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GCSE (9-1)

Examiners' report

TWENTY FIRST CENTURY SCIENCE COMBINED SCIENCE B

J260

For first teaching in 2016

J260/04 Summer 2022 series

Version 1

ocr.org.uk/science

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate answers are also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from OCR.

Advance Information for Summer 2022 assessments

To support student revision, advance information was published about the focus of exams for Summer 2022 assessments. Advance information was available for most GCSE, AS and A Level subjects, Core Maths, FSMQ, and Cambridge Nationals Information Technologies. You can find more information on our website.

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Paper 4 series overview

Paper 4 is the final paper sat by candidates for the GCSE (9-1) Combined Science B qualification.

It contains questions drawn from all areas of the specification and from all three of the science subjects.

In this year's paper, Questions 8 and 9 were the questions that were common to the higher level paper.

Questions were generally well answered and mostly attempted.

Marks were given where candidates followed the instructions in the question, (e.g. tick **one** box) where they demonstrated and applied their scientific knowledge and where candidates structured their answers using bullet points or sentences rather than writing longer, rambling answers that missed the point.

Candidates did well on the question about genetics - Question 4 - and did not do as well on the Relative Formula Mass question - Question 5.

Three questions had a statistically significantly higher rate of omission (were left blank) than others on the paper and these were 5 (a), 5 (c) and 8 (c). This could indicate that candidates are not confident with the concepts of Relative Atomic/Formula Masses and balancing symbol equations.

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
• Read the questions carefully and followed the instructions. For example, "tick one box" or "draw one line". • Showed the full working out in calculations. • Structured their answers so that one clear sentence was likely to match what the examiner was looking for a mark. • Used correct scientific language in their answers. • Used a calculator when answering calculation questions.	• Only wrote the answer on the answer line in calculation questions, without showing any working out • Wrote short answers in 2 and 3 mark questions that did not contain enough detail to score more than 1 mark • Did not read the questions carefully and so gave extra details about things that were not asked • Did not attempt questions – including tick the box and draw a line style questions • Used vague terminology such as 'electricity' rather than 'current'

Question 1 (a)

1 The energy needs of the UK are met by a wide range of energy resources.

(a) Which two energy resources are burned for heating?

Tick (✓) **two** boxes.

- Biofuel ☐
- Fossil fuels ☐
- Hydroelectricity ☐
- Nuclear fuel ☐
- The Sun ☐
- Wind ☐

[2]

Over half of candidates were given 1 mark on this question with just under half scoring 2. The most common incorrect answer was nuclear fuel.

Question 1 (b)

(b) Complete the sentences to describe how fossil fuel power stations generate electricity.

Use words from the list.

You can use each word once, more than once or not at all.

gas **hydroelectric** **transformer** **turbine** **water** **wind**

In coal and ..... power stations ..... is heated to produce steam. The steam turns a ..... which makes a generator rotate.

[3]

This question discriminated well between the candidates. Less than half were given all 3 marks. The most common incorrect first answer was nuclear, possibly leading on from the common misconception in Question 1 (a).

Question 1 (c)

(c) The table compares the ways in which the main energy resources are used to generate electricity.

For each row, tick (✓) **all** the statements that are true about the method used to generate electricity from each energy resource in the table.

	Statement		
Energy resource used to generate electricity	Has a boiler to make steam	Has a turbine to operate the generator	Does not release carbon dioxide whilst generating electricity
Nuclear Power			
The Sun			
Wind			

[3]

It was rare for examiners to award more than 1 mark here. The Sun was often correct. Nuclear was rarely filled in correctly.

Misconception

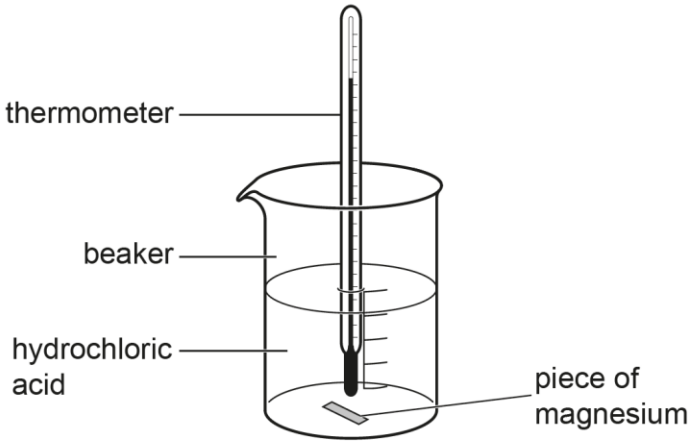
Candidates do not seem to understand how nuclear fuel is used to generate electricity, with many of them thinking that nuclear fuel is burnt.

Teachers may wish to further highlight the processes used in nuclear power stations.

Question 2 (a) (i)

2 Jack is investigating the change in temperature when a piece of magnesium is added to hydrochloric acid.

He uses the equipment in the diagram.



(a) Jack's results are in the table.

Repeat	Temperature before adding magnesium (°C)	Temperature after adding magnesium (°C)	Increase in temperature (°C)
1	26	31	5
2	24	30	6
3	24	31	7
4	25	30	5
5	23	27	4

(i) Give **one** reason why Jack repeated the experiment.

.....

..... **[1]**

Most candidates were given no marks here. More successful candidates seemed comfortable with the idea of checking results for anomalies. Those who tried other options tended to get confused between repeatable, reproducible, precision and accuracy.

Question 2 (a) (ii)

(ii) Calculate the mean increase in temperature for Jack's results.

Give your answer as a **whole number**.

Mean increase = ...°C **[3]**

A little more than half of candidates were given all 3 marks here. Some did not understand how to calculate a mean.

Those who were given 2 marks tended to leave their final answer as 5.4.

Many of those who were given 1 mark would likely have were given full marks but did not seem to have calculators in the exam because they stopped at the end of the adding up.

Question 2 (b) (i)

(b) (i) Which word describes the type of reaction Jack has investigated?

Tick (✓) **one** box.

- Combustion ☐
- Endothermic ☐
- Exothermic ☐
- Neutralisation ☐

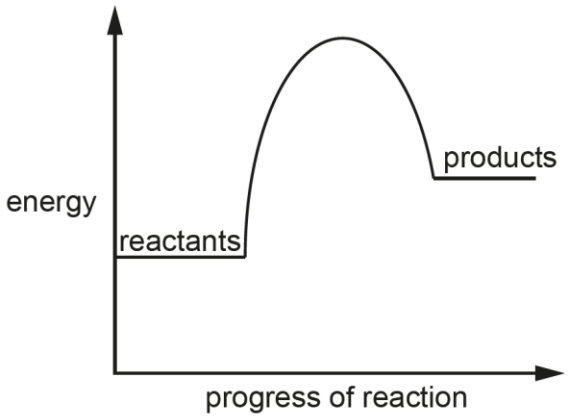
[1]

This question tended to split the cohort down the middle with just under half selecting the correct answer. Endothermic was the most common incorrect choice.

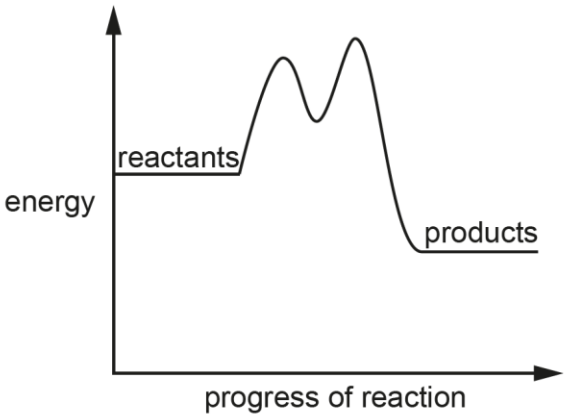
Question 2 (b) (ii)

(ii) Jack draws the reaction profile for his investigation.

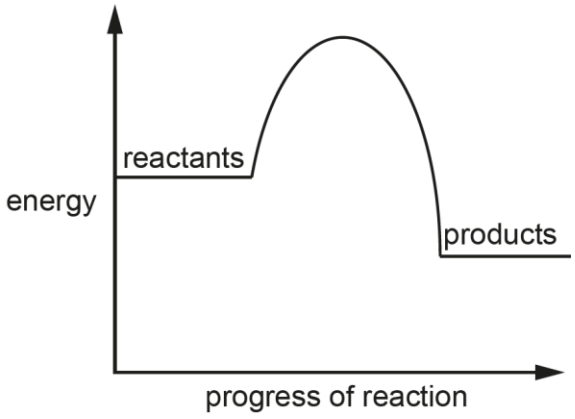
Tick (✓) the correct diagram.



A ☐



B ☐



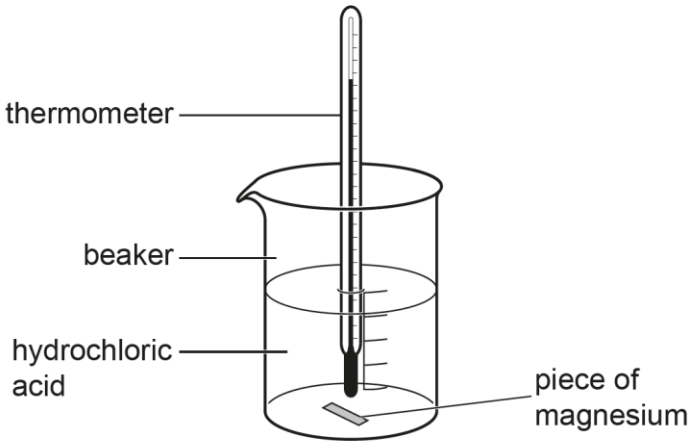
C ☐

[1]

Few candidates correctly chose C

Question 2 (c)

Jack thinks he could improve his method to make the temperature change data more accurate.



(c) Draw **one** line from an improvement Jack could make to the correct explanation, to make the temperature change data more **accurate**.

Improvement	Explanation
Change the concentration of the acid	To get a broader range of data
Insulate the beaker	To change the rate of reaction
Use a different type of metal	To reduce heat loss

[2]

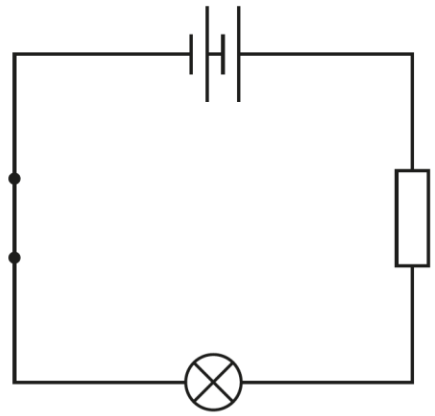
This question confused most candidates, who did not realise we only wanted one line drawn rather than every box on the left joined to a box on the right.

Examiners gave one mark to candidates who had joined 3 boxes if they had the one we were looking for. Only a few were given 2 marks by only drawing one line.

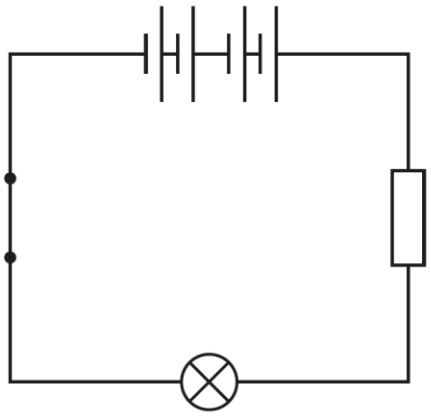
Question 3 (a)

3 Mia is investigating circuits.

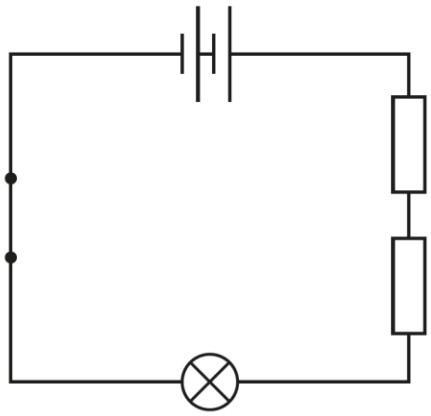
She has built the circuit in the diagram.



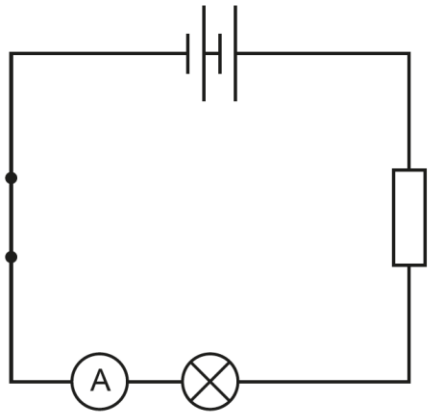
(a) Mia wants to increase the potential difference across the bulb. Here are three possible circuits she could make.



A



B



C

All the resistors in each circuit are identical.

Which circuit, **A**, **B** or **C**, will increase the potential difference across the bulb?

Explain why.

Circuit .....

Explanation .....

.....

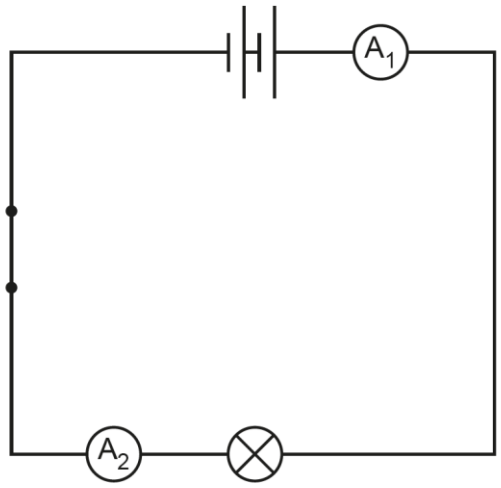
..... **[2]**

The simplest answers are often the best and in this case we were not looking for anything complicated. We just wanted the idea of more cells.

Those who chose A tended to be able to explain why this was correct.

Question 3 (b)

(b) Mia builds the circuit in the diagram to investigate current in the circuit.



Mia thinks the reading on ammeter A_1 in the circuit in the diagram will be greater than the reading on A_2 because it is closer to the battery.

Explain why Mia is wrong.

.....

.....

.....

..... **[2]**

Few candidates were given any marks on this question. Examiners saw many incorrect explanations about why the current before and after a bulb would be different in a series circuit.

Misconception

The features of series and parallel circuits are often confused by candidates.

The common misconception is that current is consumed by components, rather than the energy carried by the current being 'consumed' instead.

Question 3 (c) (i)

(c) (i) In a circuit, you can measure current, potential difference and resistance.

Draw one line from each circuit measurement to the unit it is measured in.

Measurement	Unit
current	amp
potential difference	ohm
resistance	volt

[2]

Generally well answered with a little more than half of candidates being given both marks. The most common misconception being that current is measured in volts and pd in amps.

Question 3 (c) (ii)

(ii) Mia's circuit contains a 3.0 V battery and has a total resistance of 24 Ω.

Calculate the current.

Use the equation: current (A) = potential difference (V) ÷ resistance (Ω)

Current = ... A **[2]**

Most candidates were given both marks here.

Those who didn't get 2 marks tended to multiply the numbers despite being given the formula telling them to divide.

Candidates seem to be suspicious of answers that are less than 1 and feel that these must be wrong.

We saw many instances of the correct answer of 0.125 being crossed out and replaced with 8.

Question 4 (a)

4 This question is about genes and inheritance.

(a) Draw one line from each genetic term to its correct definition.

Genetic Term	Definition
Alleles	Only one copy of this genetic variant is needed to have the feature it produces.
Dominant	The entire genetic material of an organism.
Gamete	The two versions of a gene in a pair of chromosomes.
Genome	A sex cell used in sexual reproduction.

[3]

Around half of candidates were given full marks on this question, while a small amount were given zero. Dominant and genome tended to be correct in all candidates who were given marks.

Question 4 (b)*

(b)* Sara breeds rats. Some rats have an inherited genetic condition that means they lack pigment in their skin and hair, so their hair is white. They are called albinos.

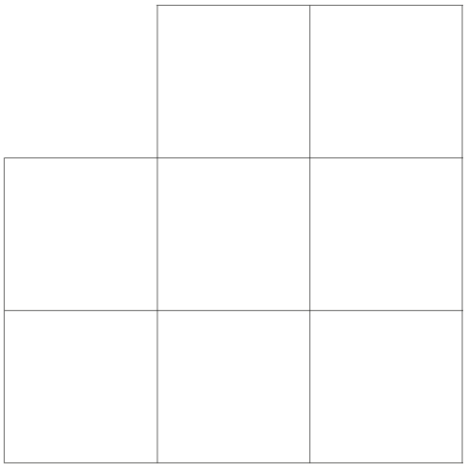
Sara breeds a brown female rat and a brown male rat.

Both brown rats have a heterozygous genotype, **Bb**.
B = brown hair
b = white hair

Her rats have had several offspring, but none of them has been albino. Sara thinks that her rats could have an albino baby.

Explain why Sara is correct.

Use the Punnet square.



.....

.....

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.....

.....

..... **[6]**

The majority of candidates drew a correct Punnet square. For those who didn't, a common error was having two Bs (BB Bb bB or bb) in the gamete boxes.

The scientific knowledge was a bit more hit and miss including albino genes being dominant and offspring being either brown or white or a mixture of the two regardless of the mixture of B and b. Higher scoring candidates related the single bb square to being indicative of a 25% chance of an albino offspring.

Exemplar 1

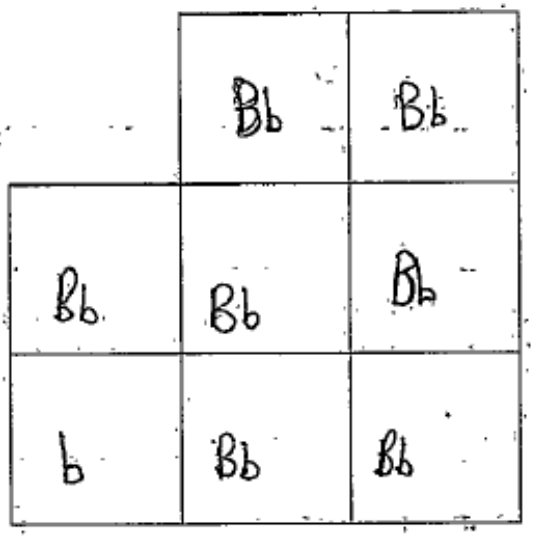
	B	b
B	BB	Bb
b	Bb	bb

because in the punnet square it says that all 3 baby babies will be brown because the capital B is dominant to the lower case b but 1 baby will be an albino because both there letters are recessive b.

Here is a good example of a Level 3, 6 mark response.

The candidate's Punnet square is correct and they identify that B is dominant, b is recessive and that 3 of the 4 offspring will be brown and 1 of the 4 offspring will be white – so this is a detailed explanation of why Sara is right and they have used the information from the square.

Exemplar 2



Sara is correct because both the brown female and male both can produce an albino baby. This will happen when their children reproduce because they will have more albino in them than the parents. An albino baby will be produced when the brown mum and dads offspring reproduce.

This response is a good illustration of an incorrect Punnet square that contains only the letters B and b but with too many of them in the gamete boxes.

The explanation does not use the Punnet square and does not meet any of the indicative content on the right hand section of the mark scheme.

The candidate does make an attempt at a Punnet square but it contains many inaccuracies. It's worth more than 0 and just about scores Level 1.

This scored Level 1 and 1 mark.

Question 5 (a)

5 (a) The table gives some information about three sugars that plants make.

Sugar	Formula	Relative Formula Mass (RFM)
Glucose	$C_6H_{12}O_6$	180
Fructose	$C_6H_{12}O_6$	180
Sucrose	$C_{12}H_{22}O_{11}$	342

Glucose and fructose react to make sucrose and water, as shown:

$$\text{glucose} + \text{fructose} \rightarrow \text{sucrose} + \text{water}$$

The relative formula mass of water is 18.

Explain how this reaction demonstrates the conservation of mass.

Use data from the table and the **Data Sheet** to support your answer.

.....

.....

.....

.....

.....

..... **[3]**

Most candidates were given 0 marks here with the remaining being evenly split between 1, 2 and 3 marks.

Generally the higher scoring candidates managed to get both sides = 360, but most candidates had the idea that if you multiply the mass of water by 10 then you get 180.

Some candidates added 180 and 180 to get 360 and 342 and 18 to get 360 but couldn't explain why this proved mass was conserved.

Question 5 (b)

(b) Plants use glucose in aerobic respiration.

Where does aerobic respiration take place in plant cells?

Tick **one** (✓) box.

chloroplast ☐

mitochondria ☐

nucleus ☐

ribosome ☐

[1]

Chloroplasts was a more popular choice than the correct answer. This is possibly because candidates know that plants photosynthesise. It seems the fact that plants also respire is not commonly understood.

Question 5 (c)

(c) Respiration produces carbon dioxide. To test for carbon dioxide we use limewater.

The limewater turns cloudy because calcium carbonate forms.

Calculate the percentage by mass of calcium in calcium carbonate, $CaCO_3$.

Element	Relative Atomic Mass
Carbon (C)	12
Oxygen (O)	16
Calcium (Ca)	40

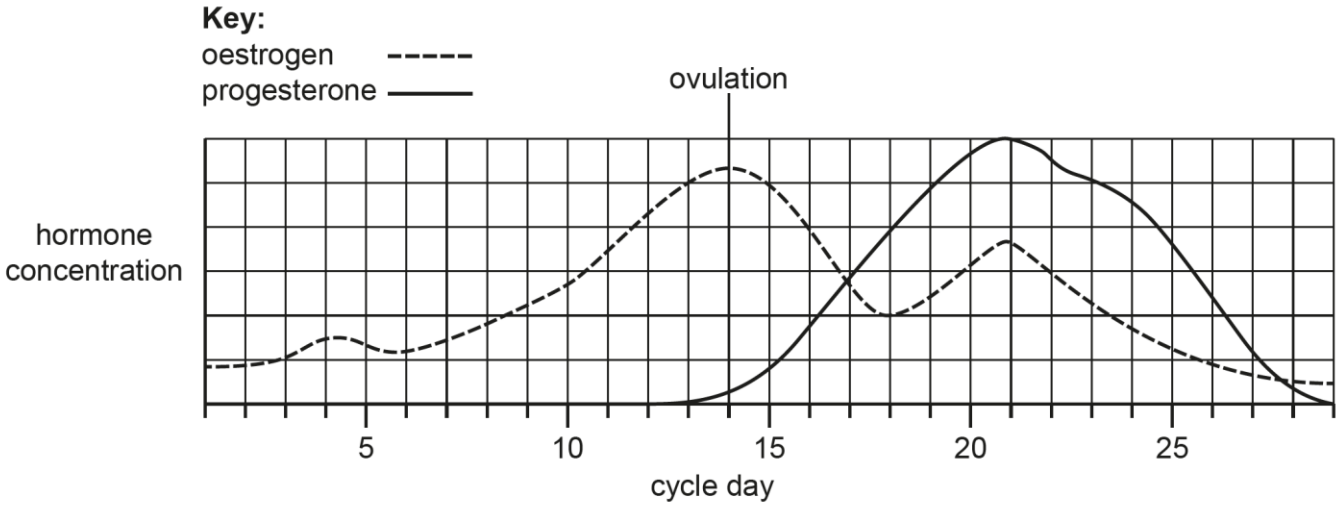
Percentage = ... % **[4]**

Just under half of candidates were given 0 marks for this question.

For many candidates, calculating the RFM of calcium carbonate caused many issues because of the 3 oxygen atoms. Examiners allowed ECF using 68 as the denominator.

Question 6 (a) (i)

6 **(a)** The graph shows the concentrations of female hormones during one complete menstrual cycle.



(i) Compare the levels of oestrogen and progesterone in the menstrual cycle up to ovulation.

.....

.....

.....

.....

.....

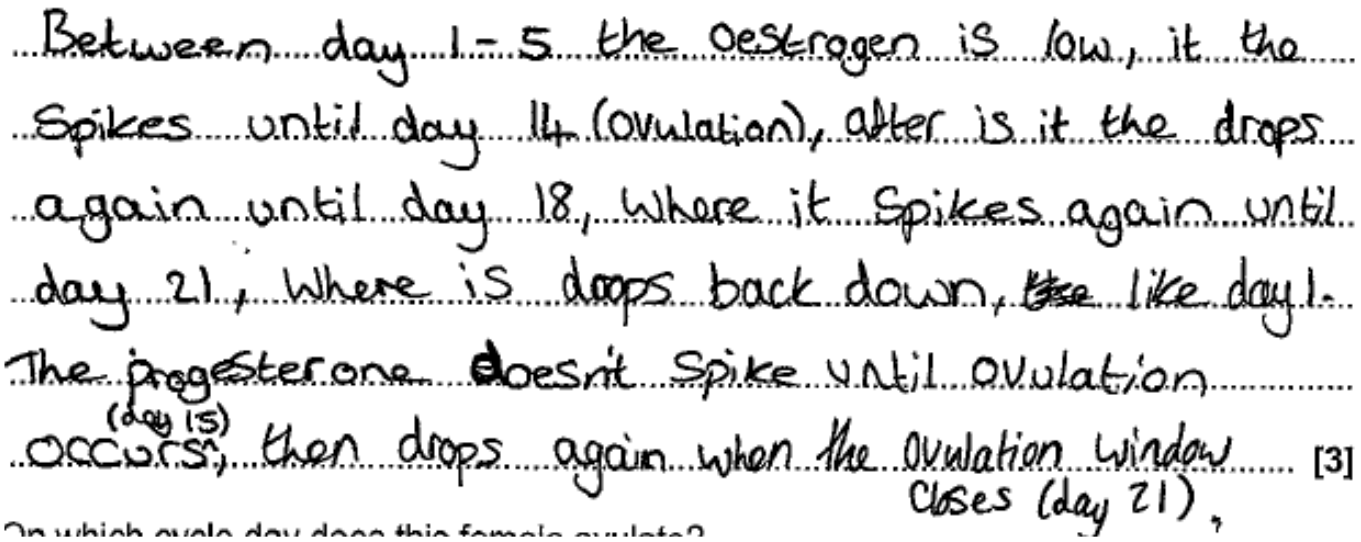
..... **[3]**

Few candidates were given 3 marks and most of these used very simple, succinct sentences describing obvious features from the graph. The rest were roughly evenly split between 0, 1 and 2 marks.

Examiners found lots of answers that gave (correct but non-creditworthy) detail about what happened to the hormones *after* ovulation. Reading the question carefully would have avoided this.

It seemed that a lot of candidates were trying to remember what they had been taught about the menstrual cycle rather than reading from the graph. While it is important to show what candidates know, they do need to apply their knowledge to what the question is asking.

Exemplar 3


Between day 1-5 the oestrogen is low, it the Spikes until day 14 (ovulation), after is it the drops again until day 18, where it Spikes again until day 21, where is drops back down, like like day 1. The progesterone doesn't Spike until ovulation (day 15) occurs, then drops again when the ovulation window closes (day 21), [3]

On which cycle day does this female ovulate?

This is an example of where a candidate describes what happens after ovulation.

The question only asks about hormones up to the day of ovulation (day 14) so the only parts that are potentially creditworthy are lines 1 and 2 and then lines 5 and 6.

On lines 1 and 2 the candidate describes oestrogen peaking at day 14, so this matches marking point 3.

Lines 3 and 4 are describing events after day 14 so are not relevant.

Lines 5 and 6 are describing the levels of progesterone but the comments about day 15 tips what they are describing into after ovulation so are not creditworthy.

Question 6 (a) (ii)

(ii) On which cycle day does this female ovulate?

Day ..... **[1]**

Well answered with most candidates being given the mark.

Question 6 (a) (iii)

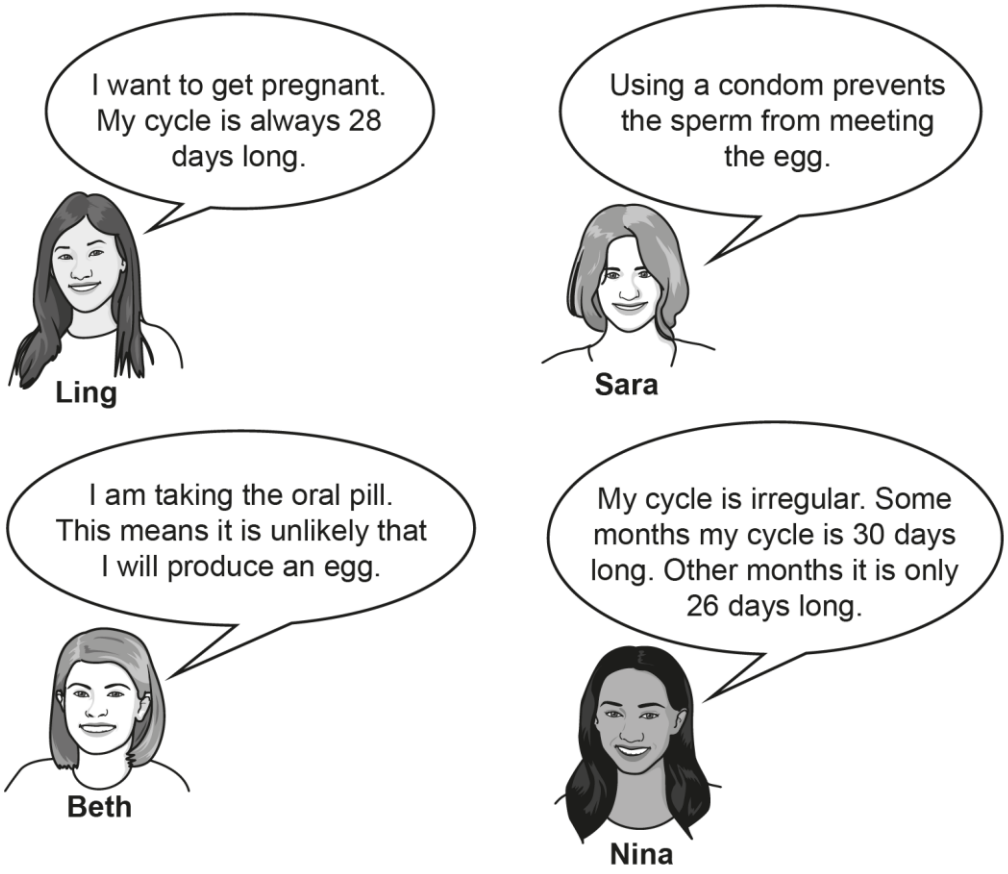
(iii) On which cycle day does the progesterone level become higher than the oestrogen level?

Day ..... **[1]**

Few candidates were given this mark. 19, 20 or 21 was most common answer. This may have come from interpreting the question as asking which day the level of progesterone exceeded the maximum level of oestrogen.

Question 6 (b) (i)

(b) Some people are talking about female hormones and the menstrual cycle.



(i) Which two people are talking about contraception?

..... **[1]**

Most candidates were given the mark.

Question 6 (b) (ii)

(ii) Who might find it hard to predict when they are ovulating?

..... **[1]**

Almost all candidates were given the mark.

Question 6 (b) (iii)

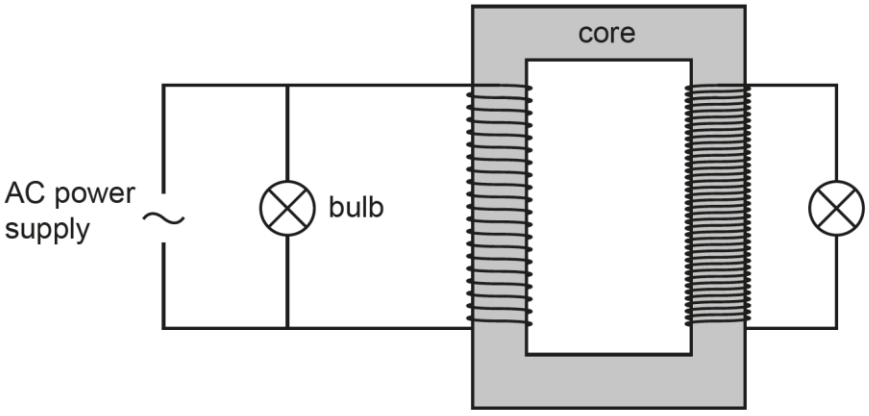
(iii) Who is preventing ovulation?

..... **[1]**

Most candidates were given the mark.

Question 7 (a)

7 Eve is investigating transformers.



(a) The power in the primary coil is equal to the power in the secondary coil.

State in what unit is power measured.

Unit of power = ... **[1]**

Few candidates were given the mark. Common wrong answers were amps, joules, "P" and volts.

Question 7 (b)

(b) Eve's circuit has a current of 1.5A in the primary coil and a potential difference of 2.5V across the primary coil.

A potential difference of 6V is induced in the secondary coil.

She uses the equation:

potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil

Calculate the current in the secondary coil.

Current = ... A **[3]**

Just under half of candidates were given 1 mark.

A common wrong answer was 1.6 (the result of 6/3.75), and candidates often crossed out their correct working and flipped it upside down, showing again that perhaps candidates are suspicious of answers less than 1. These candidates tended to be given 1 mark for 3.75.

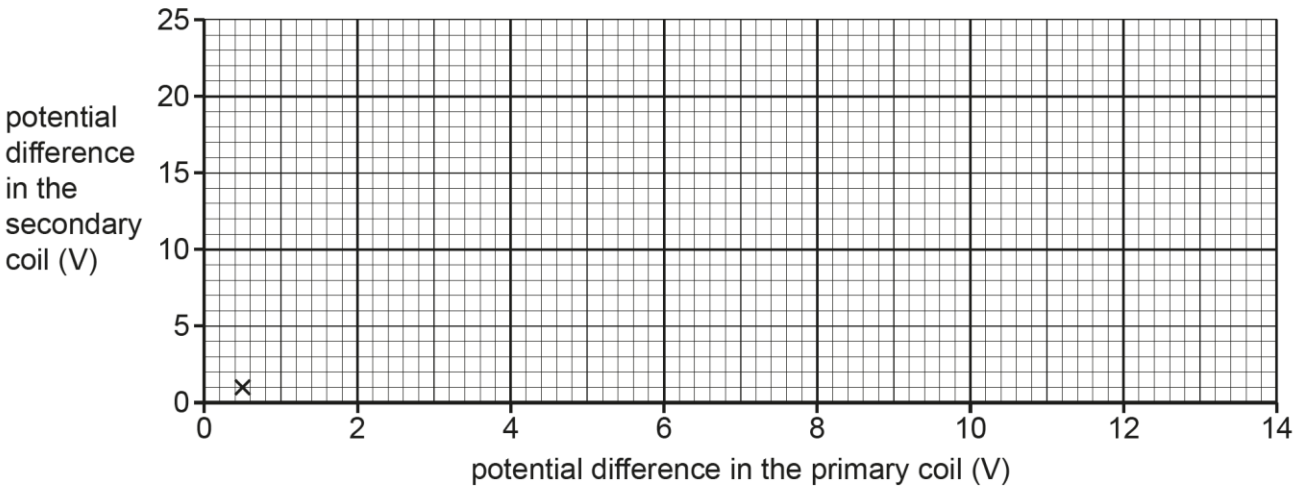
Question 7 (c) (i)

(c) Eve does experiments with five different potential differences in the primary coil and records the potential differences in the secondary coil for each one.

Her results are in the table.

Potential difference in the primary coil (V)	Potential difference in the secondary coil (V)
0.5	1.0
2.0	4.0
6.0	12.5
10.0	20.0
12.0	23.0

(i) Complete the graph of Eve's results by plotting the data points **and** drawing a line of best fit. The first point has been plotted for you.



[3]

Well answered with most candidates scoring 2 or 3 marks. Most who were given 2 marks either did not draw a line of best fit or did not use a ruler or just joined the dots

Question 7 (c) (ii)

(ii) Describe the relationship shown by the graph.

.....

..... **[2]**

A small number of candidates were given both marks with the rest being equally split between 0 and 1 mark. The 1 mark tended to be for 'positive correlation' or ' as primary pd increases, so does secondary'.

Question 7 (d)

(d) Transformers are used in the transmission of electrical power.
Eve uses her data to explain why transmitting power at higher voltages is a more efficient way to transfer electrical energy.

Complete the sentences.

Put a (ring) around each correct option.

As the potential difference across the secondary coil increases,

the current in the secondary coil **decreases / increases / stays the same**.

This **reduces / stops / increases** energy loss in electrical power transmission.

[2]

Mostly well answered with the majority of candidates scoring 1 or 2 marks.

Question 8 (a)

8 Sundip observed her teacher reacting five different metals with water and dilute hydrochloric acid.

(a) Suggest **one** safety precaution the teacher should have taken when demonstrating these reactions.

..... **[1]**

Most candidates were given the mark here with goggles being the most common answer. Vague answers about 'PPE' (which could include boots or a high viz jacket) and 'glasses' (without specifying safety glasses) were insufficient.

Question 8 (b) (i)

(b) The table shows Sundip's observations.

Metal	Reaction with water	Reaction with dilute hydrochloric acid
A	lots of bubbles and fizzing	fizzing and caught fire
B	no reaction	no reaction
C	no reaction	a few bubbles formed
D	caught fire	explosion
E	one bubble formed	lots of bubbles formed

(i) Write the letters of the metals in the boxes to show the correct order of reactivity.

The first one has been done for you.

least reactive → most reactive

B				

[3]

Almost all candidates were given all 3 marks.

Question 8 (b) (ii)

(ii) Sundip predicts that the bubbles given off by these reactions are hydrogen.

To test for this she blows out a splint and places it at the top of the test tube used for each reaction.

Will this test show whether the gas is hydrogen? Explain your answer.

.....

.....

.....

..... **[2]**

Over half of candidates were given 0 marks, examiners saw all sorts of reactions happening with the wooden splint or involving smoke and colour changes.

Most candidates who were given 1 mark got the idea that the test for hydrogen gives a squeaky pop, but very few appreciated the requirement of a *lighted* splint.

Question 8 (c)

(c) Sodium (Na) is a metal that reacts vigorously with hydrochloric acid (HCl) to give off hydrogen (H_2).

Complete the balanced symbol equation for the reaction of sodium with hydrochloric acid.

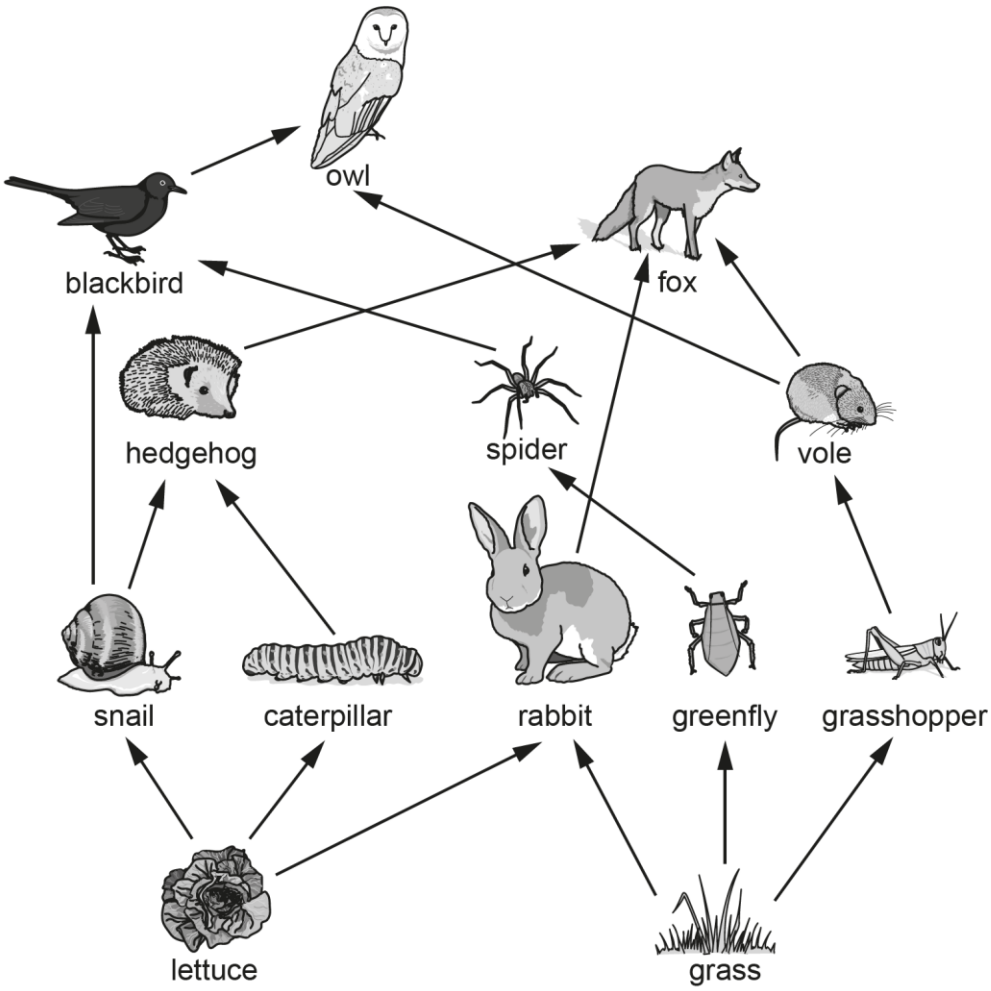
..... Na + ... HCl → ..... $NaCl$ + H_2

[3]

Candidates found this quite difficult. Just under half were given no marks here, with random numbers or even the symbols of other elements being written on the lines. Around a third of candidates were given all 3 marks.

Question 9 (a) (i)

9 The diagram shows a food web from a garden.



(a) (i) Which **two** organisms from the list below are secondary consumers in the food web diagram?

Tick (✓) **two** boxes.

- Greenfly ☐
- Hedgehog ☐
- Lettuce ☐
- Owl ☐
- Rabbit ☐
- Spider ☐

[1]

Just under half of candidates were given the mark here. Lettuce was often chosen.

Question 9 (a) (ii)

(ii) How many organisms are there in the **longest** food chain in the food web diagram?

..... **[1]**

Few candidates were given the mark here. Common wrong answers were 13 and 4.

Question 9 (a) (iii)

(iii) A disease reduced the number of caterpillars in the garden. What could happen to the number of snails in the garden? Explain your answer.

Number of snails .....

.....

Explanation .....

..... **[2]**

More than half of candidates were given both marks. Candidates who were given 1 mark tended to give answers that involved the disease killing both the caterpillars and the snails or involving other animals from the food chain that were not directly linked to the caterpillar/snail/hedgehog/lettuce quartet.

Question 9 (b)

(b) One food chain from the garden food web is

grass → grasshopper → vole → fox

On average the transfer of biomass between organisms is 10% efficient.

The biomass of **grass** in the vole's food chain is 37.5 kg.

Calculate the expected biomass of **voles** in the food chain.

Expected biomass of voles = ... kg **[2]**

An almost 50/50 split of 0 to 1 mark here with occasional 2 marks given.

3.75 was most common answer showing that candidates knew what to do, but not to carry out the multiplication (or division) twice.

Some candidates thought that 375 tonnes of vole biomass was likely. Candidates should ask 'is this a reasonable answer?' at the end of a calculation.

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