Oxford Cambridge and RSA

Accredited

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

F

J249/02 Paper 2 (Foundation Tier)

Sample Question Paper

Date – Morning/Afternoon

Version 2.1

Time allowed: 1 hour 45 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. HB pencil may be used for graphs and diagrams only.
- 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 **90**.
- 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 **24** pages.

SECTION A

Answer **all** the questions.

You should spend a maximum of 30 minutes on this section.

1 Which electromagnetic waves have the highest frequency?

A Gamma rays

B Microwaves

C Radio waves

D Ultra-violet rays

Your answer ☐ **[1]**

2 Which frequency is used for electricity supplied to homes in the UK?

A 50 Hz a.c.

B 50 Hz d.c.

C 230 Hz a.c.

D 230 Hz d.c.

Your answer ☐ **[1]**

3 A student picks up a very hot plate.

What is the **shortest** time the student can react and drop the plate?

A 2 milliseconds

B 0.2 seconds

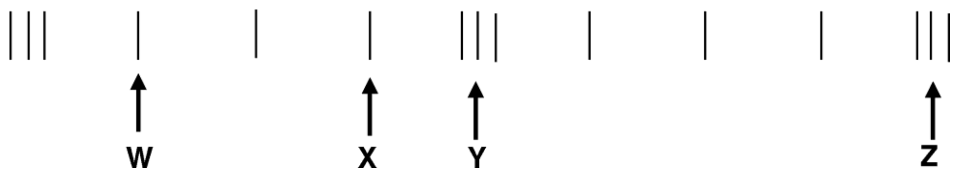
C 2 seconds

D 0.2 minutes

Your answer ☐ **[1]**

4 A longitudinal wave passes through a slinky spring.
The coils of the spring vibrate backwards and forwards.

The diagram shows a snapshot of the position of the coils as the wave passes along the spring.



Which pair of coils are one wavelength apart?

A **W** and **X**

B **W** and **Z**

C **X** and **Y**

D **Y** and **Z**

Your answer ☐ **[1]**

5 Which statement is **not** true of all electromagnetic waves?

A They have the same wavelength.

B They are transverse waves.

C They can travel through a vacuum.

D They travel at 300 000 000 m/s.

Your answer ☐ **[1]**

6 Which wave travels as a **longitudinal** wave?

A Light from a torch

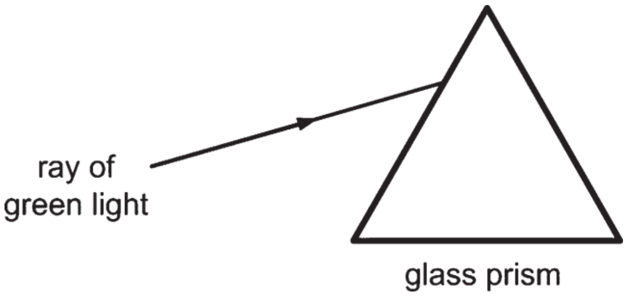
B Ripples from a stone dropped in water

C Sound from a loudspeaker

D Ultra-violet from the Sun

Your answer ☐ **[1]**

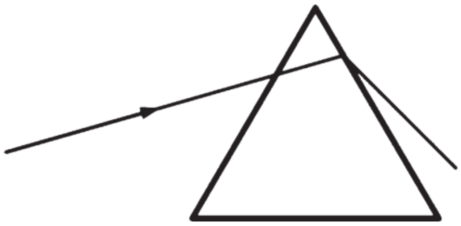
7 A ray of **green** light shines through a glass prism.



The ray travels through the prism and out of the other side.

Which diagram shows the correct path of the ray?

A



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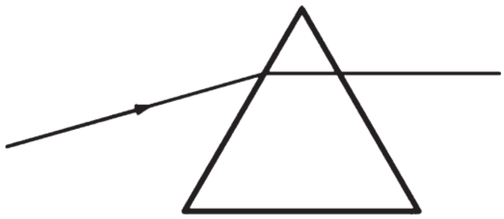

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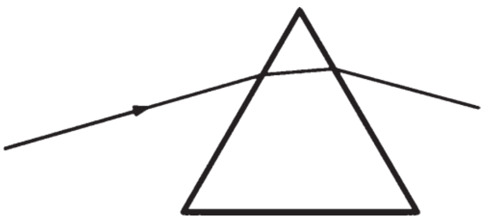
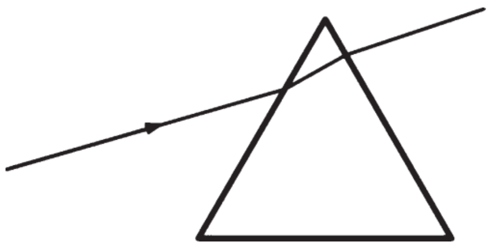


D



Your answer ☐ **[1]**

8 The Sun was formed from a cloud of dust and gas.

Which force brought together the particles of the cloud?

A Electrostatic

B Frictional

C Gravitational

D Magnetic

Your answer ☐ **[1]**

9 Which statement is evidence for an expanding universe?

A Light from galaxies is red shifted.

B Nuclear fusion occurs in stars.

C Many stars have orbiting planets.

D Stars were formed from dust and gas.

Your answer ☐ **[1]**

10 What is the number of neutrons in this isotope of uranium?

$$^{238}_{92}\mathrm{U}$$

A 92

B 119

C 146

D 238

Your answer ☐ **[1]**

11 All radioactive sources have a half-life.

Which statement about the half-life of a source is correct?

A It is half the time for an atom to decay.

B It is half the time for the activity of the source to decrease to zero.

C It is half the time for the radioactive source to become safe.

D It is the time for the activity of the source to decrease by half.

Your answer ☐ **[1]**

12 Which wall would allow the **most** heat transfer through the wall?

A A **thick** wall made from a material with **high** thermal conductivity.

B A **thick** wall made from a material with **low** thermal conductivity.

C A **thin** wall made from a material with **high** thermal conductivity.

D A **thin** wall made from a material with **low** thermal conductivity.

Your answer ☐ **[1]**

13 Why are high voltages used to transfer electrical power from power stations in the National Grid?

A They allow low resistance wires to be used.

B They produce a higher current.

C They reduce energy losses.

D Voltage can be changed using transformers.

Your answer ☐ **[1]**

14 A radio transfers 30 J of potential energy to 27 J of useful energy.

What is the efficiency and energy loss for the radio?

	Efficiency	**Energy loss**
A	10%	3J
B	10%	27J
C	90%	3J
D	90%	27J

Your answer ☐ **[1]**

15 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]**

SECTION B

Answer **all** the questions.

16 Many power stations burn fuels to generate electricity.

Fuels can be renewable or non-renewable.

(a) Wood is used in some power stations.

Why is wood called a renewable fuel?

.... **[1]**

(b) A student has completed her homework on fuels used in power stations.

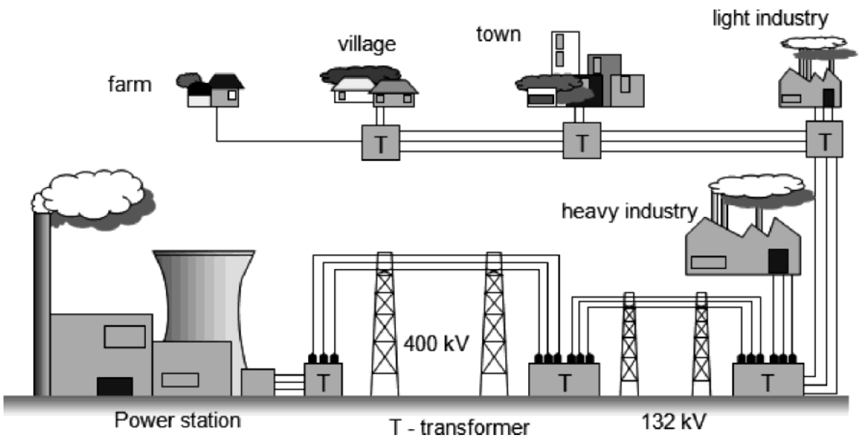
Look at her table below.

Fuel	**Type**
Wood	renewable
Plant and vegetable oils	renewable
Peat	non-renewable
Coal	renewable
North Sea gas	non-renewable
Uranium	renewable

[2]

She has made **two** mistakes, identify these in the table by putting a cross (**x**) next to them.

(c) Power stations produce electrical energy and use the National Grid to send the energy to factories and homes in the UK.



A step-up transformer is used in the National Grid.

State what a step-up transformer does.

....

.... **[1]**

(d) Domestic UK electrical wiring uses live, neutral and earth wires.

Complete the two empty boxes.

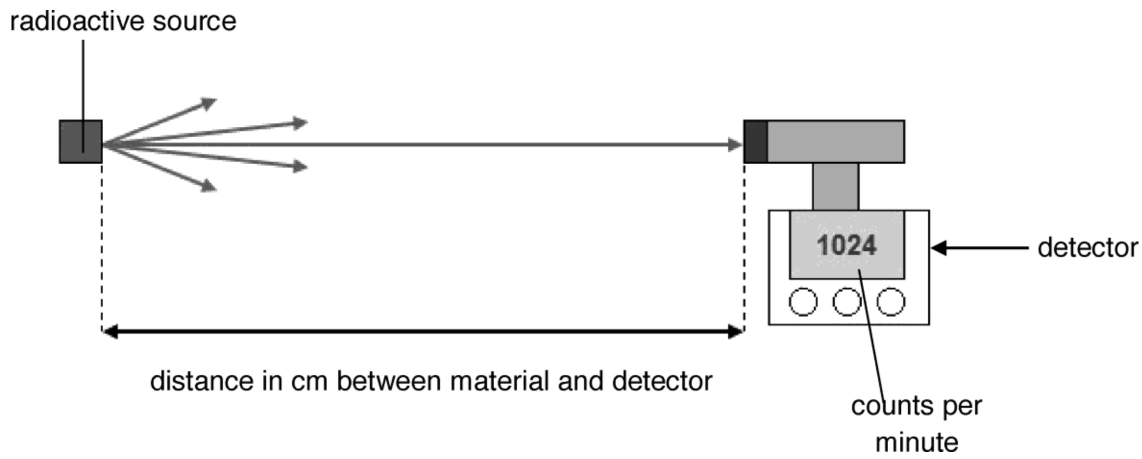
Draw lines to match up the wires to their **colour** and **function**.

Wire	**Colour**	**Function**
Live		Completes the circuit
Earth	Brown	
Neutral	Yellow and green	Has a high potential difference

[4]

17 A student does an experiment with radioactive materials.

- He investigates how the activity of radiation changes with distance.
- In the experiment, the radiation moves from the radioactive source to a detector.
- He measures the counts per minute at the detector.



The table shows the results.

Distance between source and detector (cm)	**Count rate (counts per minute)**
10	1000
20	240
40	60
80	20

(a) The student could **not** take an accurate reading at 0 cm.

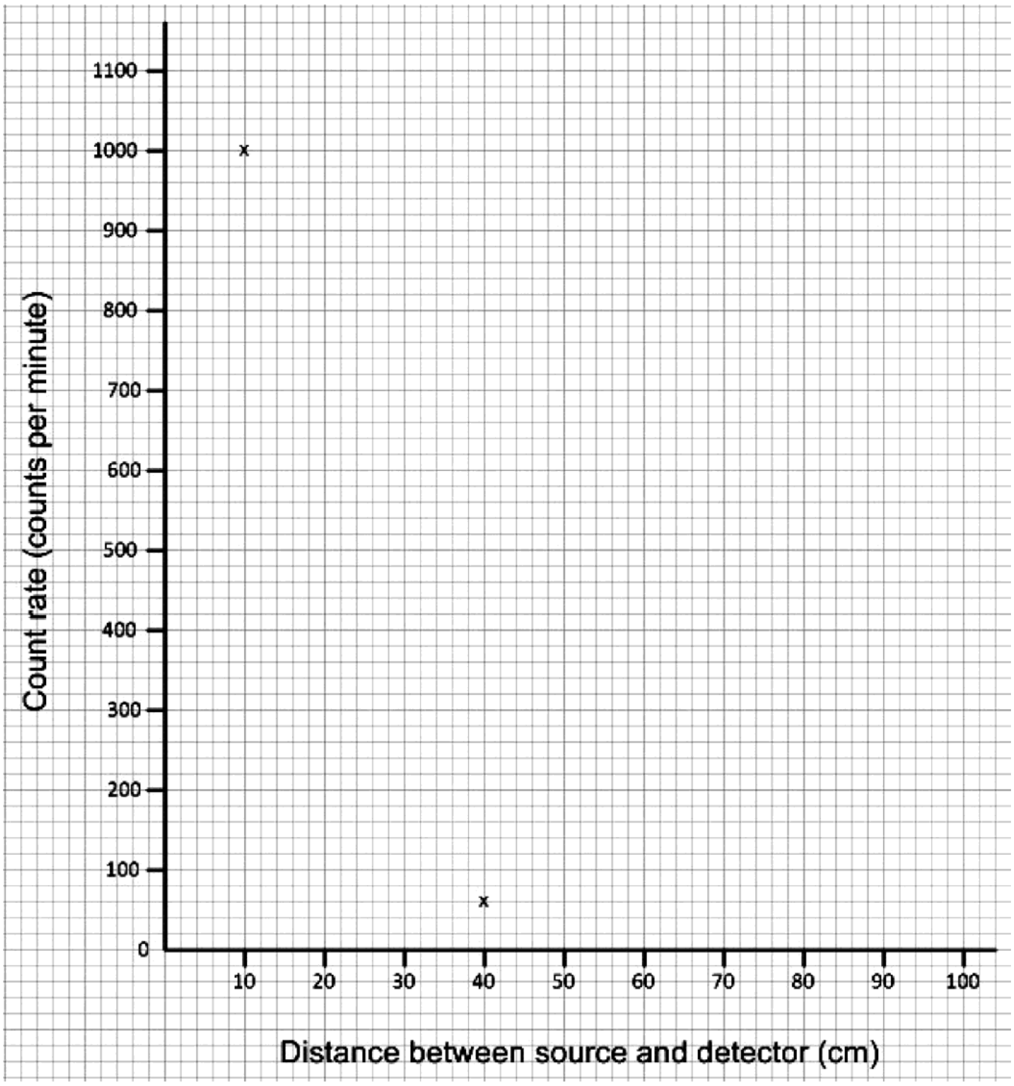
Suggest a reason why.

.... **[1]**

(b) (i) Plot the results on the graph below.

Two points for 10 cm and 40 cm have been plotted for you.

Join the points with a smooth curve.



[2]

(ii) Use the graph to estimate the count rate at **30 cm**.

Answer = …………………………………. counts per minute **[1]**

(c) (i) What pattern is shown by the results as the distance is increased from **20** to **40** cm?

....

.... **[2]**

(ii) The student wants to find the count rate at 5 cm.

Estimate the count rate at a distance of 5 cm.

Answer = …………………………………. counts per minute **[1]**

(d) The student considers the risks of doing experiments with radioactive sources.

He does experiments with two radioactive sources, **A** and **B**.

He writes down his conclusions about the sources in the table below.

Radioactive material	State	Distance from source	Irradiation risk	Contamination risk
A	solid	1 m	high	none
A	solid	4 m	low	none
B	gas	1 m	very high	high
B	gas	4 m	high	high

Describe the difference in the risks for irradiation and contamination for **A** and **B**.

....

....

....

....

.... **[4]**

18 Rockets carry satellites into space.

(a) Satellites are kept in orbit around a planet by a force.

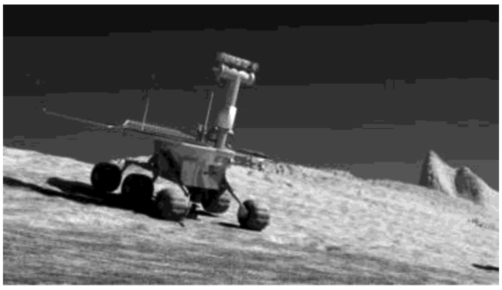
Name this force?

.... **[1]**

(b) Name the Earth's natural satellite.

.... **[1]**

(c) A vehicle called the Mars Rover was sent to Mars in a rocket.



Mars Rover

The Mars Rover has a mass of 185 kg.
The gravitational field strength (g) on Mars is 3.75 N/kg.

Calculate the weight of the Mars Rover vehicle on Mars.
State the unit for weight.

Show your working and give your answer to **3** significant figures.

....

....

....

....

Answer = …………………………………. Unit = ...**[5]**

(d) Why did the Mars Rover weigh more on Earth than on Mars?

.... **[1]**

19 A student has two radiators in her home. They are filled with different liquids and have different power ratings.

Fig. 19.1 shows information about the two heaters.

Oil radiator	**Water radiator**
 Heater contains 10 kg of **oil**	 Heater contains 10 kg of **water**
1000 W heater	**1500 W heater**

Fig. 19.1

Table 19.1 shows information about oil and water.

Material	**Specific heat capacity (J/kg°C)**	**Freezing point (°C)**	**Boiling point (°C)**
Oil	1 700	–24	250
Water	4 200	0	100

Table 19.1

(a) The student's conservatory can be very cold.
Sometimes the temperature can get as low as –6 °C.

She thinks that it may be better to use the oil radiator in the conservatory than the water radiator.

Suggest why.
Use the information in **Table 19.1** to help you answer.

....

.... **[1]**

(b) Both radiators have a ‘cut-out’ which prevents them getting hotter than 60 °C.

Suggest why.

....

.... **[1]**

(c) The student knows that the oil heater produces 800 J of energy each second.

Calculate the energy produced by the oil heater in 10 minutes.

....

....

Answer = ... J **[2]**

(d) The student wants the oil heater to heat up by 40°C.

(i) How much energy is needed?

Use the information in **Fig. 19.1** and **Table 19.1** to help you answer.

Show your working.

....

....

....

Answer = ... J **[2]**

(ii) She supplies enough energy to heat up the oil radiator by 40 °C but it only heats up to 32 °C.

Suggest **two** reasons why.

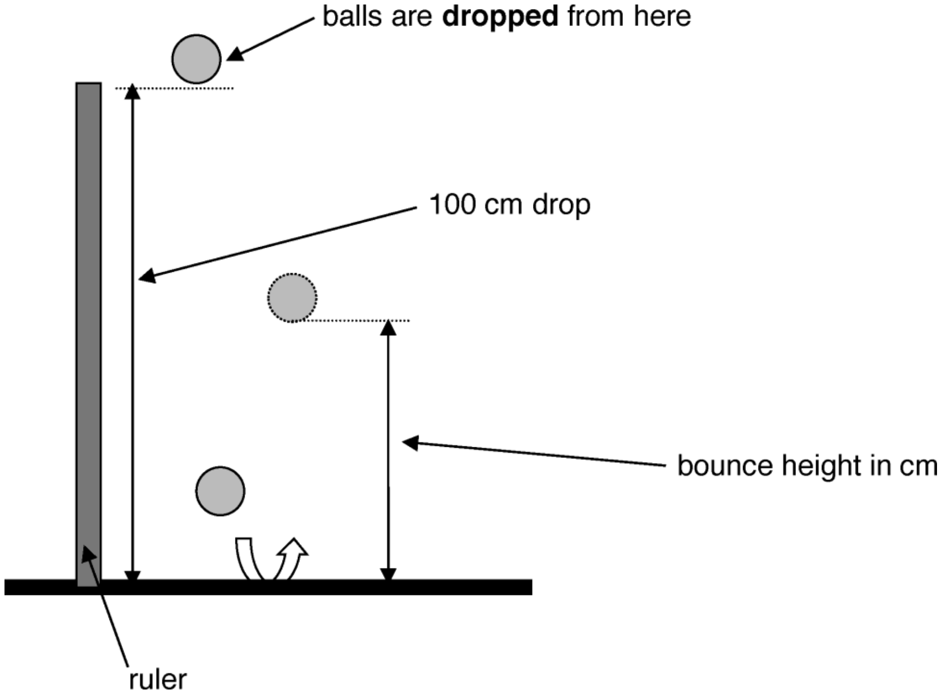
....

....

.... **[2]**

20 A student investigates how well different balls bounce.

- She drops five different balls from the same height and measures the height the balls bounce.
- She repeats the experiment three times for each ball.



Her results are shown in **Table 20.1**.

Ball	**Drop height (cm)**	**Bounce height (cm)**			**Mean bounce height (cm)**
		1st reading	**2nd reading**	**3rd reading**	
Red	100	75	77	73	75
Blue	100	61	62	60	61
Green	100	60	31	58	
White	100	84	86	85	85
Yellow	100	26	24		26

Table 20.1

(a) Calculate the **mean** bounce height for the **green** ball.

....

Answer = ... cm **[1]**

(b) The student forgot to write down one of the bounce heights for the **yellow** ball.

Suggest the **missing** result for the **yellow** ball.

....

Answer = ... cm **[1]**

(c) Evaluate the reliability of the results.

Suggest how she could have improved her experiment.

....

....

....

.... **[3]**

(d) The student suggests that 15% of the **white** ball's initial energy was not transferred usefully.

(i) Show that her suggestion is correct and suggest where the energy has been transferred to.

Use calculations and the information in **Table 19.1** to help you answer.

....

....

.... **[2]**

(ii) How could the efficiency of the ball be improved?

.... **[1]**

(e) Explain how energy is transferred and lost from the ball when it bounces.

....

....

.... **[2]**

21 The table below shows the stopping distances for a car.

Speed of car (m/s)	**Thinking distance (m)**	**Braking distance (m)**	**Total stopping distance (m)**
8	6	6	12
16	12	24	
32		96	120

(a)* Analyse the data in the table and use it to describe the trends shown.

Suggest reasons for the differences in the patterns in the data.

....

....

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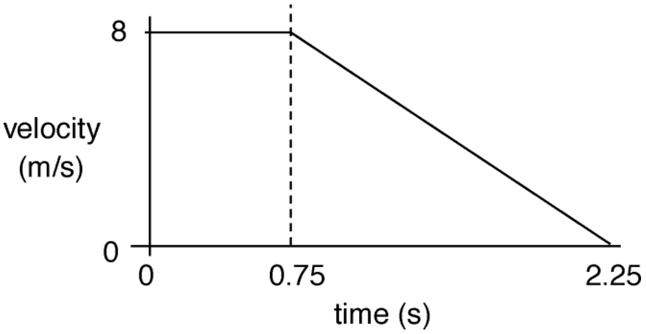
.... **[6]**

(b) The car takes 6 m to brake when moving at 8 m/s.

Look at the graph of a car travelling at 8 m/s, starting to brake and then stopping.



(i) Calculate the acceleration of the car during braking.
Show your working and state the units.

....

....

....

....

Answer = ………………………………… Unit = ...**[4]**

(ii) The car has a braking force of 5000 N.

Calculate the work done by the brakes on the car.

....

....

....

Answer = ………………………………… J **[2]**

(c) How is the braking distance affected if a driver is tired?

Explain your answer.

....

.... **[2]**

22 **(a)** A crowd makes a Mexican wave.

A Mexican wave **starts** with people lifting and lowering their arms.

The Mexican wave **continues** by people, next to them, lifting and lowering their arms.

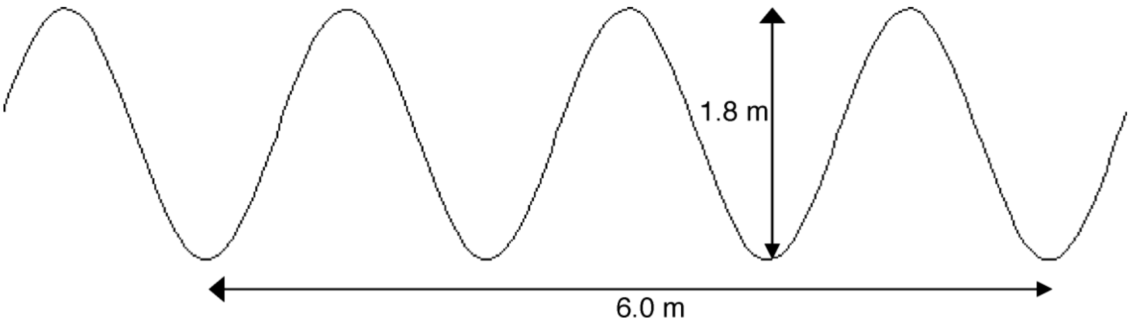
Why is a Mexican wave an example of a transverse wave?

....

.... **[1]**

(b) In the classroom a teacher demonstrates waves using a rope.

Look at the diagram of the wave.



(i) The frequency of the wave is 2 Hz.

What does this statement mean?

....

.... **[2]**

(ii) How many seconds will it take for this wave to travel 12 m?

Show your working.

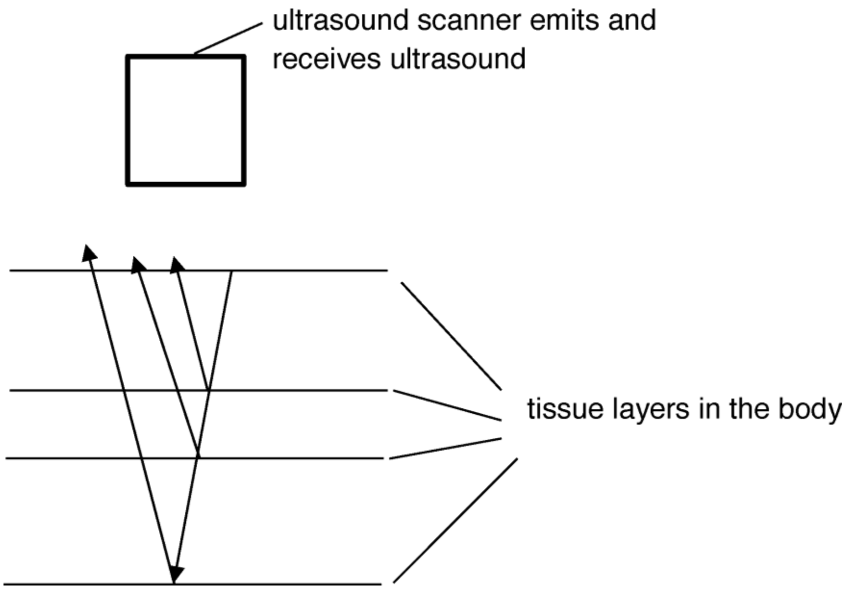
....

....

....

Answer = ... seconds **[3]**

(c) Ultrasound scans are used to produce images of tissues inside the body.



Ultrasound waves are emitted.

The waves reflect from layers of tissue inside the body.

Explain how the reflections are used to produce an image of the tissues.

....

....

....

....

.... **[3]**

(d) Ultrasound and X rays are used to scan patients in hospitals.

Complete the table to show a medical use, benefit and risk of using these waves to scan patients.

Wave	Medical use	Example of a benefit	Risk
X-rays	Shows up hard tissues inside the body.	Takes images of broken bones.	Damages living cells by causing: ....
Ultrasound	....	....	None

[3]

23 A car on a roller coaster is stationary at the top of a slope.

The car has a weight of 6 500 N and a potential energy of 217 000 J.

(a) Calculate the car's height above the ground.

....

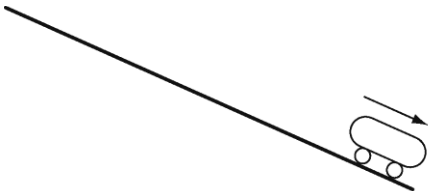
....

....

....

Answer = ... m **[2]**

(b) The diagram shows the roller coaster car moving down a slope.



The energy at the bottom of the slope is lower than expected.

Suggest **two** ways to improve the efficiency of the roller coaster car.

....

....

.... **[2]**

END OF QUESTION PAPER

Summary of updates

Date	Version	Details
October 2021	2.1	Updated copyright acknowledgements.

F

…day June 20XX – Morning/Afternoon

GCSE (9–1) Physics A (Gateway Science)
J249/02 Paper 2 (Foundation Tier)

SAMPLE MARK SCHEME

Duration: 1 hour 45 minutes

MAXIMUM MARK 90

This document consists of 20 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, concentrating on features that make it a stronger or weaker answer using the indicative scientific content as guidance. The indicative scientific content 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 science content of the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer using the guidelines described in the level descriptors in the mark scheme.

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 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.

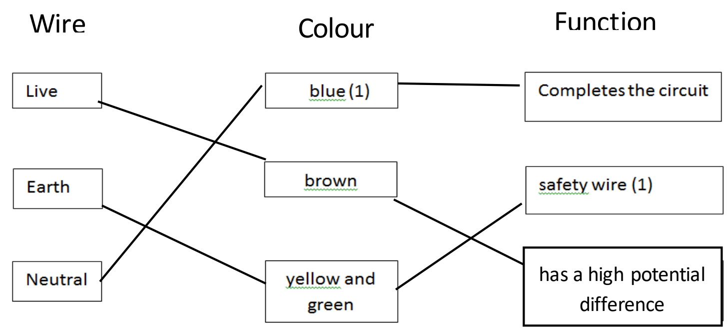
The breakdown of Assessment Objectives for GCSE (9–1) in Physics A:

	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	A	1	1.1	
2	A	1	1.1	
3	B	1	1.1	
4	D	1	1.2	
5	A	1	1.1	
6	C	1	1.1	
7	C	1	1.2	
8	C	1	1.1	
9	A	1	1.1	
10	C	1	2.1	
11	D	1	1.1	
12	C	1	2.1	
13	C	1	1.1	
14	C	1	2.1	
15	B	1	2.1	

SECTION B

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>16</td><td>(a)</td><td></td><td>more can be grown / AW (1)</td><td>1</td><td>1.1</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td><table><tr><th>Fuel</th><th>Type</th></tr><tr><td>Wood</td><td>renewable</td></tr><tr><td>Plant and vegetable oils</td><td>renewable</td></tr><tr><td>Peat</td><td>non-renewable</td></tr><tr><td>Coal</td><td>Renewable (x) (1)</td></tr><tr><td>North Sea gas</td><td>non-renewable</td></tr><tr><td>Uranium</td><td>renewable (x) (1)</td></tr></table></td><td>2</td><td>2 x 1.1</td><td>ALLOW the answer to be checked on the fuel side.</td></tr>
<tr><td></td><td>(c)</td><td></td><td>Increases output potential difference (1)</td><td>1</td><td>1.1</td><td></td></tr>
<tr><td></td><td>(d)</td><td></td><td>

Correct matching of wires to colours (1)

Correct matching of colours to functions (1)</td><td>4</td><td>4 x 1.1</td><td></td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
17	(a)		Reading would be very high (1)	1	3.2a	
	(b)	(i)	All points correctly plotted (within +/- half a square) (1) Smooth single curve (1)	2	2 x 1.2	
		(ii)	140 (1)	1	3.1b	**ALLOW** a tolerance of + / - 25
	(c)	(i)	Activity decreases (1) by a factor of 4 (1)	2	2 x 3.1b	
		(ii)	4000 scores (1)	1	3.2a	
	(d)		For A / solid • irradiation decreases with distance (1) • no contact with source so no contamination risk (1) For B / gas • gas can move so can be near person (1) • gas can be breathed in hence contamination (1)	4	 3.1a 2.2 3.1a 2.2	

Question			Answer	Marks	AO element	Guidance
18	**(a)**		Gravitational / centripetal (force) (1)	**1**	**1.1**	**ALLOW** 'gravity (1) Ignore 'weight force'
	(b)		Moon (1)	**1**	**1.1**	
	(c)		Recall weight = mass x gravitational field strength (1) Substitute: 185 x 3.75 (1) 694 to 3 sig.figs (2) N (1)	**5**	**1.1** **2.1** **2 x 2.1** **1.1**	 **ALLOW** 693.75 (1) but no marks for significant figures
	(d)		'g' is greater on Earth than Mars/weight is bigger as 'g' is greater on Earth (1)	**1**	**2.1**	

Question			Answer	Marks	AO element	Guidance
19	**(a)**		Oil will not freeze (as easily as water) / **ORA** (1)	**1**	**3.2b**	
	(b)		Reduces risk of burns to people / children (1)	**1**	**2.2**	
	(c)		Time conversion: 10 x 60 = 600 seconds (1) 800 x 600 / 480 000 (J) (1)	**2**	**1.2** **2.1**	**ALLOW** 480 (kJ)
	(d)	**(i)**	Substitute into formula for specific heat capacity / 10 x 40 x 1 700 (1) 680 000 (J) (1)	**2**	**2 x 2.1**	**ALLOW** 680 (kJ)
		(ii)	Any two from: Some energy used to heat the radiator case (rather than the oil) (1) Energy passed from oil to air in room / oil undergoes cooling whilst heating up (1) Energy is dissipated to surroundings (1) It is not 100% efficient at transferring energy (1)	**2**	**2 x 2.2**	

Question			Answer	Marks	AO element	Guidance
20	(a)		59 (anomalous result should be left out of calculation) (1)	1	1.2	
	(b)		28 (1)	1	3.1b	
	(c)		Green results unreliable / large variation / anomalous result (1) Should have repeated 31 (green) reading/other results (red, blue, white, yellow) are reliable (1) A sensible suggested improvement (1)	3	3.1b 3.3a 3.3b	e.g. use camera to measure bounce heights (1)
	(d)	(i)	bounce height/ drop height x 100% = 85% useful, therefore 15% wasted. (1) transferred to heat and sound (1)	2	2 x 2.1	
		(ii)	If the bounce height was greater then the efficiency would be higher / **ORA** (1)	1	2.1	
	(e)		Any 2 from: (Moving) ball has KE (1) Ball heats up (1) Some energy lost as heat to surroundings/ moving air/particles in floor (1)	2	2 x 2.2	

Question			Answer	Marks	AO element	Guidance
21	(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)** **Mathematical comparisons made and an explanation provided suggesting why the thinking distance does not increase at the same rate as the braking distance.** *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)** **Both distances calculated AND a simple description of the patterns shown in the thinking or braking distance.** *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)** **Both distances calculated OR a simple description of the patterns shown in the thinking or braking distance.** *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.*	6	2 x 3.2b 2 x 3.1b 2 x 2.1	**AO3.2b: Mathematical comparisons made with suggestions of the difference in the rate of increase of thinking and braking distance** • Idea that the thinking distance and braking distance do not increase at the same rate • Suggestion that the thinking distance is dependent on reaction time which is constant • Braking distance is effected by speed of the car as it will have more KE (energy $\propto v^2$) and will require more energy to stop **AO3.1b: Analysis of data in the completed table to describe the patterns shown** • When speed doubles thinking distance doubles • When speed doubles braking distance quadruples • Reference to how this effects the overall stopping distance

Question			Answer	Marks	AO element	Guidance
						AO2.1: Apply knowledge of braking distances • Total stopping distance at 16m/s = 36m • Thinking distance at 32m/s = 24m • Idea that as speed increases so does the thinking/braking/stopping distance
	(b)	**(i)**	Use of graph to calculate time / t = 2.25 – 0.75 / t = 1.5 (1) Substitution into acceleration formula: 8 / 1.5 (1) (-) 5.3 (1) m/s^2 (1)	**4**	**2.2** **2.1** **2.1** **1.1**	
		(ii)	5 000 x 6 (1) 30 000 (J)	**2**	**2 x 2.1**	
	(c)		No effect (1) Braking distance is not effected by the driver / braking distance is only based on the car and road conditions (1)	**2**	**2 x 1.1**	

Question			Answer	Marks	AO element	Guidance
22	(a)		Arms move at 90º to wave direction / **AW** (1)	1	2.1	e.g. arms move at right angles to the wave (1)
	(b)	(i)	2 waves pass the same point (1) each second (1)	2	2 x 1.1	
		(ii)	Use of velocity = frequency x wavelength / 2 x 2 (1) 4 m/s scores (1) 12/4 = 3 s scores (1)	3	1.2 2.1 2.1	**ALLOW** use of speed = distance/time to calculate final answer
	(c)		Either: Reflections return at different times / **AW** (1) **OR** speed of ultrasound is known / **AW** (1) **AND** Times indicate depth (of tissue boundaries) / **AW** (1) Depth can be calculated by speed x time (1)	3	 1.1 2 x 2.1	
	(d)		1st column: shows up soft tissues / **AW** (1) 2nd column: pregnancy scans / **AW** (1) 3rd column: mutations / damage to DNA (1)	3	1.1 2.2 1.1	 **ALLOW** other uses of scans e.g. scanning tissues other than bones (1) **ALLOW** cancer (1)

Question			Answer	Marks	AO element	Guidance
23	**(a)**		Re-arrange and substitute into WD = F x D: 217 000 / 6 500 (1) 33 (m) (1)	**2**	**2 x 2.1** **2.1** **2.2**	**ALLOW** 33.4 (m)
	(b)		Reduce the friction between the car and track/lubrication of wheel bearings (1) Make the shape of the car more streamlined to reduce drag (1)	**2**	**2 x 3.3b**	

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

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