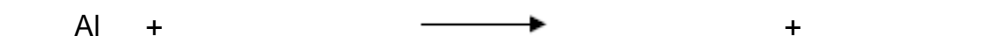
(2)  
(Total 13 marks)

**Q8.**

Formulae and equations are used to describe chemical reactions.

- (a) Aluminium reacts with sulfuric acid ( $\text{H}_2\text{SO}_4$ ) to produce aluminium sulfate,  $\text{Al}_2(\text{SO}_4)_3$  and hydrogen ( $\text{H}_2$ ).

Complete and balance the equation for this reaction.



(2)

- (b) Calcium carbonate reacts with nitric acid to produce calcium nitrate.

Calculate the relative formula mass ( $M_r$ ) of calcium nitrate,  $\text{Ca}(\text{NO}_3)_2$

Relative atomic masses ( $A_r$ ): N = 14; O = 16; Ca = 40

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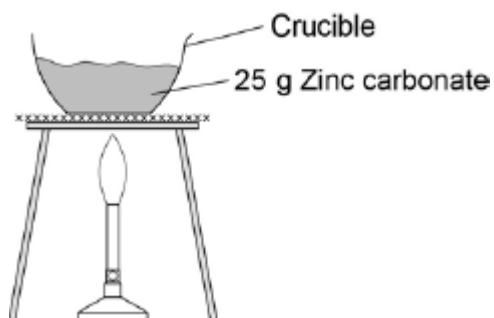
Relative formula mass ( $M_r$ ) = \_\_\_\_\_

(2)

- (c) Zinc carbonate decomposes when heated.

A student heated 25 g zinc carbonate ( $\text{ZnCO}_3$ ).

The figure below shows how he set up the apparatus.



The balanced chemical equation for the decomposition reaction is:



The student measured the mass of solid product after heating until there was no further change in mass.

The student did the experiment four times. The table below shows the results.

Experiment	1	2	3	4
Mass of solid product in g	17.4	19.7	17.6	16.9

Calculate the mean mass of the solid product.

Do **not** use any anomalous results in your calculation.

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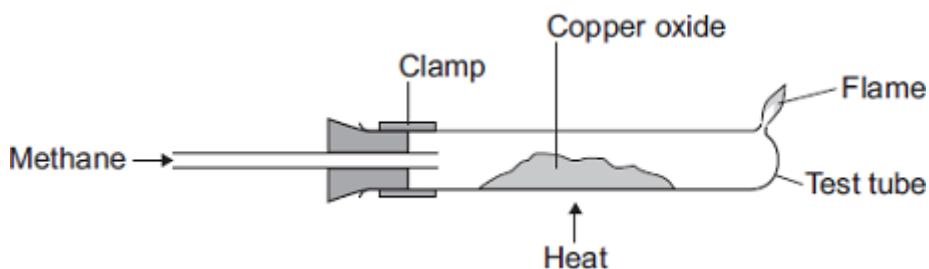
Mean mass = \_\_\_\_\_ g

(2)

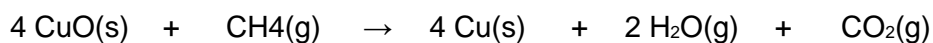
(Total 6 marks)

**Q9.**

This apparatus is used for the reaction of copper oxide (CuO) with methane (CH<sub>4</sub>).



(a) The symbol equation for this reaction is shown below.



The water and carbon dioxide produced escape from the test tube.

Use information from the equation to explain why.

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(1)

(b) (i) Calculate the relative formula mass ( $M_r$ ) of copper oxide (CuO).

Relative atomic masses ( $A_r$ ): O = 16, Cu = 64

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Relative formula mass ( $M_r$ ) = \_\_\_\_\_

(2)

(ii) Calculate the percentage of copper in copper oxide.

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Percentage of copper = \_\_\_\_\_ %

(2)

(iii) Calculate the maximum mass of copper that could be produced from 4.0 g of copper oxide.

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Mass of copper produced = \_\_\_\_\_ g

(1)

(c) The experiment was done three times.

The mass of copper oxide used and the mass of copper produced were measured each time.

The results are shown in the table.

	Experiment		
	1	2	3
Mass of copper oxide used in g	4.0	4.0	4.0
Mass of copper produced in g	3.3	3.5	3.2

(i) Calculate the mean mass of copper produced in these experiments.

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Mean mass of copper produced = \_\_\_\_\_ g

(1)

(ii) Suggest how the results of the experiment could be made more precise.

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---

(1)

(iii) The three experiments gave different results for the amount of copper produced.

This was caused by experimental error.



Suggest two causes of experimental error in these experiments.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

(2)

(Total 10 marks)

### Q10.

Aqamed is a medicine for children.

- (a) The medicine is a formulation.

What is meant by a formulation?

\_\_\_\_\_

\_\_\_\_\_

(1)

- (b) Children often do not like taking medicine.

Suggest a substance that could be added to Aqamed to increase the desire for children to take it.

Give a reason for your suggestion.

Substance \_\_\_\_\_

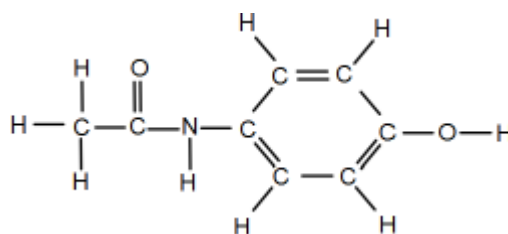
Reason \_\_\_\_\_

\_\_\_\_\_

(2)

- (c) The main ingredient in Aqamed is a painkiller called paracetamol.

The figure below represents a molecule of paracetamol.



Give the molecular formula of paracetamol.

Calculate its relative formula mass ( $M_r$ ).

Relative atomic masses ( $A_r$ ): H = 1; C = 12; N = 14; O = 16

Molecular formula \_\_\_\_\_

Relative formula mass \_\_\_\_\_

\_\_\_\_\_

$M_r =$  \_\_\_\_\_

(2)

(d) Aspirin is a medicine for use by adults.

An aspirin tablet contains 300 mg of acetylsalicylic acid.

Calculate the number of moles of acetylsalicylic acid in one aspirin tablet.

Give your answer in standard form to three significant figures.

Relative formula mass ( $M_r$ ) of aspirin = 180

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Number of moles = \_\_\_\_\_

(4)

(Total 9 marks)

## Mark schemes

### Q1.

(a) **B**

*no mark for **B** - marks are for the explanation  
first two mark points can score even if **A** is chosen*

draught increases (the rate of) evaporation  
*accept more evaporation happens  
accept draught removes (evaporated) particles faster  
do **not** accept answers in terms of particles gaining energy  
from the fan / draught*

1

evaporation has a cooling effect  
*accept (average) kinetic energy of (remaining) particles  
decreases*

1

so temperature will fall faster / further

1

(b) larger surface area

1

increasing the (rate of) evaporation  
*accept more / faster evaporation  
accept easier for particles to evaporate*

**or**

for water to evaporate from  
*accept more particles can evaporate  
accept water / particles which have evaporated are trapped  
(in the bag)  
answers in terms of exposure to the Sun are insufficient*

1

[5]

### Q2.

(a) any **two** from:

- water evaporates  
*accept steam / water vapour for water molecules  
accept water turns to steam*
- water molecules / particles go into the air
- mirror (surface) is cooler than (damp) air  
*accept the mirror / surface / glass is cold*
- water molecules / particles that hit the mirror lose energy

*accept water molecules / particles that hit the mirror cool down*

- cooler air cannot hold as many water molecules / particles

2

(causes) condensation (on the mirror)

*accept steam changes back to water (on the mirror)*

**or**

particles move closer together

1

- (b) mirror (surface) is warm

*mirror is heated is insufficient*

1

(rate of) condensation reduced

*accept no condensation (happens)*

1

[5]

### Q3.

- (a) (approximate same size particles as each other and as liquid and gas) touching  
*do **not** accept particles that overlap*

1

regular arrangement (filling the square)

1

- (b) condensing

1

- (c) solid

1

- (d) physical

1

- (e) particles have more kinetic energy

1

particles move faster

1

- (f) mass of the liquid

1

specific latent heat of vaporisation

1

- (g)  $2 \times 4\,200 \times 80$

1

672 000 (J)

*an answer of 672 000 (J) scores 2 marks*

1

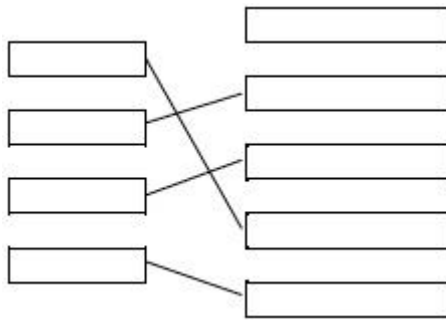
[11]

**Q4.**

(a) salmonella

1

(b)



1  
1  
1  
1

(c) lower concentration of antibiotic / chemical further from the fungus  
*allow less antibiotic / chemical further from the fungus*

1

(d) lead to mass production of antibiotics  
**or**  
lead to development of other antibiotics

1

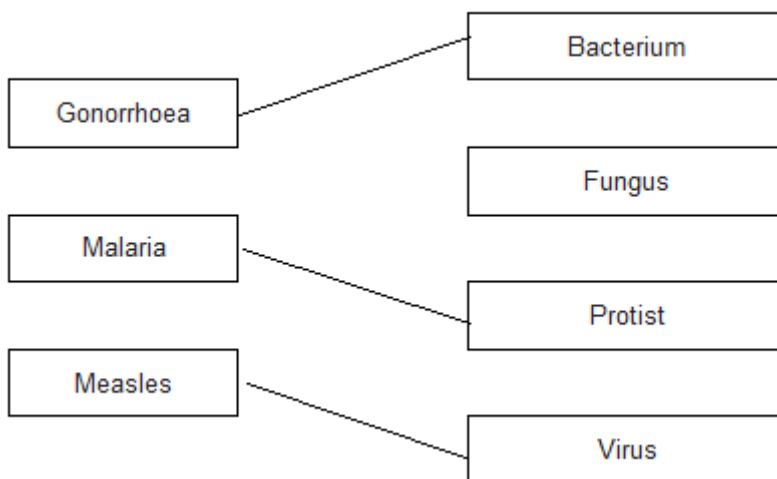
reduced infection by bacteria  
**or**  
antibiotics have saved many lives

1

[8]

**Q5.**

(a)



3

(b) (trachea) has mucus

1

to <u>trap</u> pathogens	1
(trachea) has cilia	1
to <u>move</u> mucus out of trachea	1
(c) <b>dependent variable:</b> number of times mosquitoes landed on socks	1
<b>control variable:</b> any <b>one</b> from:	
<ul style="list-style-type: none"> <li>• number of mosquitoes in each container</li> <li>• length of time socks worn</li> <li>• dampness of socks</li> <li>• same type of socks</li> <li>• size of container</li> <li>• time</li> <li>• temperature</li> <li>• species of mosquito</li> <li>• age of mosquito</li> </ul>	1
(d) use worn socks <b>or</b> use chemical from worn socks	1
to attract / trap infected mosquitoes	1
<p style="text-align: center;"><i>or accept:</i> wear clean socks / change socks regularly (1) to reduce the chance of attracting mosquitoes (1)</p>	
(e) less chlorophyll present	1
(so) less light absorbed	1
(so) reduced photosynthesis <b>or</b> (so) less sugar / food made	1
	<b>[14]</b>
<b>Q6.</b>	
(a) xylem / phloem <i>allow translocation / transpiration</i>	1
(b) any <b>one</b> from: <ul style="list-style-type: none"> <li>• through tools or hands (after touching infected plants)</li> </ul>	

- in the soil
  - infected plants in contact with healthy plants
- 1
- (c) GM is faster
- 1
- GM is less dependent on chance at fertilisation
- 1
- (d) any **four** from:
- gene for resistance is cut out with enzymes
  - placed into a vector (virus or plasmid)
  - inserted into early stage of young plants
  - that grow by mitosis
  - plants grow with gene in most cells
- points must be in correct order to gain credit*
- 4
- (e) any **two** from:
- a species is less likely to survive in changing conditions
- allow named change such as new disease*
- less links in food webs **or** populations become smaller and have less variation
  - less likely have suitably adapted individuals
- 2
- (f) any **one** from:
- habitat for predators of pests
  - natural barrier against disease transmission / herbivores
  - reduce wind damage
- ignore references to cost*
- 1
- [11]**

### Q7.

- (a) any **two** from:
- only one 'chromosome'
- allow one strand of DNA*
- circular
- allow loop*
- may have plasmids
  - not in a nucleus / no nucleus
- 2
- (b) (i) any **one** from:
- London is much higher
- or converse*
- more variable / wider range
- allow 'on average it is 5 / 6 times greater'*
- 1
- (ii) increases
- Included figures must be correct*
- 1

- (iii) overall slight increase  
*accept 'doesn't change much'* 1
- variable / goes up and down 1
- (c) (i) both axes correctly labelled
- x = Year
- y = Number of cases 1
- correct points  
*all correct = 2 marks*  
*1-2 errors = 1 mark*  
*> 2 errors = 0 marks* 2
- suitable line of best fit  
*accept straight line or smooth curve* 1
- (ii) doesn't fit the pattern / line of best fit 1
- (d) provides immunity / protection (to TB)  
*ignore 'stops people catching it'*  
*ignore 'resistance'* 1
- prevents TB spreading  
*accept ref to herd immunity* 1
- [13]**

**Q8.**

- (a)  $2\text{Al} + 3\text{H}_2\text{SO}_4 \longrightarrow \text{Al}_2(\text{SO}_4)_3 + 3\text{H}_2$   
*formulae correct* 1  
*balancing correct* 1
- (b)  $40 + 2(14 + (3 \times 16))$   
  
 $= 164$   
*allow 164 with no working shown for 2 marks* 1
- (c)  $(17.4 + 17.6 + 16.9) / 3$   
  
 $= 17.3$   
*allow 17.3 with no working shown for 2 marks* 1



**Q9.**

- (a) because they are gases  
*ignore vapours / evaporate / (g)*  
*allow it is a gas* 1
- (b) (i) 80 / 79.5  
*correct answer with or without working = 2 marks*  
*ignore units*  
*if no answer **or** incorrect answer then evidence of 64 / 63.5 + 16 gains 1 mark* 2
- (ii) 79.375 - 80  
*correct answer with or without working = 2 marks*  
*if no answer **or** incorrect answer then evidence of*  

$$\frac{64}{80} \text{ or } \frac{63.5}{79.5} (\times 100) \text{ gains 1 mark}$$
  

$$\frac{64 \text{ or } 63.5}{\text{answer (b)(i)}} \times 100 \text{ for 2 marks}$$
  
*accept (ecf) if answer correctly calculated.*  
*if incorrectly calculated evidence of  $\frac{64 \text{ or } 63.5}{\text{answer (b)(i)}} (\times 100)$  gains 1 mark* 2
- (iii) 3.2  
*correct answer with or without working = 1 mark*  
*allow (ecf)*  
*4 x ((b)(ii)/100) for 1 mark if correctly calculated* 1
- (c) (i) 3.3  
*accept 3.33..... **or** 3 1 / 3 **or** 3.3•*  
***or** 3.3r* 1
- (ii) (measure to) more decimal places **or** (use a) more sensitive balance / apparatus  
*allow use smaller scale (division) **or** use a smaller unit*  
*ignore accurate / repeat* 1
- (iii) any **two** from:  
*ignore systematic / human / apparatus / zero / measurement / random / weighing / reading / recording errors unless qualified*  
 different balances used **or** faulty balance

*ignore dirty apparatus*

reading / using the balance incorrectly

*accept incorrect weighing of copper / copper oxide*

spilling copper oxide / copper

*allow some copper left in tube*

copper oxide impure

*allow impure copper (produced)*

not all of the copper oxide was reduced / converted to copper **or** not enough / different amounts of methane used

*accept not all copper oxide (fully) reacted*

heated for different times

heated at different temperatures

*if neither of these points awarded allow different amounts of heat used*

*accept Bunsen burner / flame at different temperatures*

some of the copper produced is oxidised / forms copper oxide

some of the copper oxide / copper blown out / escapes (from tube)

*ignore some copper oxide / copper lost*

some water still in the test tube

2

[10]

**Q10.**

(a) (medicine is) a mixture **and**

(designed as) a useful product

1

(b) sugar / flavouring

1

to make it taste better

**or**

colouring

to make it look more attractive

1

(c)  $C_8H_9NO_2$

*any order of elements*

1

151

1

(d) mass of acetylsalicylic acid = 0.3 g

$$= \frac{0.3 \text{ (mol)}}{100}$$

*method mark – divide mass by  $M_r$*

$$= 0.00167 \text{ (mol)}$$

*allow 0.0016666(66)*

$$1.67 \times 10^{-3} \text{ (mol)}$$

*correct answer with or without working scores 4 marks*

*allow ecf from steps 1, 2 and 3*

1

1

1

1

**[9]**