



GCSE SCIENCE EQUIVALENCY

Combined Science Sample Paper - 2022/2023

Please write clearly in block capitals

Forename:
Surname:

Materials

For this paper you must have:

- a ruler
- a scientific calculator

TOTAL

Instructions

- Write your name and other details in the spaces provided above.
- You must answer all sections of this exam.
- Additional sheets may be used.
- In all calculations, show clearly how you work out your answer.

Advice

- 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.

1 Eye colour is controlled by genes.

The dominant allele of the gene (**B**) produces brown eyes, whereas the recessive allele produces blue eyes (**b**).

1(a) Define the term allele.

[1 mark]

1(b) A homozygous brown eyed man and a homozygous blue-eyed woman have three children.

All three children have brown eyes.

State what is meant by the term homozygous.

[1 mark]

1(c) Draw a genetic diagram to represent the information above.

[2 marks]

1(d) Using your answer to part (c), explain why all of the children have brown eyes.

[1 mark]

Turn over for next question

- 2** Feeding relationships within an ecosystem can be shown using food chains.
The food chain below describes a forest ecosystem.

Willow tree → Caterpillar → Robin → Owl

- 2(a)** Name the producer in this food chain.

[1 mark]

- 2(b)** Name the primary consumer in this food chain.

[1 mark]

- 2(c)** State what an ecological pyramid of numbers represents.

[1 mark]

- 2(d)** Draw a pyramid of numbers drawn for this food chain.

[2 marks]

Question continued on next page

- 2(e)** Describe how a pyramid of biomass for the same food chain would differ from the pyramid of numbers.

[2 marks]

- 2(f)** Explain why only around 10 % of energy is transferred from one trophic level to the next.

[2 marks]

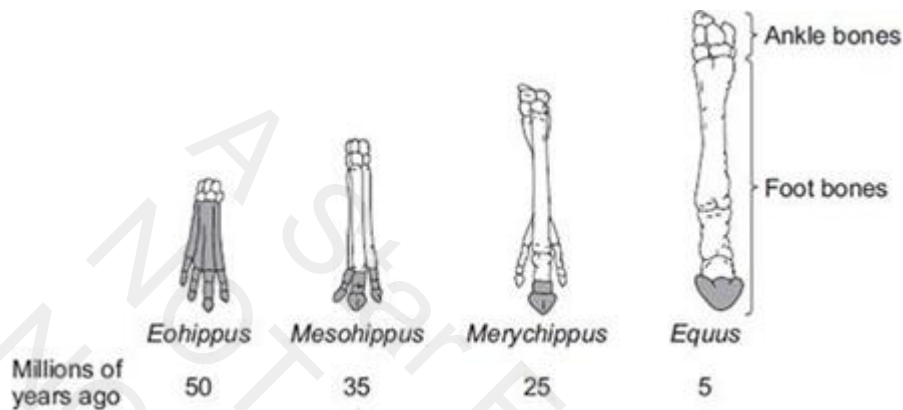
- 2(g)** There are many different factors that affect the number and distribution of organisms in an ecosystem.

State **one** biotic factor and **one** abiotic factor in a forest ecosystem

[2 marks]

Turn over for next question

- 3** The diagram shows changes in the foot bones of four ancestors of horses over the past 50 million years.



The shaded bones are the bones which touched the ground when moving or standing.

- 3(a)** State **two** visible changes to the bones in the feet of these ancestors that have taken place over the last 50 million years.

[2 marks]

1.

2.

- 3(b)** Eohippus lived in swampy areas with soft mud.

Since this time the ground in the habitat has become drier and harder.

Explain how the arrangement of the foot bones could have evolved from the Eohippus to the Equus.

Use Darwin's theory of evolution by natural selection to support your answer.

[3 marks]

Turn over for next question

4 Plants make their own food by the process of photosynthesis.

4(a) State the word equation for photosynthesis.

[2 marks]

4(b) Identify source of energy required for photosynthesis

[1 mark]

4(c) State **two** environmental factors that can limit the rate of photosynthesis.

[2 marks]

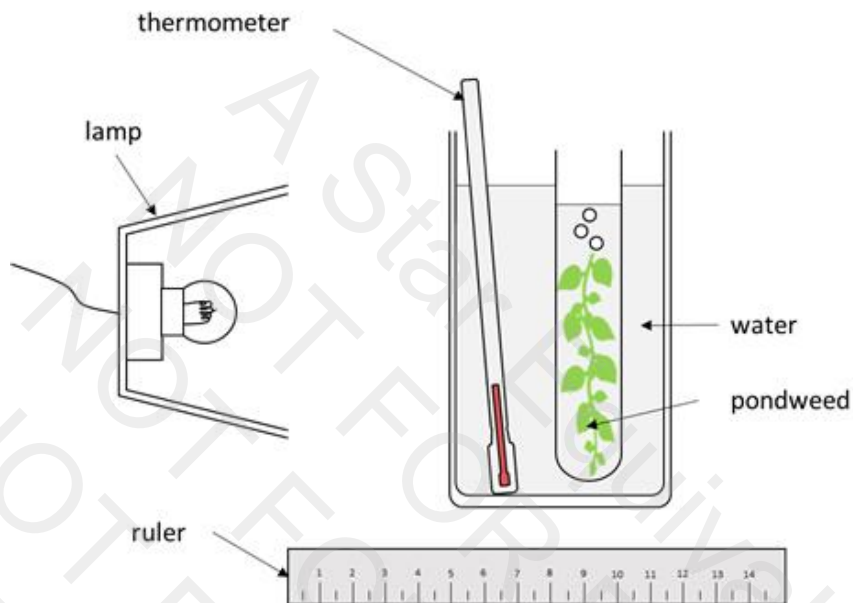
1.

2.

Question continues on next page.

4(d) A student investigates how light intensity affects the rate of photosynthesis using pondweed.

They set up the apparatus as follows.



Describe the procedure the student should use

[4 marks]

Question continues on next page

4(e) State **two** control variables in this experiment.

[2 marks]

1. _____

2. _____

4(f) Explain the results you would expect the student to see from this experiment, and what conclusion can be made on how light intensity affects the rate of photosynthesis

[2 marks]

Turn over for next question

5 Objects are made up of particles called atoms.

5(a) Complete the sentences

The nucleus contains and

[1 mark]

5(b) An atom has no overall charge because there are an equal number of

..... and

[1 mark]

5(c) Atoms bond together to form

[1 mark]

Turn over for next question

6 This question is about rates of reaction.

6(a) Identify the change you would **not** expect to affect the rate of reaction to increase.

- A.** Increasing the temperature
- B.** Decreasing the particle size
- C.** Increasing the concentration of the acid
- D.** Increasing the particle size

[1 mark]

Answer _____

6(b) Give the name of a substance that increases the rate of reaction and is chemically unchanged at the end of the reaction.

[1 mark]

6(c) Complete the sentence.

When the temperature of reaction mixture increases, the particles gain more

..... energy.

[1 mark]

Turn over for next question

7 Rusting is a chemical reaction that occurs with iron and the most common alloy of iron, steel.

7(a) Give the conditions under which iron rusts

[1 mark]

7(b) Galvanised iron does not rust.

Describe how iron can be galvanised and explain why this method prevents the iron from rusting

[2 marks]

Turn over for next question

8 A student performs some tests on several compounds.

8(a) One of the compounds is a hydrocarbon. The student wants to determine if the hydrocarbon is an alkane or alkene.

Describe a chemical test for an alkene.

[2 marks]

8(b) The student has another compound which is a salt.

The student performs a flame test to determine what metal ion is present in the salt.

A lilac flame is produced.

Identify the metal ion is present in the salt.

[1 mark]

8(c) Sodium carbonate reacts with hydrochloric acid to produce a salt, water and carbon dioxide.

Give the balanced symbol equation of this reaction.

[3 marks]

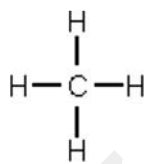
8(d) Describe the test for the gas evolved in part (c)

[2 marks]

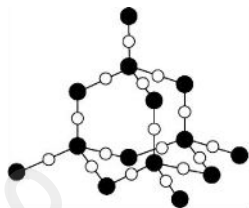
Turn over for next question

9 The diagrams below show the structures of methane, sodium chloride and silicon dioxide.

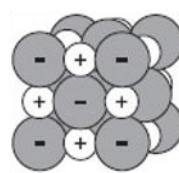
9(a) Draw **one** line from each compound to its structure and bonding.



Methane



Silicon Dioxide



Sodium Chloride

Methane

Ionic Lattice

Sodium Chloride

Giant Covalent Structure

Silicon Dioxide

Simple Covalent Molecule

[3 marks]

9(b) Explain the high melting point of silicon.

[3 marks]

9(c) Draw **one** line from each type of bonding to its definition.

Covalent Bonding

A shared pair of electrons

Ionic Bonding

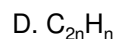
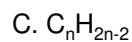
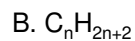
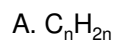
Electrostatic attraction
between two oppositely
charged ions

[2 marks]

Turn over for next question

10 This question is about organic compounds.

10(a) Identify the correct general formula for an alkane.



[1 mark]

Answer _____

10(b) Give the name of the hydrocarbon, based on its formula: C_4H_{10} .

[1 mark]

10(c) Give the name of the repeating units that make up a polymer.

[1 mark]

10(d) Draw the display formula of poly(ethene).

[1 mark]

Question continued on next page

- 10(e)** Poly(ethene) is used to produce many single-use plastic products and plastic bags.
State **two** issues with the disposal of plastics by landfill.

[2 marks]

1.

2.

- 10(f)** State **two** issues with the disposal of plastics by incineration.

[2 marks]

1.

2.

Turn over for next question

11 Different electromagnetic waves have different uses and effects on humans.

11(a) Draw **one** straight line from each electromagnetic wave to its associated use.

Radio	Detecting bone fractures
X-rays	Night vision equipment
Infrared	Cooking
Visible Light	Optical Fibers
Microwaves	Communications

[5 marks]

11(b) State a harmful affect for each of the following electromagnetic waves.

1. Gamma rays
2. Ultraviolet

[2 marks]

Turn over for next question

12 You may find the following formulae useful.

$$\text{Power} = \frac{\text{Work Done}}{\text{Time Taken}}$$

$$\text{Power} = \frac{\text{Energy Transferred}}{\text{Time Taken}}$$

A teacher investigates the efficiency of two torches, A and B.

12(a) The teacher finds that torch A has an efficiency of 70%.

Explain in terms of energy what is meant by an efficiency of 70%.

[2 marks]

12(b) State what is meant by the power of an electrical device.

[1 mark]

12(c) Torch A has a power rating of 15 W .The teacher uses the torch for 30 seconds.

Calculate the energy supplied to the torch.

Give your answer in Joules (J).

[2 marks]

Energy = _____ J

Question continued on next page

- 12(d)** Torch B has a useful output power of 16 W when the input power is 20 W.
Calculate the efficiency of torch B.

[2 marks]

Efficiency = _____ %

- 12(e)** The teacher states that all the energy supplied to a torch is transferred to other forms of energy.
Identify the scientific principle that supports the teacher's statement.

[1 mark]

Turn over for next question

13 Doctors use radioactive Technetium to trace the flow of blood around a patient's body.

The radioactive Technetium emits gamma radiation.

13(a) Give **two** properties of gamma radiation.

[2 marks]

1. _____

2. _____

13(b) Explain why alpha radiation is not used to trace blood flow.

[2 marks]

13(c) A sample of radioactive Technetium is tested in a laboratory.

State the names of the instruments needed to measure the count rate of the sample accurately.

[1 mark]

13(d) These instruments detect a corrected count rate of 1200 in one minute from the sample.

Calculate the number of counts per second from the sample.

[1 mark]

Answer _____

Question continued on next page

- 13(e)** 6 hours later, the corrected count rate is 600 in one minute.

One of the reasons radioactive Technetium is chosen as a medical tracer is due to the time it takes to decay.

State the half-life of this sample of Technetium. Include the units in your answer.

[1 mark]

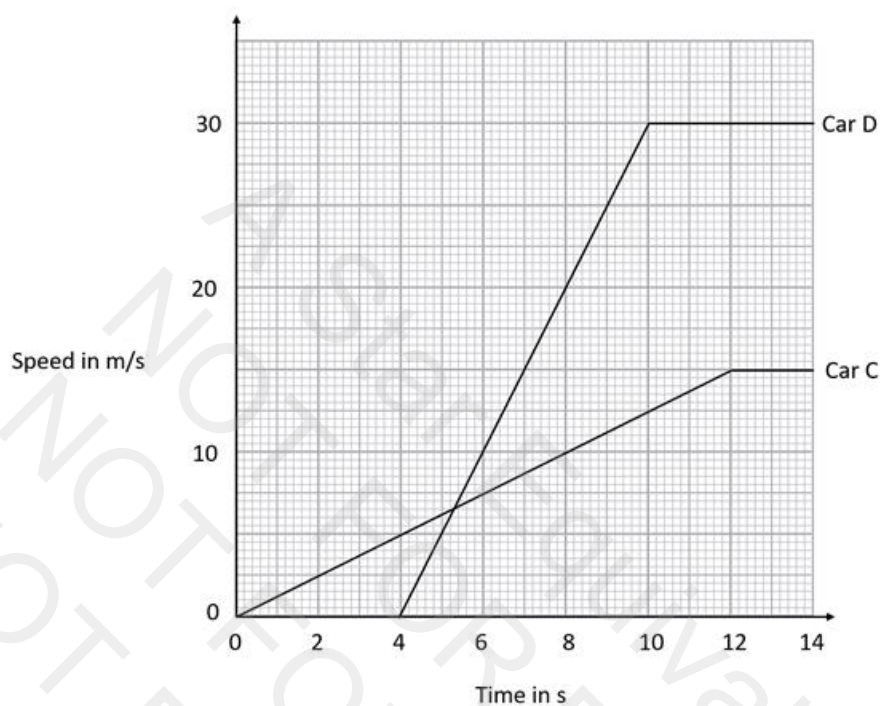
Answer _____

- 13(f)** Explain why doctors do not use an isotope that has a much longer half-life than this sample of Technetium.

[3 marks]

Turn over for next question

- 14 The graph below shows how the speed of two cars, C and D, varies with time.



- 14(a) Deduce what the graph shows about the motion of the two cars.
Refer to total distance travelled, speed and acceleration in your answer.
Further, use calculations to support your answer.

[5 marks]

Question continued on next page

- 14(b)** The surface gravitational field strength on Mars is 3.7 N/kg
A space probe with a mass of 40 kg landed on the surface of Mars.
Calculate the weight of the space probe.
Give the units.

[3 marks]

Weight = _____

End of questions

END