OCR
Oxford Cambridge and RSA

Accredited

GCSE (9–1) Combined Science (Physics) A (Gateway Science)

H

J250/12 Paper 12 (Higher Tier)

Sample Question Paper

Date – Morning/Afternoon

Version 2.2

Time allowed: 1 hour 10 minutes

You must have:
- the Data Sheet

You may use:
- a scientific or graphical calculator
- a ruler

First name									
Last name									
Centre number						Candidate number				

INSTRUCTIONS
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION
- The total mark for this paper is **60**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **20** pages.

SECTION A

You should spend a maximum of 20 minutes on this section.

Answer **all** the questions.

1 A boy kicks a football with a mass of 400 g.

What is the potential energy of the football when it is 0.8 m above the ground?

* gravitational field strength (g) = 10 N/kg

A 0.032 J

B 3.2 J

C 320 J

D 3 200 J

Your answer ☐ **[1]**

2 The National Grid transfers energy efficiently using high voltages.

Why are high voltages more efficient than low voltages?

A Increasing the voltage decreases the current, which heats the wires less.

B Increasing the voltage decreases the current, which heats the wires more.

C Increasing the voltage increases the current, which heats the wires less.

D Increasing the voltage increases the current, which heats the wires more.

Your answer ☐ **[1]**

3 Which factors affect braking distance but **not** thinking distance?

A Drinking alcohol and a car full of people.

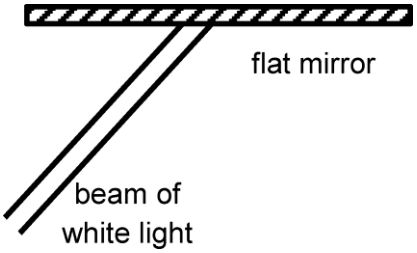
B Speed and drinking alcohol.

C Speed and wet road conditions.

D Wet road conditions and a car full of people.

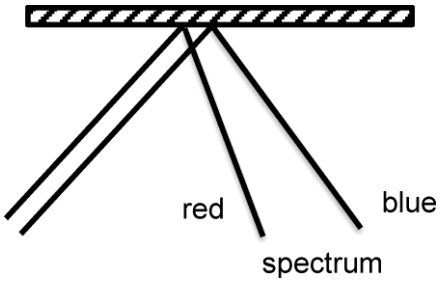
Your answer ☐ **[1]**

4 A parallel beam of white light is reflected from a flat mirror.

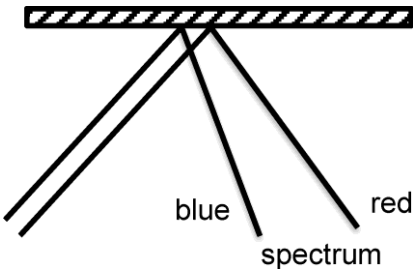


Which diagram shows the beam reflected correctly?

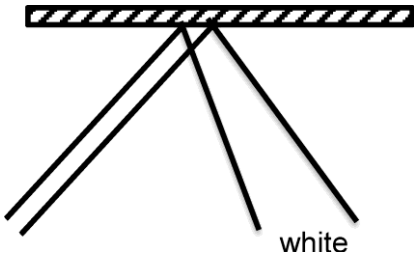
A



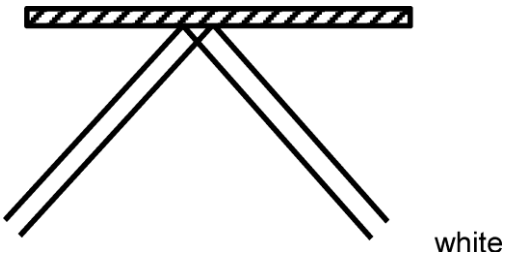
B



C



D



Your answer ☐ **[1]**

5 Which row gives the features of the domestic electricity supply in the UK?

	Direct current	Frequency (Hz)	Voltage (V)
A	no	50	230
B	no	230	50
C	yes	50	230
D	yes	230	50

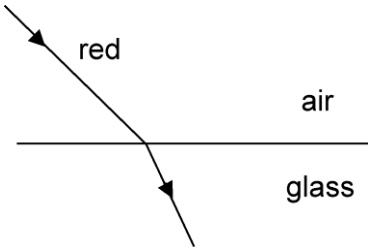
Your answer ☐ **[1]**

6 Which row would increase the efficiency of a machine?

	Decreased energy input without changing the energy output	Increased energy losses due to friction	Increased work output without changing the work input
A	no	yes	yes
B	no	yes	no
C	yes	no	no
D	yes	no	yes

Your answer ☐ **[1]**

7 Red light refracts when it enters glass from air.



The red light is replaced by blue light.

Which statement is correct about the refraction of **blue** light?

A It refracts less than red because its speed in glass is greater than that of red light.

B It refracts less than red because its speed in glass is less than that of red light.

C It refracts more than red because its speed in glass is greater than that of red light.

D It refracts more than red because its speed in glass is less than that of red light.

Your answer ☐ **[1]**

8 Radium-226 is the most abundant isotope of radium.

Its mass number is 226 and its nucleus contains 138 neutrons.

Which of the following is another isotope of radium?

A mass number 226; 137 neutrons

B mass number 226; 139 neutrons

C mass number 227; 138 neutrons

D mass number 227; 139 neutrons

Your answer ☐ **[1]**

9 10.0 J of work is done lifting a ball a distance of 1.8 metres.

How much force was used to lift the ball?

A 0.18 N

B 18 N

C 5.6 N

D 8.2 N

Your answer ☐ **[1]**

10 A kettle full of water takes 3 minutes to boil.

The kettle has a power output of 2 kW.

How much energy is transferred?

A 360 000 J

B 36 000 J

C 6 000 J

D 600 J

Your answer ☐ **[1]**

BLANK PAGE

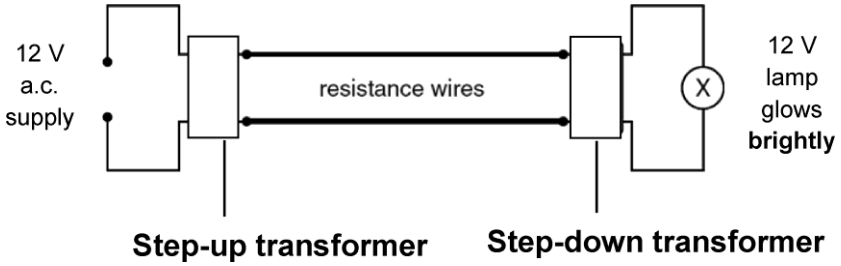
TURN OVER FOR THE NEXT QUESTION

SECTION B

Answer **all** the questions.

11 A student sets up two circuits to investigate the difference that transformers make to circuits.

Circuit 1



Circuit 2

(a)* Compare the two circuits, including reasons why the transformers make a difference.

Suggest how **Circuit 1** could be improved to make the bulb glow more brightly.

.....

.....

.....

.....

.....

.....

.....

.....

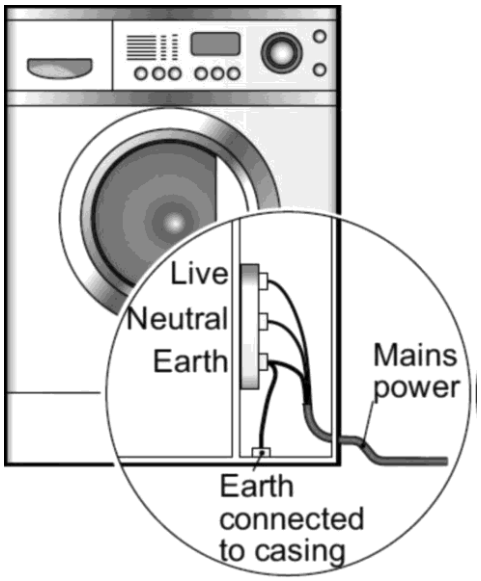
.....

.....

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

(b) Washing machines have an outer casing made of metal.

The picture shows the earth wire connected to the outer casing.



The live wire becomes loose and touches the outer casing.

(i) Explain why this does **not** give you an electric shock.

.....

.....

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

(ii) The earth wire is thicker than the live wire and neutral wire.
Suggest why the earth wire is thicker.

.....

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

12 **(a)** State the **two** changes to an electromagnetic wave when it travels from a medium of low density to high density.

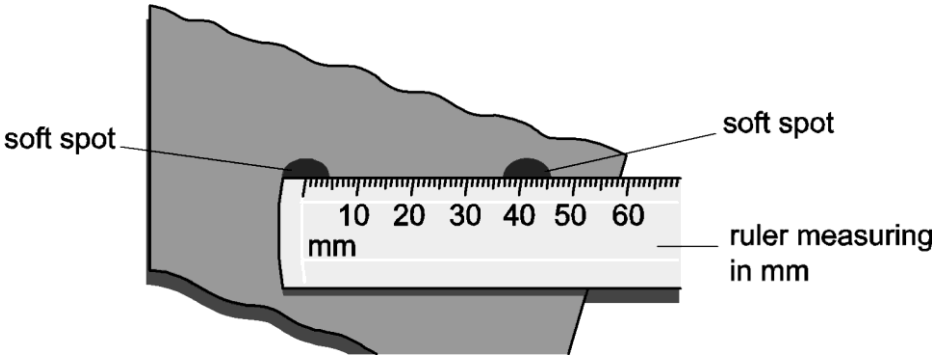
.....

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

(b) The wavelength of microwaves can be measured using chocolate.

- The turntable is taken out of the microwave oven.
- Chocolate is put in the oven.
- The microwave oven is left on full power for 10 seconds.

The picture shows the closest two soft spots in the chocolate.



Here is the position of the soft spots on a wave diagram.

What is the wavelength of this microwave **in metres**?

.....

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

Answer =..... m

(c) The frequency of the microwaves used in the oven is 2 450 MHz.

Calculate the speed of the microwaves used in the oven.

Use the wavelength you measured from part **(b)**.

.....

.....

.....

.....

.....

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

Answer = ... m/s

(d) The speed of all electromagnetic waves in air is approximately 3×10^8 m/s.

How far apart should the spots have been?

.....

.....

.....

.....

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

Answer =..... m

(e) The investigation is repeated with bread dough.

Why is the wavelength measured of the microwave different than in chocolate?

.....

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

13 Some nuclei are radioactive because they are unstable.

(a) The terms half-life and random decay are used when describing radioactivity.

(i) Explain the concept of half-life.

.....

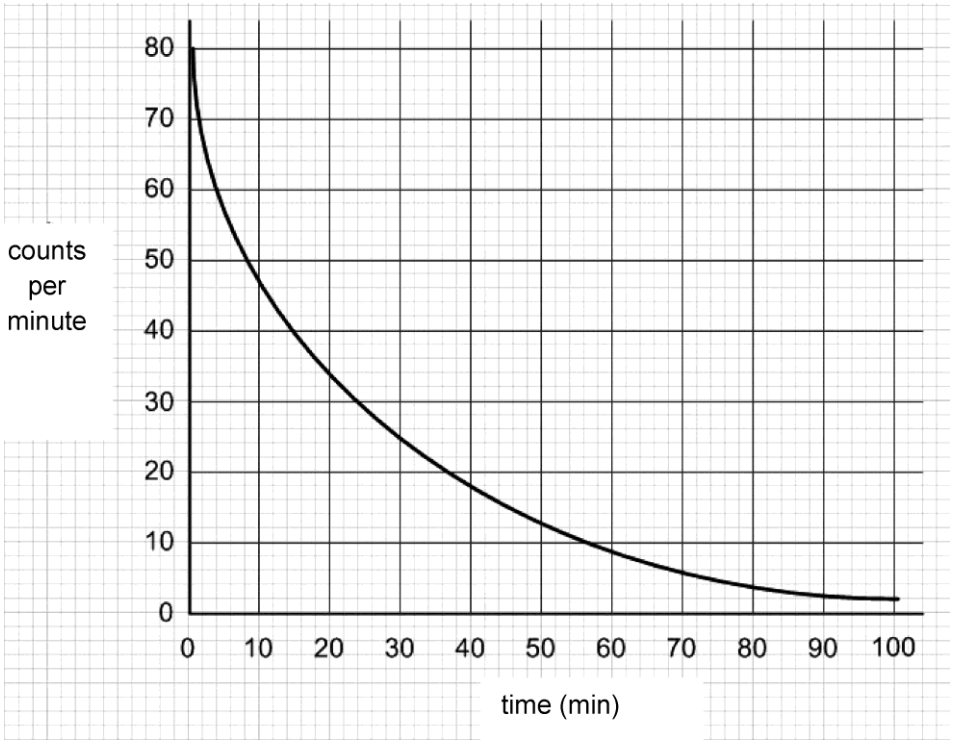
..... **[2]**

(ii) Why is radioactive decay described as random?

.....

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

(b) A student collects information about the half-life of francium-223.



(i) Calculate the half-life of francium.

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

Answer = ... minutes

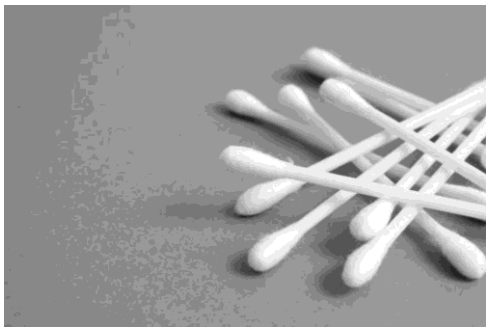
(ii) Calculate the net decline, expressed as a ratio, during radioactive emission after 3 half-lives.

.....

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

Answer = ...

(c) These cotton wool buds have been treated with gamma rays.



The cotton wool buds have been **irradiated** but not **contaminated**.

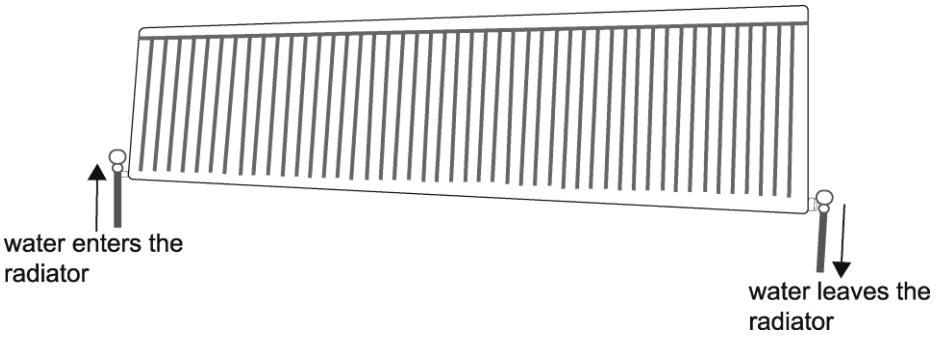
Describe the difference between irradiated and contaminated.

.....

.....

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

14 The picture shows a radiator which is being used to heat a room of a house.



The radiator is full of water which flows from a boiler through the radiator and back to the boiler.

(a) Describe the energy transfers that are taking place.

Assume no energy is lost from the room.

.....

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

(b) The water in the radiator decreases in temperature by 3°C.

This is caused by the radiator giving out 18 900 J of energy each second.

The specific heat capacity of water is 4 200 J /kg°C.

Calculate the mass of water flowing though the radiator each second.

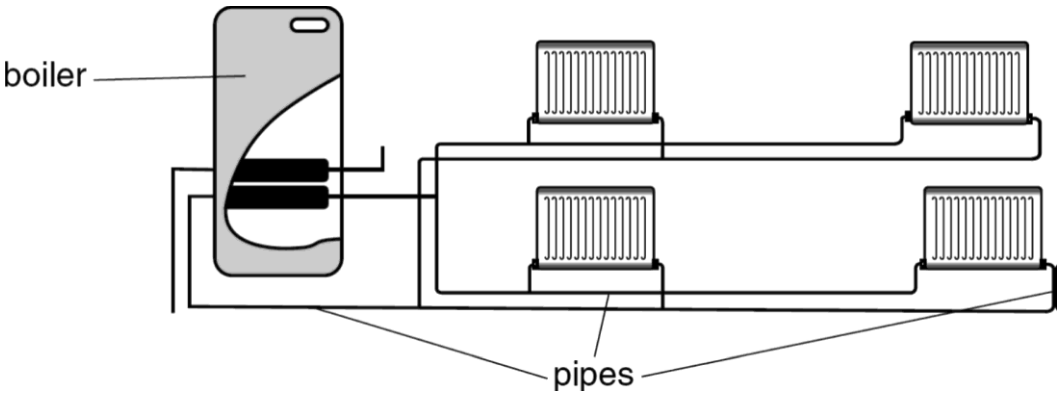
.....

.....

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

Answer = ... kg

(c) The picture shows the radiators in the house connected by pipes to the boiler.



The main boiler can be replaced to improve efficiency.

Describe **three** different ways that the efficiency of the **pipe** system can be improved.

.....

.....

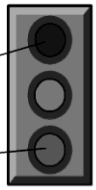
..... **[3]**

15 The stopping distance of a car is important for road safety.

One factor that affects stopping distance is reaction time.

The instructions below are for a reaction time test.

Instructions
Press button to start.
Wait for red light to go off and green light to go on. When green light is on press the button again.

Reaction time	Lights	Button
.....		
red light		
green light		

(a) (i) Use the experiment above to write a method to compare the reaction time with different distractions.

In your method describe the variables you would control and how would make the test precise.

.....

.....

.....

..... **[4]**

(ii) The table shows six of the results collected.

Reaction time (s)
0.60
0.97
0.88
0.67
0.99
0.71

Select the **three** reaction times from the table when there were **no** distractions Calculate their mean reaction time.

.....

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

Answer = ... s

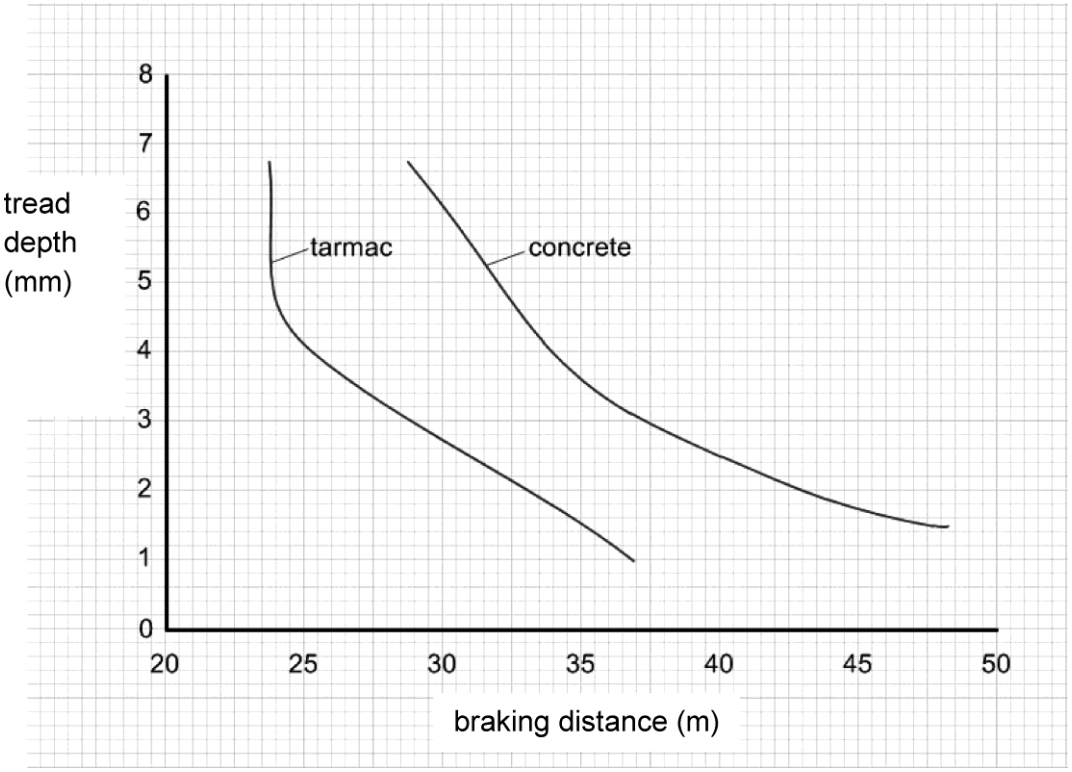
(iii) State why it is important that the driver of a car is not distracted?

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

(b) Braking distance is another factor that affects stopping distance.

The graph shows the braking distances for tyres of different tread depths on concrete and tarmac.

The car is always travelling at the same speed.



The legal minimum tyre tread depth is 1.6 mm.

What conclusions can you make from the graph about how the tread depth on different surfaces affects the braking distance?

Use data from the graph in your answer.

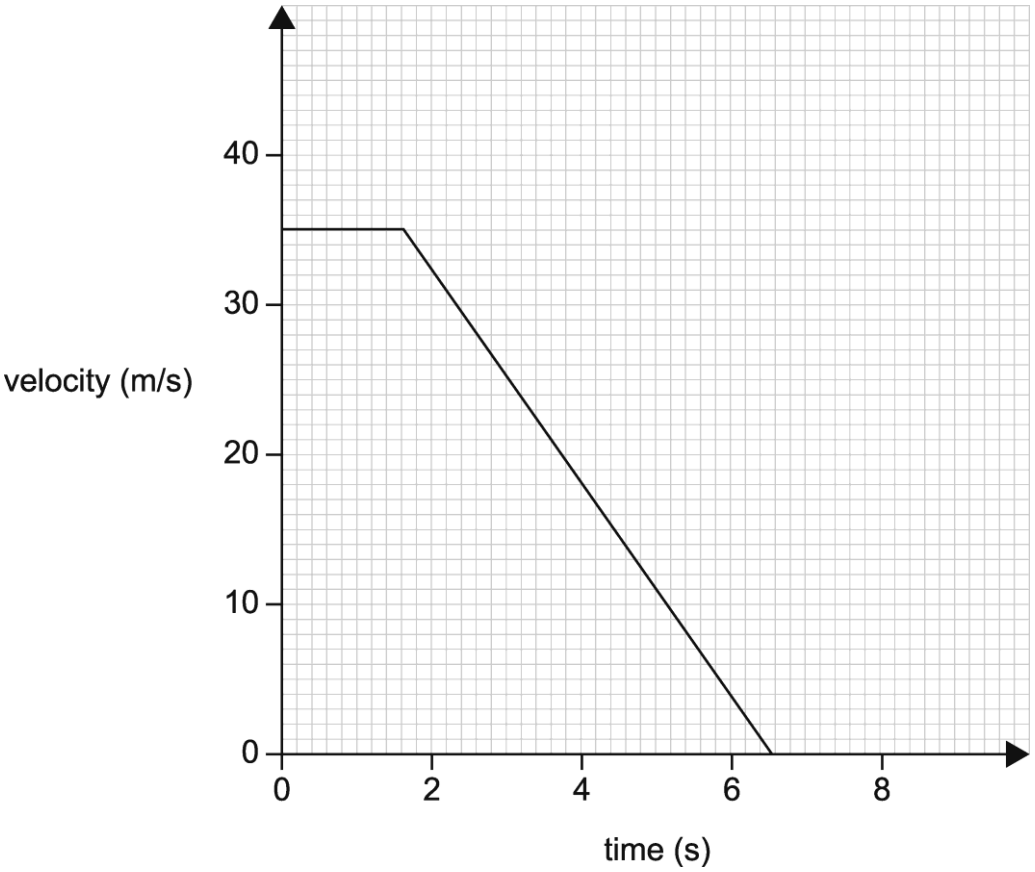
.....

.....

.....

..... **[4]**

(c) The graph below shows the motion of a car before it comes to rest.



(i) Shade the section on the graph which shows the braking distance. **[1]**

(ii) Use the graph to calculate the stopping distance of the car.

Show your working.

.....

.....

.....

.....

Stopping distance = ……m **[3]**

END OF QUESTION PAPER

Summary of updates

Date	Version	Details
November 2021	2.2	Updated copyright acknowledgements.

OCR
Oxford Cambridge and RSA

H

…day June 20XX – Morning/Afternoon

GCSE (9–1) Combined Science (Physics) A (Gateway Science)
J250/12 Paper 12 (Higher Tier)

SAMPLE MARK SCHEME

Duration: 1 hour 10 minutes

MAXIMUM MARK 60

This document consists of 16 pages

MARKING INSTRUCTIONS

PREPARATION FOR MARKING

SCORIS

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *scoris assessor Online Training*; *OCR Essential Guide to Marking*.

2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal http://www.rm.com/support/ca

3. Log-in to scoris and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

   YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.

2. Marks awarded must relate directly to the marking criteria.

3. The schedule of dates is very important. It is essential that you meet the scoris 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the scoris messaging system.

5. Work crossed out:
   a. where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks
   b. if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.

7. There is a NR (No Response) option. Award NR (No Response)
   - if there is nothing written at all in the answer space
   - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
   - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.

   Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

8. The scoris **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
If you have any questions or comments for your Team Leader, use the phone, the scoris messaging system, or email.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance.

Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer. Once the level is located, award the higher or lower mark:

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

In summary:

The skills and science content determines the level.
The communication statement determines the mark within a level.

11. Annotations

Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
_	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

12. Subject-specific Marking Instructions

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

The breakdown of Assessment Objectives for GCSE (9–1) in Combined Science A (Gateway Science).

	Assessment Objective
AO1	**Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.**
AO1.1	Demonstrate knowledge and understanding of scientific ideas.
AO1.2	Demonstrate knowledge and understanding of scientific techniques and procedures.
AO2	**Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.**
AO2.1	Apply knowledge and understanding of scientific ideas.
AO2.2	Apply knowledge and understanding of scientific enquiry, techniques and procedures.
AO3	**Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.**
AO3.1	Analyse information and ideas to interpret and evaluate.
AO3.1a	Analyse information and ideas to interpret.
AO3.1b	Analyse information and ideas to evaluate.
AO3.2	Analyse information and ideas to make judgements and draw conclusions.
AO3.2a	Analyse information and ideas to make judgements.
AO3.2b	Analyse information and ideas to draw conclusions.
AO3.3	Analyse information and ideas to develop and improve experimental procedures.
AO3.3a	Analyse information and ideas to develop experimental procedures.
AO3.3b	Analyse information and ideas to improve experimental procedures.

SECTION A

Question	Answer	Marks	AO element	Guidance
1	B	1	2.1	
2	A	1	1.2	
3	C	1	1.1	
4	D	1	1.1	
5	A	1	1.1	
6	D	1	1.1	
7	D	1	1.1	
8	D	1	2.1	
9	C	1	2.1	
10	A	1	2.1	

SECTION B

Question			Answer	Marks	AO element	Guidance
11	(a)*		Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** **Explains how transformers affect the circuit AND provides suggestions of how the circuit could be improved.** *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** **Detailed comparison of the circuits AND states how transformers affect the circuit. Provides a simple suggestion of how the circuit could be improved.** *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** **Simple comparison of the circuits OR states how transformers affect the circuit.** *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	**6**	**3.1b** **3.3b** **2 x 2.2** **2 x 1.2**	**AO3.1a: Analysing the affect of transformers in the circuit** • more efficient transfer as lower current results in less heat loss in wires • high voltages low current • more efficient to transfer the electrical power means bulb glows brightly **AO3.3b: Suggestion of improvements** • wire used could be made of a lower resistance material • the step up transformer could have more turns on the secondary coil to step up the p.d. more **AO2.2: Comparison of the circuits and function of transformers** • the bulb in Circuit 1 glows more brightly / ORA • the resistance wires are made of the same material • the p.d. supplied in both circuits is the same **AO1.2: States how transformers work and affect the circuit** • step up transformer increases the voltage across the wire • step down decreases the voltage for the lamps • the bulb in Circuit 1 glows more brightly / **ORA** • circuit 1 has transformers in it / **ORA**

Question			Answer	Marks	AO element	Guidance
	(b)	(i)	Earth wire provides a safe route for the current (1) Earth wire has a low resistance/high current (1) Fuse breaks / circuit disconnected (1)	3	1.1 2.2 2.2	
		(ii)	(idea that it) reduces the resistance (1)	1	2.1	

Question			Answer	Marks	AO element	Guidance
12	(a)		Wavelength decreases (1) Velocity decreases (1)	2	2 x 1.1	**DO NOT ALLOW** frequency stays the same
	(b)		41 x 2 / indication of the spots being half a wavelength apart (1) 82 (mm) / 0.082 (m) (1)	2	2.2 2.1	**ALLOW** 0.08(0) / 0.081 / 0.083 / 0.084 (m) (2) **ALLOW** 80 /81 / 83 / 84 (1)
	(c)		Convert frequency in MHz to Hz = 2 450 000 000 (1) Recall and apply wave speed = frequency x wavelength = 2 450 000 000 x 0.082 (1) Answer = 200 900 000 (m/s) (1)	3	1.2 2.1 2.1	**ALLOW ECF** from part (b)
	(d)		3×10^8/2 450 000 000 (1) 0.12/2 (indication of spots being half a wavelength apart (1) 0.06 m (1)	3	3 x 2.1	
	(e)		The velocity of the wave through the bread will be different from the chocolate (1)	1	1.2	

Question			Answer	Marks	AO element	Guidance
13	(a)	(i)	the average time it takes (1) for the number of nuclei of an isotope in a sample to halve (1) **or** the time it takes (1) for the count rate from a sample containing an isotope to fall to half its starting level (1)	**2**	**2 x 1.1**	
		(ii)	(idea that) it is not possible to predict when an individual atoms may decay (1)	**1**	**1.1**	
	(b)	**(i)**	calculation of half-life to be 20 minutes (1)	**1**	**2.1**	**Allow** 20 $\pm$ 2 minutes
		(ii)	so after 3 half-lives counts per minute decreases from 80 to 40 to 20 to 10 (1) 70/80 or 7/8th (1)	**2**	**2 x 2.1**	
	(c)		Contamination transfers the source / irradiation is emission from the source (1) idea that contamination lasts for a long period of time / irradiation is temporary (1)	**2**	**1.1** **2.2**	

Question			Answer	Marks	AO element	Guidance
14	(a)		Energy from the hot water in the radiator is transferred to the metal radiator (1) (idea that) temperature of radiator decreases and temperature of room increases as the energy is transferred from the radiator to the room(1)	2	2 x 2.2	**ALLOW** the same amount of energy is transferred
	(b)		$\frac{18\ 900}{4200 \times 3}$ (1) (mass) 1.5 (kg) (1)	2	2 x 2.1	**ALLOW** 1.5 (kg) (2)
	(c)		**Any three from** (thermal) insulation to reduce heat loss (1) make the pipes as short as possible so less temperature drop along the pipe (1) change the diameter of the pipes so less heat loss from surface / (idea of) smaller surface area to volume ratio (1) paint pipes silver or white as these are bad emitters of heat (1)	3	3 x 1.1	

Question			Answer	Marks	AO element	Guidance
15	(a)	(i)	Repeat test at each distraction and find the mean (1)	4	1.2	**ALLOW** named types of distraction e.g. using a mobile phone / talking / shouting / listening to the radio / reading / buzzer / flashing lights **ALLOW** use same hand / no practising first **ALLOW** only use girls / only use boys / use people of the same age **ALLOW** any correct control of variables e.g. not tired / not been taking drugs **ALLOW** only use right hand
			Details of 2 or more distractions (1)		1.2	
			Idea of control e.g use same person each time (1)		3.3a	
			Idea of same named variable e.g. same level of tiredness / same time of day / no stimulants (1)		3.3a	
		(ii)	0.66 (s) (1)	1	3.1b	
		(iii)	(idea that) distractions lead to a longer reaction time so car stops in a longer distance / distractions leads to a longer reaction time so more likely to hit the car in front (1)	1	1.1	
	(b)		(idea that) less depth gives a greater braking distance / **ORA** (1)	4	3.1b	
			(idea that) the relationship between tread depth and braking distance is not linear/ for tread depths less than 1.6 mm the braking distance increases rapidly (1)		3.1b	
			any correct uses of data e.g. when tread depth is 1.6 mm on tarmac the stopping distance is 33.5 m / when tread depth is 1.6 mm on concrete the stopping distance is 42 m (1)		3.1b	
			(idea that) the shortest braking distance possible is best for preventing accidents/ greater braking distances on concrete (1)		3.2b	

Question			Answer	Marks	AO element	Guidance
	(c)	(i)	Area under triangle shaded (1)	1	1.2	
		(ii)	Calculation of total area under graph: Area under rectangle / 35 x 1.6 = 56 (1) Area under triangle / 0.5 x 35 x (6.6 – 1.6) = 87.5 (1) Total area: 56 + 87.5 = 144 (m) (1)	3	3 x 3.1b	**ALLOW** 143.5 (m)

Summary of updates

Date	Version	Change
May 2018	2	We've reviewed the look and feel of our papers through text, tone, language, images and formatting. For more information please see our assessment principles in our "Exploring our question papers" brochures on our website.
October 2019	2.1	Question 13(b) (i) – Mark Scheme correction from 15 to 20 minutes. Addition to guidance column: **Allow** 20 ± 2 minutes.