



Sample questions: maths in science

These sample questions show how the five mathematical skills areas could be assessed in GCSE Combined Science. You can use them to understand the types of maths questions which might appear in the live papers and prepare your students.

Questions have been selected to cover the five mathematical skills areas, and where possible, the individual skills within these areas.

We've included the mark scheme for each item at the end of this document.

All questions are taken from our first set of specimen papers which can be found on aqa.org.uk and Exampro.

Questions

Questions will target maths skills at a level of demand appropriate to each subject.

In Foundation Tier papers questions assessing maths requirements will not be lower than that expected at Key Stage 3 (as outlined in *Mathematics programmes of study: Key Stage 3* by the DfE, document reference DFE- 00179-2013).

In Higher Tier papers questions assessing maths requirements will not be lower than that of questions and tasks in assessments for the Foundation Tier in GCSE Mathematics.

At the beginning of each question we have referenced the paper it is taken from, the skill area it addresses and the level of demand (low targets grades 1–3, standard targets grades 4–5 and high targets grades 6–8).

Arithmetic and numerical computation

Synergy 3F

Skill 1b

Low demand

1 0

This question is about speed.

1 0 . 1

What is a typical value for the speed of sound?

[1 mark]

Tick **one** box.

3.3 m/s

$3.3 \times 10^2 \text{ m/s}$

$3.3 \times 10^3 \text{ m/s}$

$3.3 \times 10^6 \text{ m/s}$

Chemistry 1F**Skill 1c****Low demand**

0 5 . **8** A coarse particle has a diameter of $1 \times 10^{-6} \text{ m}$.

A nanoparticle has a diameter of $1.6 \times 10^{-9} \text{ m}$.

Calculate how many times bigger the diameter of the coarse particle is than the diameter of the nanoparticle.

[2 marks]

Physics 1F**Skill 1c****Standard demand**

Table 1 shows how the count rate from a radioactive source changes with time.

Table 1

Time in seconds	0	40	80	120	160
Count rate in counts/second	400	283	200	141	100

0 7 . **4** Use **Table 1** to calculate the count rate after 200 seconds.

[2 marks]

Trilogy Biology 2H**Skills 1b, 2e****High demand**

0 6 . **3** Two alleles control the body colour of carp:
brown (B)
blue (b).

The brown allele is dominant to the blue allele.

Two carp that are heterozygous for colour are crossed and produce 2.6×10^5 offspring.

Approximately how many of the offspring are expected to be blue?

Draw a genetic diagram to explain your answer.

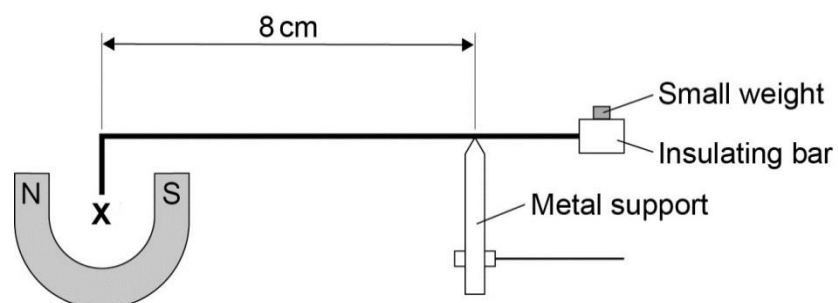
Give your answer in standard form.

[5 marks]

Number of offspring expected to be blue = _____

Physics 2H**Skills 1c, 3b, 3c, 3d****High demand**

Figure 21 shows how a small weight placed on the insulating bar makes the wire **X** go back and balance in its original position.

Figure 21

1 2 . **3** The wire **X** is 5 cm long and carries a current of 1.5 A

The small weight causes a clockwise moment of 4.8×10^{-4} Nm.

Calculate the magnetic flux density where the wire **X** is positioned

Give the unit.

[6 marks]

Magnetic flux density = _____ Unit -

Trilogy Physics 1F

Skills 1d, 2c

Standard demand

0 7 . **5** A driver wishes to buy a new car.

Table 2 gives some data about an electric car and one with a petrol engine.

Table 2

	Electric car	Petrol engine car
Cost (£)	27 000	15 000
Running cost per year (£)	250	2 000
Average lifetime (years)	12	12

Which car would be the most economic over its 12 year lifetime?

Use data from **Table 2** to support your answer.

You should include the difference in cost in your answer.

[4 marks]

Physics 2F

Skill 1d

Standard demand

1 0 . 7 A car driver sees a fallen tree lying across the road ahead and makes an emergency stop.

The braking distance of the car depends on the speed of the car.

For the same braking force, explain what happens to the braking distance if the speed doubles.

You should refer to kinetic energy in your answer.

[4 marks]

Handling data

Trilogy Chemistry 2F

Skills 2a, 2b

Low demand

0 2 . 7 A student measured the melting point of a solid hydrocarbon four times.

The student's results are in **Table 2**.

Table 2

	Trial 1	Trial 2	Trial 3	Trial 4
Melting point in °C	35	48	37	

				37
--	--	--	--	----

Calculate the mean melting point of the hydrocarbon, leaving out any anomalous result.

Give your answer to two significant figures.

[2 marks]

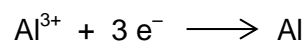
Mean melting point = _____ °C

Synergy 3H

Skill 2a

High demand

0 6 . 5 The half equation at the cathode is:



Calculate the number of moles of electrons needed to produce 1 000 kg of aluminium.

Give your answer to three significant figures.

Relative atomic mass (A_r): Al = 27

[3 marks]

Answer = _____ moles

Biology 2F

Skill 2b

Standard demand

Table 2

Test number	Distance ruler dropped in cm	
	Student A	Student B
1	9	12
2	2	13
3	6	13
4	7	9
5	7	8
Mean	7	X

0 7 . 5 Calculate the value of **X** in **Table 2**.

[1 mark]

Mean distance ruler dropped = _____ cm

Trilogy Physics 2F

Skill 2c

Low demand

0 2 . 7 **Table 1** shows some results with a different spring.

Table 1

Force applied in N	Extension in m
0.0	0.000
0.5	0.025
1.0	0.050
1.5	0.075

What would the extension be with a force of 2.0 N?

[1 mark]

Tick **one** box.

0.080 m

0.090 m

0.095 m

0.100 m

Chemistry 2F

Skill 2c

Standard demand

0 6

Table 2 gives information about four alcohols.

Table 2

Alcohol	Formula	Melting point in °C	Boiling point in °C
Methanol	CH ₃ OH	-94	65
Ethanol	CH ₃ CH ₂ OH	-118	78
Propanol	CH ₃ CH ₂ CH ₂ OH	-129	97
Butanol	CH ₃ CH ₂ CH ₂ CH ₂ OH	-89	118

0 6

. 1

Which alcohol in Table 2 is liquid over the greatest temperature range?

[1 mark]

Trilogy Biology 2F

Skill 2e

Low demand

Two alleles control the body colour of carp:

- brown (**B**)
- blue (**b**).

The brown allele is dominant to the blue allele.

The genetic cross from breeding two carp is shown in Figure 8.

Figure 8

	B	b
b	Bb	
b		

0 4 . 4

What is the probability that the offspring from this genetic cross will be brown?

[1 mark]

Tick **two** boxes.

0 0.25 0.5 1.0 **Biology 2F****Skill 2e****Standard demand**

0 8 . 4

Complete the genetic diagram in **Figure 12**.

- Identify any children with CF.
- Give the probability of any children having CF.

[3 marks]

Each parent does not have CF.

The following symbols have been used:

D = dominant allele for **not** having CF

d = recessive allele for having CF

Figure 12

		Mother	
		D	d
Father	D	DD	
	d		

Probability of a child with CF = _____

Biology 2H**Skill 2e****High demand**

0 7 . **4** A recessive allele causes syndrome H.

A heterozygous woman and a homozygous recessive man want to have a child.

Draw a Punnett square diagram to determine the probability of the child having syndrome H.

Identify any children with syndrome H.

[5 marks]

Use the following symbols:

A = dominant allele

a = recessive allele

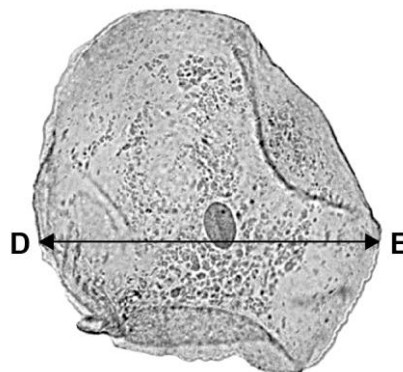
Probability = _____

Biology 1F**Skill 2h****Low demand**

0 3 . **5** The cheek cell in **Figure 6** is magnified 250 times

The width of the cell is shown by the line **D** to **E**.

Figure 6



Calculate the width of the cheek cell in micrometres (μm).

Complete the following steps.

[3 marks]

Measure the width of the cell using a ruler _____ mm

Use the equation to work out the real width of the cell in mm:

$$\text{real size} = \frac{\text{image size}}{\text{magnification}} \quad \text{_____ mm}$$

Convert mm to μm _____ μm

Synergy 1H

Skill 2h

High demand

Table 4

	Fluid A	Fluid B
pH	7.3	5.6
Sugar in mg/cm ³	118	1.18
Nitrate ions in mg/cm ³	10	600
Potassium ions in $\mu\text{g/cm}^3$	1.18	2500

0 8 . **3** In fluid **A**, how many times greater is the concentration of sugar than the concentration of potassium ions?

[2 marks]

Algebra

Physics 2F

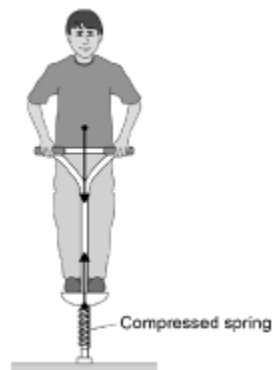
Skill 3b

Standard demand

0 9 Figure 15 shows the forces acting on a child who is balancing on a pogo stick.

The child and pogo stick are not moving.

Figure 15



The child has a weight of 343 N.

Gravitational field strength = 9.8 N/kg

- 0 9** . **3** Write down the equation which links gravitational field strength, mass and weight.

[1 mark]

- 0 9** . **4** Calculate the mass of the child.

[3 marks]

The weight of the child causes the spring to compress elastically from a length of 30cm to a new length of 23cm.

- 0 9** . **5** Write down the equation which links compression, force and spring constant.

[1 mark]

- 0 9** . **6** Calculate the spring constant of the spring.

_____ Mass = _____ kg

Give your answer in newtons per metre.

[4 marks]

Spring constant = _____ N/m

Trilogy Physics 2F**Skills 3c, 3d****Low demand**

0 2 . **8** The spring constant for the spring in **Table 1** is 20 N/m.

Calculate the work done in stretching the spring until the extension of the spring is 0.050m

Use the correct equation from the Physics Equation Sheet.

[2 marks]

Work done = _____ J

Trilogy Physics 2F**Skills 3c, 3d****Low demand**

0 1 . **2** The car travels a distance of 2040 metres in 2 minutes.

Use the following equation to calculate the mean speed of the car.

$$\text{mean speed} = \frac{\text{distance}}{\text{time}}$$

[2 marks]

Mean speed = _____ m/s

Physics 1H

Skills 3b, 3c, 3d

High demand

- 1 1** . **5** At the lowest point in the jump, the energy stored by the stretched bungee cord is 24.5 kJ.
The bungee cord behaves like a spring.

Calculate the spring constant of the bungee cord.

Use the correct equation from the Physics Equation Sheet.

[3 marks]

Spring constant = _____ N / m

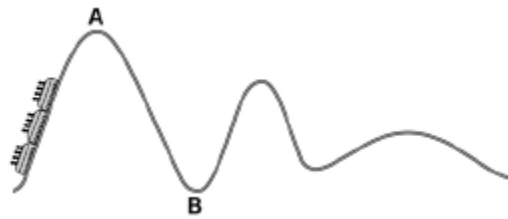
Synergy 4H

Skill 3b

High demand

- 0 9** **Figure 7** shows a rollercoaster.

Figure 7



The rollercoaster car is raised a vertical distance of 35 m to point A by a motor in 45 seconds.

The mass of the rollercoaster is 600 kg.

The motor has a power rating of 8 000 W.

- 0 9** . **2** The rollercoaster rolls from point **A** to point **B**, a drop of 35 m.

Calculate the speed of the roller coaster at point **B**.

Assume that the decrease in potential energy store is equal to the increase in kinetic energy store.

[6 marks]

Speed at point **B** = _____ m/s

Graphs

Physics 2F

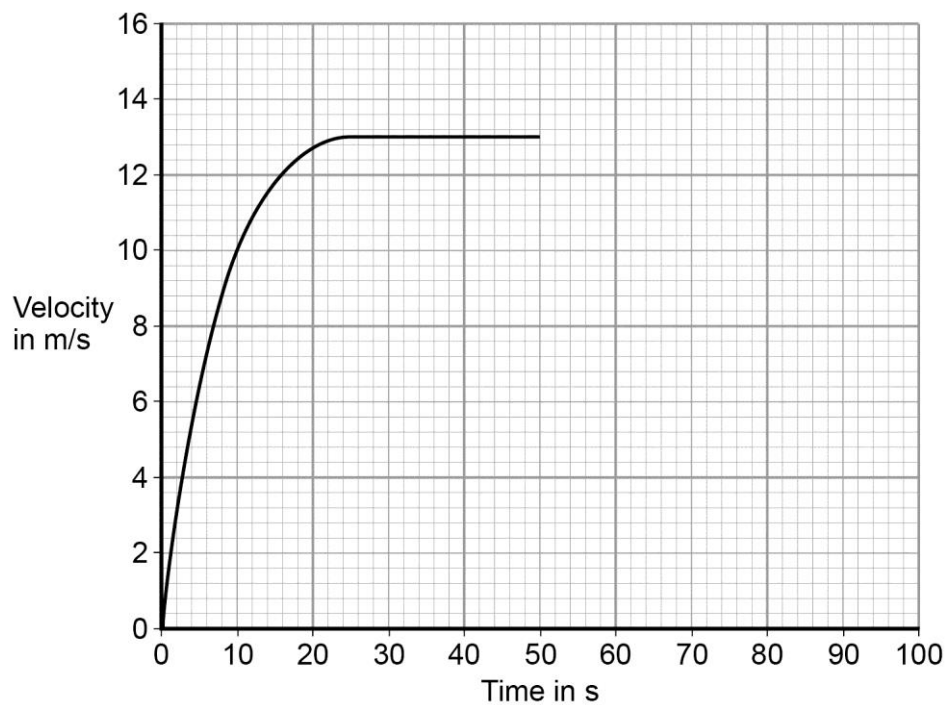
Skill 4a

Low demand

At the top of the slope the skier leaves the drag lift and skis back to the bottom of the slope.

Figure 13 shows how the velocity of the skier changes with time as the skier moves down the slope.

Figure 13



0 7 . **4** After 50 seconds the skier starts to slow down.

The skier decelerates at a constant rate coming to a stop in 15 seconds.

Draw a line on **Figure 13** to show the change in velocity of the skier as she slows down and comes to a stop.

[2 marks]

Trilogy Biology 1F

Skill 4a

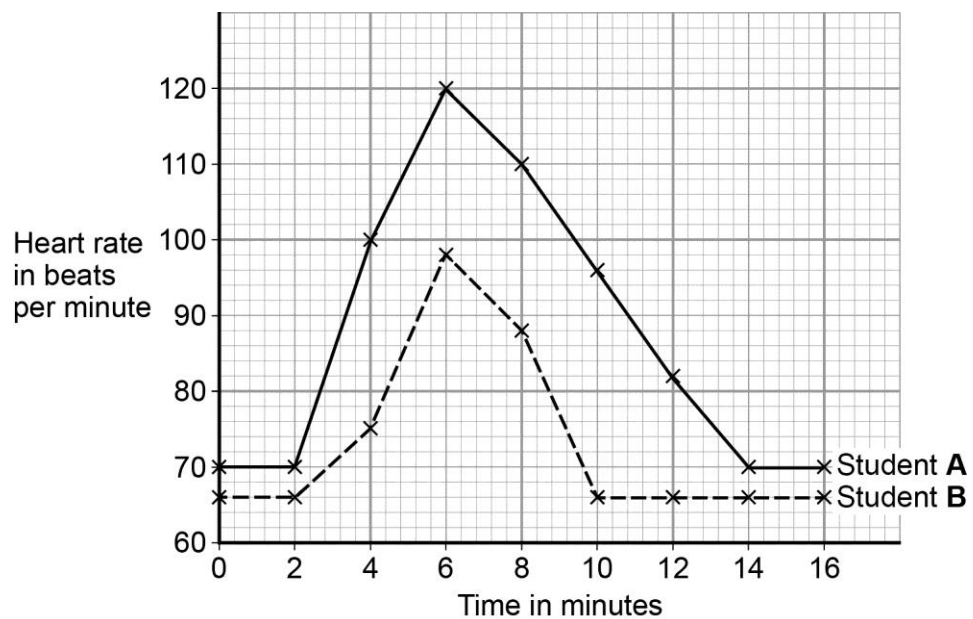
Low demand

0 4

Some students investigated how exercise affects heart rate.

Figure 4 shows their results.

Figure 4



0 4 . **3**

For how many minutes did the students run?

[1 mark]

Tick **one** box.

2

4

6

—

14



Synergy 2F

Skill 4c

Low demand

0 3 . **2** **Table 3** shows the blood sugar levels for two people after eating a meal.

Table 3

Time after eating in hours	Blood sugar levels in mg per 100 cm ³ of blood	
	Person A	Person B
0	70	130
1	150	230
2	90	185
3	80	165
4	75	140

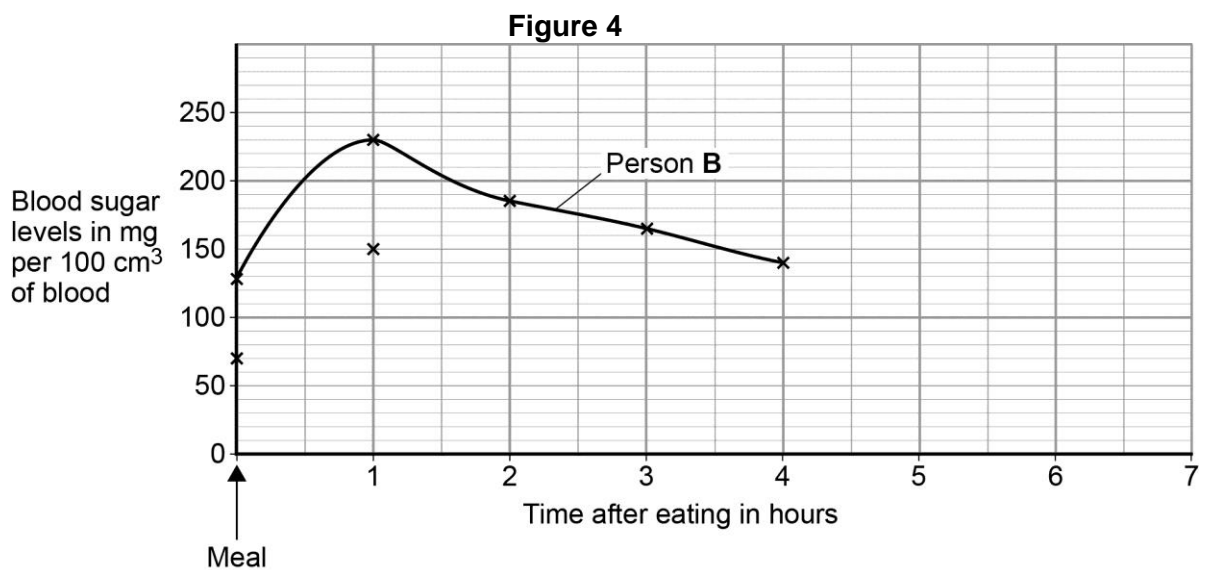
Use data from **Table 3** to complete the graph in **Figure 4**.

Plot the points for person A.

The first two points have been plotted for you.

Draw a line through all the points.

[3 marks]



Trilogy Chemistry 1F

Skill 4c

Standard demand

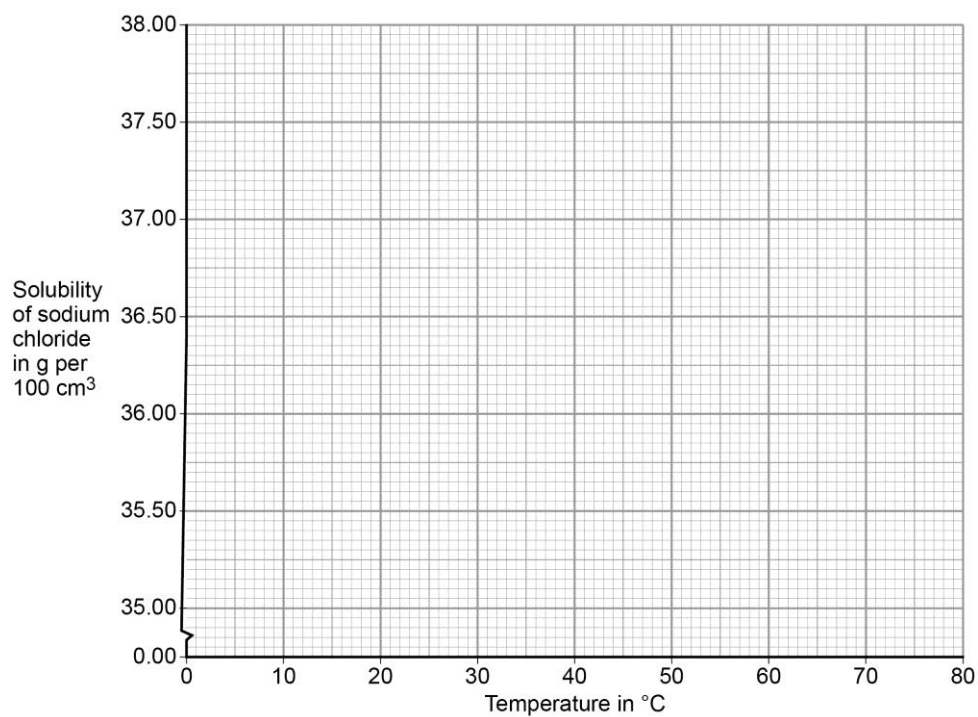
0 8 . **2** **Table 3** shows the solubility of sodium chloride in 100 cm³ of aqueous solution at different temperatures.

Table 3

Solubility of sodium chloride in g per 100cm ³	Temperature in °C
35.72	10
35.89	20
36.09	30
37.37	40
36.69	50
37.04	60

On **Figure 13**:

- plot this data on the grid
- draw a line of best fit.

[3 marks]**Figure 13**

Geometry and trigonometry

Physics 2H

Skill 5a

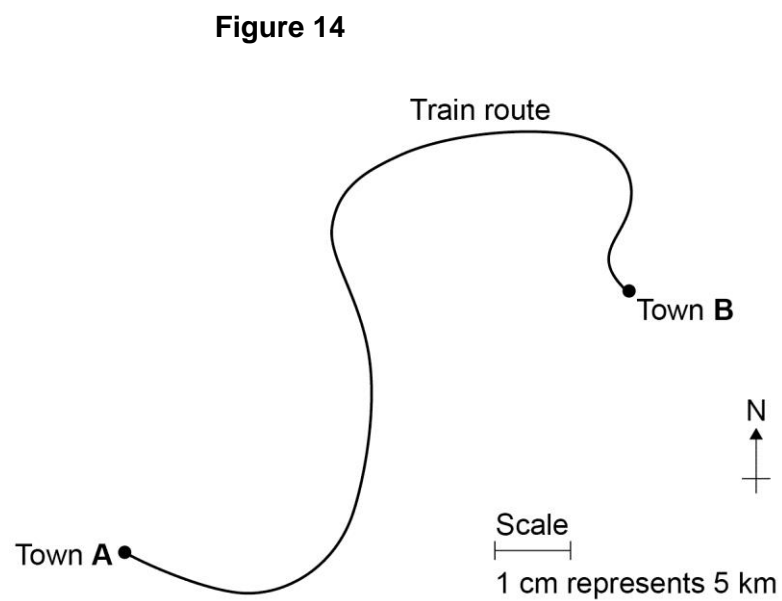
High demand

0 8

A train travels from town **A** to town **B**.

Figure 14 shows the route taken by the train.

Figure 14 has been drawn to scale.



0 8

2

Use **Figure 14** to determine the displacement of the train in travelling from **A** to **B**.

Show how you obtain your answer.

[2 marks]

Displacement = _____ km

Direction = _____

Chemistry 2F

Skill 5b

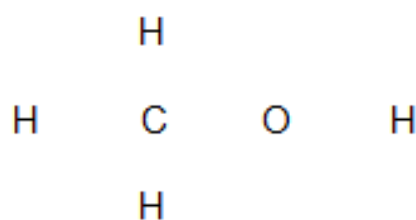
Low demand

0 6 . **3** A molecule of methanol has five single covalent bonds.

Draw the missing bonds in **Figure 6** to complete the displayed formula for methanol.

[1 mark]

Figure 6



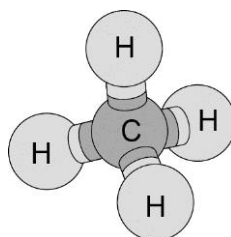
Synergy 3F

Skill 5b

Standard demand

0 5 . **1** **Figure 6** shows a 3D model of a molecule of methane (CH_4).

Figure 6



Draw the 2D structure of a methane molecule.

Trilogy B2H
Question 6.3

Question	Answers	Extra information	Mark	AO/Spec ref
06.3	parents genotype both Bb	allow correctly derived gametes	1	AO2/2 4.6.1.4
	offspring genotypes correctly derived		1	AO2/2 4.6.1.4
	bb identified as blue	allow ring around bb only	1	AO3/1b 4.6.1.4
	65 000		1	AO2/2 4.6.1.4
	6.5×10^4	allow ecf or $260\,000 \times 0.25$	1	AO2/2 4.6.1.4

Physics 2H
Question 12.3

Question	Answers	Extra information	Mark	AO/Spec ref
2.3	$4.8 \times 10^{-4} = F \times 8 \times 10^{-2}$		1	AO2/1
	$F = 6 \times 10^{-3}$ (N)		1	4.7.2.2
	$6 \times 10^{-3} = B \times 1.5 \times 5 \times 10^{-2}$		1	4.5.4
	$B = \frac{6 \times 10^{-3}}{7.5 \times 10^{-2}}$		1	
	$B = 8 \times 10^{-2}$ or 0.08	allow 8×10^{-2} or 0.08 with no working shown for 5 marks a correct method with correct calculation using an incorrect value of F gains 3 marks	1	
Tesla	accept T do not accept t	1	AO1/1 4.7.2.2	

Trilogy P1F
Question 7.5

Question	Answers	Mark	AO/Spec ref
7.5	Level 2: A relevant and coherent argument which demonstrates processing and numerical analysis of the information presented and draw a conclusion which is logically consistent with the reasoning and refers to payback time for the vehicles.	3–4	AO3/2b 6.1.3
	Level 1: Simple comparisons are made which demonstrate a basic ability to numerically analyse the information presented. The conclusion, if present, may not be consistent with the calculations.	1–2	
	No relevant content	0	
	<p>Indicative content</p> <ul style="list-style-type: none"> • The electric car costs £12 000 more to buy • Running cost of electric car = £3 000 • Running cost of petrol engine car = £24 000 • Total cost of electric car = £30 000 • Total cost of petrol engine car = £39 000 • The electric car cost £1 750 less to run each year • The electric car will save £9 000 • Additional cost is covered in 6.9 years • So the electric car will be cheaper over the 12 year lifetime <p>or</p> <p>Electric</p> $27000 / 12 = 2250$ $\text{Annual cost} = 2250 + 250 = 2500$ <p>Petrol</p> $15000 / 12 = 1250$ $\text{Annual cost} = 1250 + 2000 = 3250$ <p>So electric is £750 cheaper per year</p>		

Physics 2F
Question 10.7

Question	Answers	Extra information	Mark	AO/Spec ref
10.7	Level 2: A detailed and coherent explanation is provided. The response makes logical links between clearly identified, relevant points that include references to the numerical factor.	3–4	4	AO2/1 4.1.1.2 4.5.6.3
	Level 1: Simple statements are made. The response may fail to make logical links between the points raised.	1–2		
	No relevant content	0		
	Indicative content <ul style="list-style-type: none"> • doubling speed increase the kinetic energy • kinetic energy increases by a factor of 4 • work done (by brakes) to stop the car increases • work done increases by a factor of 4 • work done is force x distance and braking force is constant <p>so if work done increases by 4 then the braking distance must increase by 4</p>			
Total			14	

Handling data

Trilogy C2F
Question 2.7

Question	Answers	Extra information	Mark	AO/Spec ref
02.7	$(35 + 37 + 37/3) = 36.33$	allow $(35 + 48 + 37 + 37/4 =) 39(.25)$ for 1 mark	1	AO2/1 5.7.1.3
	36		1	

Synergy 3H
Question 6.5

Question	Answers	Extra information	Mark	AO/Spec ref
06.5	3 moles of electrons are needed to produce 27 g or 0.027 kg aluminium		1	AO2/1 4.5.2.5
	so moles of electrons to produce 1 000 kg = $1\,000/0.027 \times 3$		1	
	= 111 000	allow 111 000 with no working shown for 3 marks incorrect no. of sig. figs max 2 marks	1	

Biology 2F
Question 7.5

Question	Answers	Extra information	Mark	AO/Spec ref
07.5	$(12 + 13 + 13 + 9 + 8 / 5 =)$ 11		1	AO2/2 4.5.2.1

Trilogy P2F
Question 2.7

Question	Answers	Extra information	Mark	AO/Spec ref
02.7	0.100 m	if more than one box ticked apply list principle	1	AO3/2a 6.5.3 WS3.5

Chemistry 2F
Question 6.1

Question	Answers	Extra information	Mark	AO/Spec ref
06.1	Propanol		1	AO2/1 4.2.2.1 4.2.2.4 4.7.2.3

Trilogy B2F

Question 4.4

Question	Answers	Extra information	Mark	AO/Spec ref
04.4	0.5	allow ecf from 04.2	1	AO3/1b 4.6.1.4

Biology 2F

Question 8.4

Question	Answers	Extra information	Mark	AO/Spec ref
08.4	correct derivation of children's genotypes		1	AO2/1 4.6.1.6
	identification of children with cystic fibrosis (dd)		1	AO3/1b 4.6.1.6
	0.25	allow ecf allow $\frac{1}{4}$ / 25% / 1 in 4 / 1:3 do not accept 1:4	1	AO2/1 4.6.1.6

Biology 2H

Question 7.4

Question	Answers	Extra information	Mark	AO/Spec ref
07.4	mother / woman's gametes correct: A a		1	AO2/2 4.6.1.6
	father / man's gametes correct: a a		1	AO2/2 4.6.1.6
	correct derivation of offspring	ecf	1	AO2/2 4.6.1.6

	identification of child with syndrome H or genotype aa		1	AO2/2 4.6.1.6
	0.5	ecf allow 50% / 1/2 / 1 in 2 / 1:1 do not accept 1:2	1	AO3/2b 4.6.1.6

Biology 1F**Question 3.5**

Question	Answers	Extra information	Mark	AO/Spec ref
03.5	45 (mm)		1	AO2/2 4.1.1.5
	45 / 250 or 0.18 (mm)	allow ecf	1	AO2/2 4.1.1.5
	180 (µm)	allow 180 (µm) with no working shown for 3 marks	1	AO2/2 4.1.1.5

Synergy 1H**Question 8.3**

Question	Answers	Extra information	Mark	AO/Spec ref
08.3	correct conversion of 1.18 µg to mg/cm ³		1	AO2/1 4.2.2.3
	$\frac{118}{0.00118} = 100\,000$	allow 1 mark for 100 (ie no conversion to mg) allow 100 000 with no working shown for 2 marks	1	

Algebra

Physics 2F

Questions 9.3 – 9.6

Question	Answers	Extra information	Mark	AO/Spec ref
09.3	weight = mass x gravitational field strength	accept gravity for gravitational field strength accept $W = mg$ accept correct rearrangement ie mass = weight / gravitational field strength or $m = W/g$	1	AO1/1 4.5.1.3
09.4	$343 = m \times 9.8$ $m = \frac{343}{9.8}$ $m = 35$	allow 35 with no working shown for 3 marks	1 1 1	AO2/1 AO2/1 AO2/1 4.5.1.3
09.5	force = spring constant x compression	accept force = spring constant x extension accept $F = k e$ accept correct rearrangement ie constant = force / extension or $k = F/e$	1	AO1/1 4.5.3
09.6	compression = 0.07m $343 = k \times 0.07$ $k = 343 \div 0.07$ $k = 4900$	allow 4900 with no working shown for 4 marks allow 49 with no working shown for 3 marks	1 1 1 1	AO2/1 AO2/1 AO2/1 AO2/1 4.5.3

Trilogy Physics 2F

Question 2.8

Question	Answers	Extra information	Mark	AO/Spec ref
02.8	$0.5 \times 20 \times (0.050)^2$ $= 0.025 \text{ (J)}$	allow 0.025 (J) with no working for 2 marks	1	AO2/1
			1	6.5.3

Trilogy Physics 2F

Question 1.2

Question	Answers	Extra information	Mark	AO/Spec ref
01.2	2040 / 120 17 (m/s)	allow 17 (m/s) with no working shown for 2 marks	1	AO2/1
			1	6.5.4.1.2

Physics 1H

Question 11.5

Question	Answers	Extra information	Mark	AO/Spec ref
11.5	extension = 35 (m) and conversion of 24.5 kJ to 24500 J $24\ 500 = \frac{1}{2} \times k \times 35^2$ 40	allow 40 with no working shown for 3 marks an answer of '16.2' gains 2 marks	1	AO2/2
			1	4.1.1.2
			1	WS4.3

Synergy 4H

Question 9.2

Question	Answers	Extra information	Mark	AO/Spec ref
09.2	gpe = 600 x 9.8 x 35	allow 26.2 with no working shown for 6 marks	1	AO2/1
	= 205 800		1	AO2/1
	gpe = KE = $\frac{1}{2} m v^2$		1	AO2/1
	$v = \sqrt{\frac{2 \times KE}{m}}$		1	AO2/1
	= $\sqrt{\frac{411\,600}{600}}$		1	AO2/1
	= 26.2 (m/s)		1	AO2/1 4.6.1.5 4.7.1.9

Graphs

Physics 2F

Question 7.4

Question	Answers	Extra information	Mark	AO/Spec ref
07.4	straight line drawn from 13 m/s to 0 m/s finishing on x-axis at 65 s		1	AO2/2
			1	4.5.6.1.5

Biology 1F

Question 4.3

Question	Answers	Extra information	Mark	AO/Spec ref
04.3	4		1	AO2/1 4.4.2.2

Synergy 2F

Question 3.2

Question	Answers	Extra information	Mark	AO/Spec ref
03.2	all three plots correct	accept two correct plots	2	AO2/2

	suitable line drawn	for 1 mark	1	4.3.1.5
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Trilogy C1F

Question 8.2

Question	Answers	Extra information	Mark	AO/Spec ref
08.2	all points correct	$\pm \frac{1}{2}$ small square	2	AO2/2
	best fit line	allow 1 mark if 5 points correct	1	5.3.2.5

Geometry and trigonometry

Physics 2H

Question 8.2

Question	Answers	Extra information	Mark	AO/Spec ref
08.2	37.5 km	accept any value between 37.0 and 38.0 inclusive	1	AO2/2
	062° or N62°E	accept 62° to the right of the vertical accept an angle in the range 60° -64° accept the angle correctly measured and marked on the diagram	1	4.5.6.1.1

Chemistry 2F

Question 6.3

Question	Answers	Extra information	Mark	AO/Spec ref
06.3	$\begin{array}{c} \text{H} \\ \\ \text{H} - \text{C} - \text{O} - \text{H} \\ \\ \text{H} \end{array}$		1	AO2/1 4.2.1.4 4.7.2.3

Synergy 3F

Question 5.1

Question	Answers	Extra information	Mark	AO/Spec ref
05.1	$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{H} \\ \\ \text{H} \end{array}$		1	AO2/1 4.6.2.4