GCSE COMBINED SCIENCE: SYNERGY

Higher Tier

AQA

Paper 2H

Specimen 2018

Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:

- a ruler
- a calculator
- the periodic table (enclosed)
- the Physics equation sheet (enclosed).

Instructions

- Answer all questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- There are 100 marks available on this paper.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- When answering questions 03.1, 06.3 and 09 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.

Advice

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

Please write clearly,	in block capitals.
Centre number	Candidate number
Surname	
Forename(s)	
Candidate signature	

Oxides of nitrogen are produced when fuels are burnt.



Write a balanced symbol equation for the production of nitrogen dioxide (NO_2) from nitrogen and oxygen.

[2 marks]

0 1 . 2 Figure 1 gives information about emissions of oxides of nitrogen in the UK.



Calculate the percentage decrease in emissions of oxides of nitrogen from 1990 to 2014.

Give your answer to three significant figures.

[3 marks]

Percentage decrease = _____

0 1 . **3** Give **one** advantage of reducing the emissions of oxides of nitrogen.

[1 mark]

%

02 A student used chromatography to identify the pigments in spinach leaves. She used propanone as a solvent.

Figure 2 shows the student's results.





0 2 . 1 Name the mobile phase and the stationary phase in the student's experiment.

Mobile phase ______Stationary phase ______

[2 marks]

02.2	What does Figure 2 tell you about the green pigment from spinach?	[3 marks]
02.3	Write the equation that links distance moved by solvent, distance moved by solute and R_f value.	[1 mark]
02.4	Use Figure 2 to calculate the R _f value for pigment B .	[3 marks]
	R _f value =	

Question 2 continues on the next page

0 2 . 5 Another student set up the apparatus shown in Figure 3.

Figure 3

This student did not set up the apparatus correctly.

Identify the errors the student made.

Explain how the errors she made would affect her results.

[4 marks]

Turn over for the next question

0 3 A student investigated the specific heat capacity of metals.

Describe an experiment the student could do to measure the specific heat capacity of a metal. 03.1 [6 marks]

Table 1 shows the student's results.

Table 1

Metal	Mass of material in kg	Time in minutes	Temperature change in °C	Change in thermal energy in J	Calculated specific heat capacity of material in J/kg °C
Aluminium	1	10	2	4 780	2 390
Brass	1	10	4	4 660	1 165
Copper	1	10		4 600	657
Steel	1	10	5	4 690	938

0 3 . 2 Use data from **Table 1** to calculate the temperature change for copper.

Use the correct equation from the Physics Equation Sheet.

[3 marks]

°C

Temperature change =

0 3 . 3 What is the independent variable in the student's investigation? [1 mark] Tick **one** box. Mass of material Power used Time in minutes Type of material

03.4	The student calculated the specific heat capacity of aluminium to be 2 390 J/kg $^\circ$ C.
	The 'true' specific heat capacity of aluminium is 900 J/kg °C.
	Suggest why the student's result for aluminium is different from the 'true' value. [2 marks]
03.5	The teacher suggested that putting bubble wrap round the metal block would change the results.
	How would using bubble wrap change the results?
	Give a reason for your answer. [2 marks]

Turn over for the next question

Figure 4 shows two nerve pathways.

0 4 . 1 Nerve pathway **A** is 92 cm long.

A nerve impulse travels along pathway **A** at 76.2 m/s.

Calculate how long it takes for the nerve impulse to travel the length of the pathway.

Use the equation:

distance = speed × time

[3 marks]

Time = _____ s

0 4 . **2** Nerve pathways **A** and **B** are the same length.

The nerve impulse takes longer to travel along pathway A than along pathway B.

Use Figure 4 to explain why.

[3 marks]

Question 4 continues on the next page

Two students compare their reactions using a ruler.

This is the method used.

- 1. Student **A** sits with his elbow on a table top.
- Student B holds the ruler so the bottom of the ruler is level with the top of student A's thumb.
- 3. Student **B** drops the ruler.
- 4. Student **A** catches the ruler.
- 5. Record the drop distance.
- 6. Repeat steps 1 to 5 four more times.
- Repeat the whole experiment with student A dropping the ruler and student B catching it.

Both students are right-handed.

Student **A** uses his right hand to catch the ruler.

Student **B** uses her left hand to catch the ruler.

Table 2

Student	Drop distance in mm						
Student	Test 1	Test 2	Test 3	Test 4	Test 5		
Student A – right hand	203	167	140	156	163		
Student B – left hand	230	211	279	215	264		

0 4 . 3 What is the range of student **A**'s results?

[1 mark]

04.4 The students are testing the hypothesis:

The drop distance of the ruler is smaller when a right-handed person uses their right hand to catch the ruler.

The students' results in Table 2 are not a good test of the hypothesis.

Suggest what the students should have done to test the hypothesis.

[3 marks]

0 4 . 5 Student A's mean reaction time was 0.19 s.

Mean reaction time can be calculated using the equation:

Mean reaction time =
$$\sqrt{\frac{2 \times \text{mean drop distance in m}}{9.8 \text{ m/s}^2}}$$

Calculate the mean reaction time for Student **B**.

Give your answer to two significant figures.

Student **B**'s results are repeated here to help you answer the question.

	Drop distance in mm				
	Test 1	Test 2	Test 3	Test 4	Test 5
Student B – left hand	230	211	279	215	264

[4 marks]

Mean reaction time = _____ s

Turn over for the next question

Figure 5 shows some different breeds of horse.

Figure 5

0 5 . **1** All breeds of horse are of the same species.

Suggest what you could do to show this.

[2 marks]

0 5 . 2 Horse racing is an ancient sport.

Selective breeding has been used for centuries to produce racehorses.

Describe the steps involved in selective breeding to produce a racehorse.

[3 marks]

Question 5 continues on the next page

Another way of producing organisms with desired characteristics is genetic engineering.

Bt cotton is a variety of cotton that has been genetically engineered to produce a poison.

The poison kills several different species of insect that feed on cotton plants.

The poison is naturally produced by a soil bacterium called *Bacillus thuringiensis*.

0 5 . 3 Describe how cotton plants can be genetically engineered to produce the Bt poison.

[3 marks]

Turn over for the next question

SPECIMEN MATERIAL

0 6 Huntington's disease is an inherited disorder that affects the nervous system.

It is caused by a dominant allele.

A man is heterozygous for Huntington's disease.

His partner is healthy and does not have the allele that causes Huntington's disease.

06.1

What are the genotypes of the man and the woman?

Use:

- **H** for the allele that causes Huntington's disease
- **h** for the healthy allele.

[1 mark]

Man's genotype

Woman's genotype

06. **2** The couple want to have a child.

Use a Punnett square to determine the probability of the child having Huntington's disease.

Circle the genotypes of any children that will have Huntington's disease.

[4 marks]

Probability of child having Huntington's disease =

Question 6 continues on the next page

06. **3** The couple visit a genetic counsellor, who gives them the following options.

- 1. Adopt a child.
- 2. Gamete donation uses sperm from another man to fertilise the woman's eggs by in vitro fertilisation (IVF).
- 3. Conceive naturally.
- 4. Use pre-implantation genetic diagnosis (PGD).
 - Many embryos are produced by IVF using gametes from the man and woman.
 - Embryos are tested for Huntington's disease and a healthy embryo is implanted into the woman's uterus.
 - The risk of implanting an embryo with the allele for Huntington's disease is 0.2%.
 - Costs the NHS about £11 000.
- 5. Conceive naturally and use prenatal diagnosis (PND) once the woman becomes pregnant.
 - A sample of the placenta is taken at 10 weeks of pregnancy or a sample of fluid is taken from around the developing baby at 16 weeks of pregnancy.
 - The sample is tested for the Huntington's allele.
 - A 0.5–1.0% risk of miscarriage.
 - About 1% of samples collected are unsuitable for testing.
 - Costs the NHS about £600.

The couple decide they want to have a healthy baby that is their own biological offspring.	
Evaluate the options.	
Suggest which option would be best for the couple.	[6 marks]

Turn over for the next question

0 7

Figure 6 shows the plum pudding model of the atom.

This model was used by some scientists after the discovery of electrons in 1897.

Figure 6

In 1911 the scientists Geiger and Marsden investigated the effect of firing alpha particles at very thin sheets of gold foil.

Their experiment is shown in **Figure 7**. The arrows show the paths taken by alpha particles in the experiment.

Question 7 continues on the next page

07. 3 In 1931 a scientist discovered that there are hydrogen atoms with mass number 2 as well as hydrogen atoms with mass number 1.

A year later, another scientist discovered neutrons.

Explain why the discovery of neutrons could explain the presence of hydrogen atoms with different mass numbers.

[3 marks]

How would the results of the experiment shown in **Figure 7** change if neutrons were used instead of alpha particles to bombard a thin sheet of gold?

[2 marks]

08 A student investigated the effect of light intensity on the rate of photosynthesis in pondweed.

 $\fbox{0}$ $\fbox{8}$. $\fbox{1}$ The formula for glucose is $C_6H_{12}O_6$

Use the formula for glucose to write the balanced symbol equation for photosynthesis.

[2 marks]

Question 8 continues on the next page

Figure 8 shows the apparatus the student used.

Figure 8

The student altered the distance of the lamp from the pondweed and counted the number of bubbles produced in 30 seconds for each distance.

Table 5 shows the student's results.

Distance in cm	Number of bubbles produced in 30 seconds
10	27
20	23
30	16
40	7
50	2

Table 5

[3 marks]

08. 3 The student concluded that the rate of photosynthesis is inversely proportional to the distance of the lamp from the pondweed.

Does the student's data support this conclusion?

Use data from **Figure 9** to justify your answer.

[3 marks]

Question 8 continues on the next page

08. **4** The volume of one bubble can be calculated using the equation:

 $V = 4/3 \pi r^3$

The radius of one bubble is 0.1 cm.

The value for π is 3.14

Use data from **Table 5** and the information above to calculate the rate of gas production at a distance of 40 cm.

Give your answer in standard form to three significant figures.

[5 marks]

Rate of reaction = _____ cm³ per minute

09	In the last 200 years the concentration of carbon dioxide in the Earth's atmosphere has risen.			
	Explain how a rise in carbon dioxide concentration in the atmosphere can decrease biodiversity.			
		[6 marks]		

END OF QUESTIONS

There are no questions printed on this page

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