OCR
Oxford Cambridge and RSA

Accredited

GCSE (9–1) Physics A (Gateway Science)
J249/04 Paper 4 (Higher tier)
Sample Question Paper

H

Date – Morning/Afternoon
Time allowed: 1 hour 45 minutes

You must have:
- the Data Sheet

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

* 0 0 0 0 0 0 *

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 **28** pages.

SECTION A

Answer **all** the questions.

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

1 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%	3 J
B	10%	27 J
C	90%	3 J
D	90%	27 J

Your answer ☐

[1]

2 A boy kicks a football.

The football has a mass of 400 g.

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

Use the constant: 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]

3 The National Grid transfers energy efficiently using high voltages.

Why are high voltages more efficient?

A High voltages produce a high current which heats wires less.

B High voltages produce a low current which heats wires more.

C High voltages produce a high current which heats wires more.

D High voltages produce a low current which heats wires less.

Your answer

[1]

4 Which statement describes nuclear fusion?

A Two hydrogen nuclei join to form a helium nucleus.

B A helium nucleus joins with a hydrogen nucleus to form an alpha particle.

C Uranium nuclei split and produce high energy neutrons causing a chain reaction.

D Two helium nuclei join to form a hydrogen nucleus.

Your answer

[1]

5 Which row correctly describes the domestic electricity supply in the UK?

	a.c. or d.c.	**frequency (Hz)**	**voltage (V)**
A	a.c.	50	230
B	a.c.	230	50
C	d.c.	50	230
D	d.c.	230	50

Your answer

[1]

6 What is a typical weight of an empty single decker school bus?

A 1 200 N

B 12 000 N

C 120 000 N

D 1 200 000 N

Your answer ☐

[1]

7 How was the Sun formed?

A From dust and gas pushed together by gravity leading to a fission reaction.

B From dust and gas pulled together by gravity leading to a fusion reaction.

C From dust and gas pushed together by gravity leading to a fusion reaction.

D From dust and gas pulled together by gravity leading to a fission reaction.

Your answer ☐

[1]

8 An element has more than one isotope.

Which correctly describes the atoms of all isotopes of this element?

	Numbers of electrons	**Numbers of protons**	**Numbers of neutrons**
A	different	different	different
B	same	different	different
C	same	same	different
D	same	different	same

Your answer ☐

[1]

9 The most abundant form of radium is radium-226.

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

Which is an **isotope** of radium?

A nuclear mass 226; 137 neutrons

B nuclear mass 226; 139 neutrons

C nuclear mass 227; 138 neutrons

D nuclear mass 227; 139 neutrons

Your answer

[1]

10 A sound wave travels from water into air.

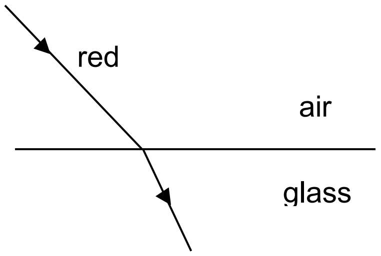
Its wavelength in air is longer than in water.

How do the frequency and speed of the wave in air compare with their values in water?

	Frequency in air	**Speed in air**
A	higher	faster
B	higher	same
C	same	faster
D	same	same

[1]

11 Red light refracts when it enters glass from air because its speed changes.



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 red.

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

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

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

Your answer

[1]

12 Which row **increases** the efficiency of a machine?

	increase energy losses due to friction	**increase** the work output without changing the work input
A	Yes	yes
B	Yes	no
C	No	no
D	No	yes

Your answer

[1]

13 A hockey player used pads on her legs to reduce injuries when hit by the ball. How do the pads affect the ball?

A The acceleration and force of the ball is reduced.

B The acceleration of the ball is increased and the force is decreased.

C The acceleration of the ball is decreased and the force is increased.

D The acceleration and force of the ball is increased.

Your answer ☐

[1]

14 Radium-226, $^{226}_{88}Ra$, decays to become radon-222, $^{222}_{86}Rn$.

What is emitted when a nucleus of radium-226 decays?

A a beta particle

B an alpha particle

C four neutrons

D four protons

Your answer ☐

[1]

15 A radioactive source has a half-life of 80 s.

How long will it take for $^{7}/_{8}$ of the source to decay?

A 10 s

B 70 s

C 240 s

D 640 s

Your answer ☐

[1]

Section B

Answer **all** the questions.

16 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.

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

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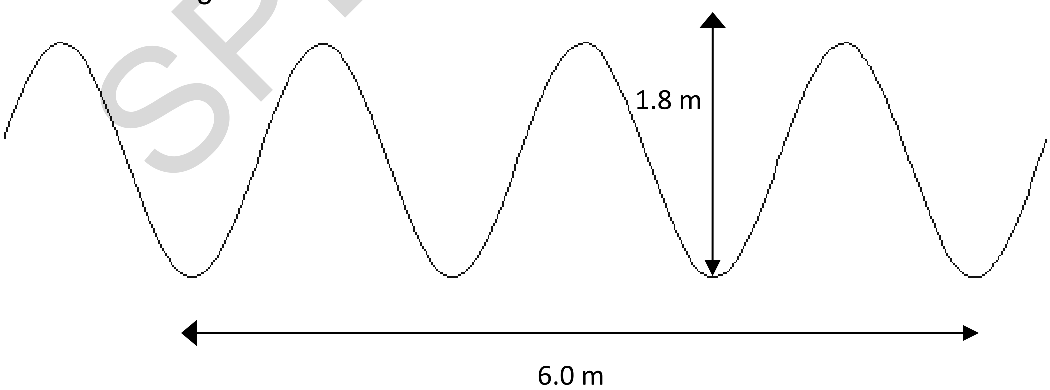
……………………………………………………………………………………………………… **[1]**

(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 this wave to travel 12 m?

Show your working.

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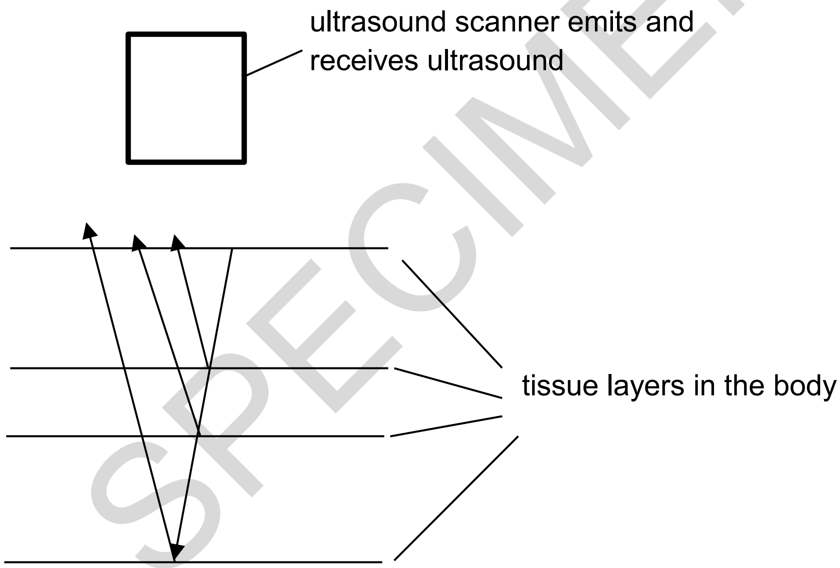
answer: .... seconds **[3]**

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



Ultrasound waves are emitted.

They reflect from layers of tissue inside the body.

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

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.... **[3]**

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

Complete the table to show a medical use, benefits 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]

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

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

(a) Calculate how high above the ground it is.

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answer: ………………m **[2]**

(b)

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

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

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

18 The information below shows information on radioactive isotopes.

Radioactive isotope	**Type of radiation**	**Half-life**	**Penetration through human flesh**
A	alpha	300 years	2mm
B	beta	7 hours	60mm
C	gamma	7 hours	> 10m
D	alpha	9 seconds	2mm
E	gamma	3 years	> 10m

(a) A doctor injects a patient with isotope **C** to track blood flow through the body.

Use the data to suggest why the doctor uses isotope **C**.

....

.... **[1]**

(b) A doctor implants radioactive isotope **A** into a patient to treat a localised cancer which is a few mm in size.

She intends to remove the isotope in a few weeks.

Use the data to suggest **two** reasons why the doctor uses isotope **A**.

....

.... **[2]**

(c) A doctor wants to irradiate a tumour using gamma rays.

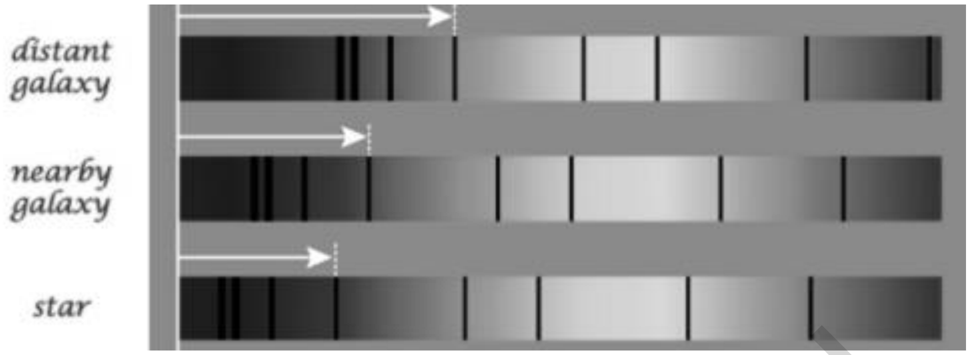
Why does the activity of the source need to be checked before it is used on a patient?

....

.... **[2]**

19* Scientists collect evidence from the universe and develop theories to explain their observations.

Here are three absorption spectra showing red shift. The white arrows show the relative position of the same band in the absorption spectra of a star, a nearby galaxy and a distant galaxy.



Using your knowledge of red shift, describe how the information in the diagrams supports the idea of the Big Bang model.

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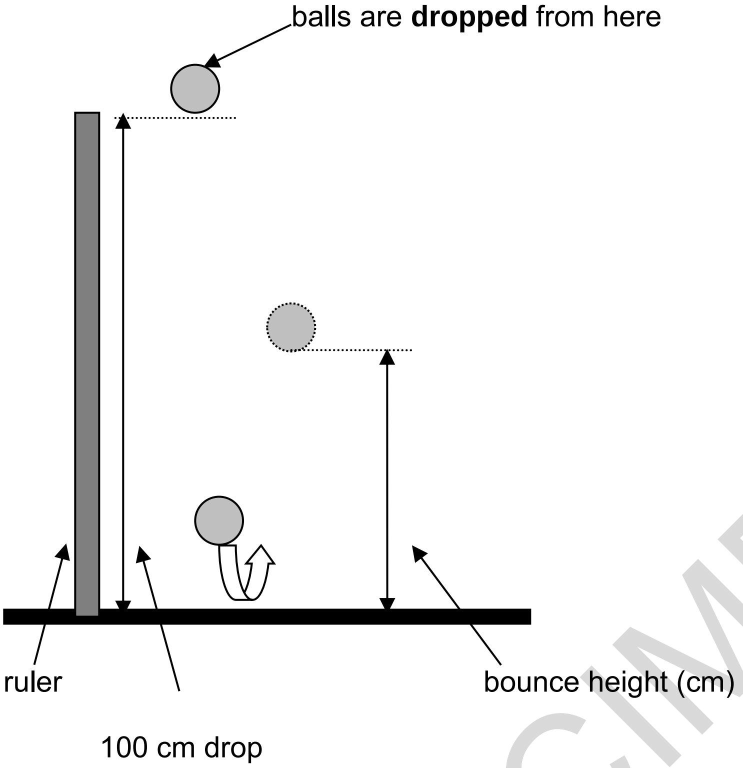
…………………………………………………………………………………………………… **[6]**

20 Kate investigates how well different balls bounce.

She drops different balls from the same height and measures the height the balls bounce.

She repeats the experiment 3 times for each ball.



Her results are shown in the table.

Ball	Drop height (cm)	1st reading bounce height (cm)	2nd reading bounce height (cm)	3rd reading bounce height (cm)	Mean bounce height (cm)
blue	100	61	62	60	61
green	100	60	31	59	50
white	100	84	86	85	85
yellow	100	26	24		26

(a) Kate forgot to record one of the results for the **yellow** ball.

Suggest the value of the **missing** result.

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……………………………………………………………………………………………..

answer: ……………………… cm

[1]

(b) Josh does an experiment with bouncing balls.

He does his experiment with a drop height of **200 cm**.

One ball bounces **100** cm.

Josh says that this ball is a better bouncer than any of Kate's.

Use the data and ideas about efficiency to explain why Josh is incorrect.

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……………………………………………………………………………………………… **[2]**

(c) Josh uses a new ball. He says this ball is an amazing bouncer.

He says if you drop it from **200** cm it will bounce to a height of **250** cm.

Explain why this is not possible.

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

21 Alex has two radiators in her home. They are filled with 10 kg of different liquids.

The radiators have different power ratings.

oil-filled radiator	**water-filled radiator**
 **Heater contains 10 kg of oil** **400 W heater** **Specific heat capacity for oil is 1680 J/kg^{0}C**	 **Heater contains 10 kg of water** **1000 W heater** **Specific heat capacity for water is 4200 J/kg^{0}C**

(a) The heaters are turned on and the temperature of each rises by 40 ºC in 1 680 seconds.

Use the data to show that the heaters take the same time to heat up.

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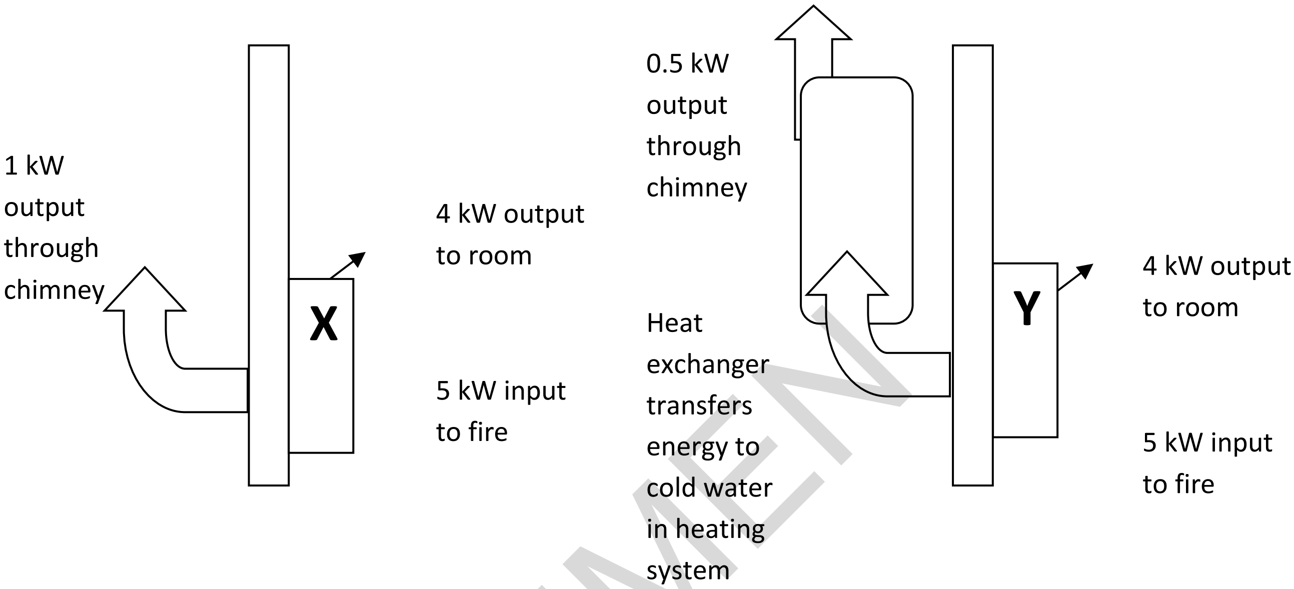
.... **[4]**

(b) Alex has two fires in her home, **X** and **Y** shown in the diagrams below.



Why does Fire **Y** helps save money on the energy bills for her home?

Use calculations of efficiency in your answer.

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.... **[4]**

22 **(a)** State **two** features of a satellite in a **polar orbit**?

Suggest a use for a satellite in a polar orbit.

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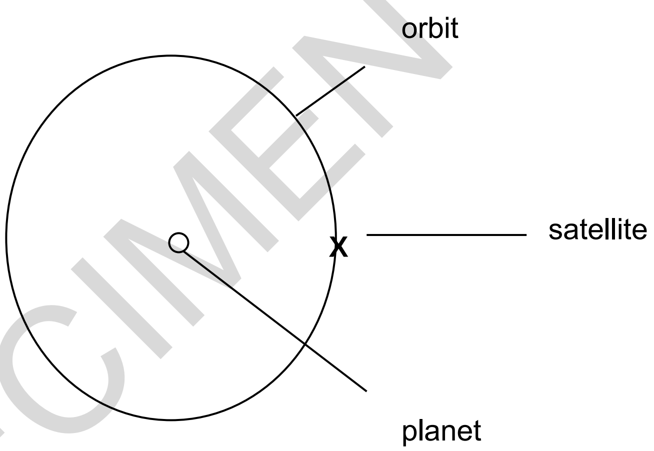
……………………………………………………………………………………………………… **[3]**

(b) An artificial satellite (**X**) is kept in a stable circular orbit around a planet by a centripetal force caused by gravity.



(i) Explain how the velocity of a satellite is constantly changing whilst its speed remains the same when it is in orbit.

………………………………………………………………………………………………

……………………………………………………………………………………………… **[2]**

(ii) The satellite is remotely controlled from Earth.

The scientists want the satellite to move slower.

What effect will this change in speed have on the height of its orbit?

Explain your answer.

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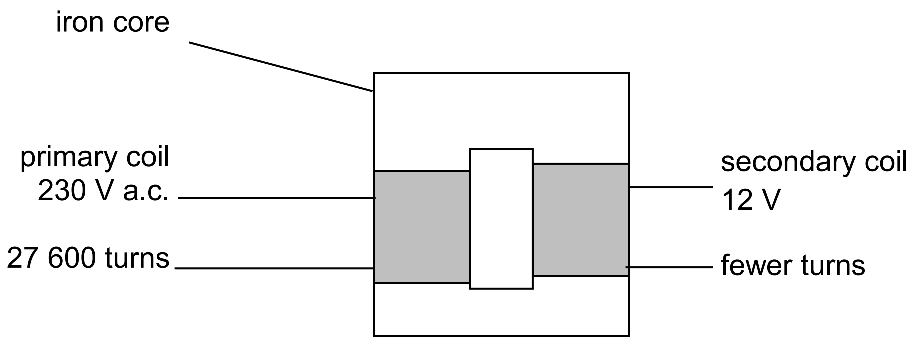
.... **[2]**

23 The diagram below shows the structure of a transformer.



(a) Explain why there is more alternating current in the secondary coil than in the first.

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.... **[3]**

(b) The secondary coil produces an output of 12 V.

Calculate the number of turns needed on the secondary coil.

Show your working.

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.... **[2]**

(c) Voltage is increased before transmission through the National Grid.

It is increased from 25 000 V up to 400 000 V. This increases the voltage 16 times.

(i) How much would this increase in voltage affect the current?

……………………………………………………………………………………

…………………………………………………………………………………… **[2]**

(ii) Use the formula: **power = current^2 x resistance**

to explain why this voltage increase is important to power loss in transmission cables.

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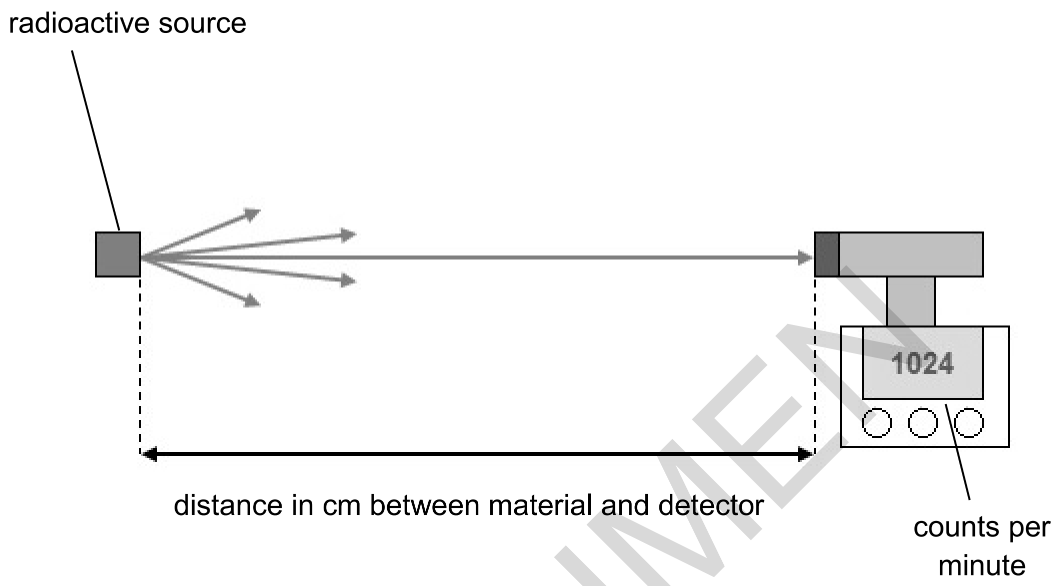
…………………………………………………………………………………… **[2]**

24 Matt experiments with radioactive materials.

He investigates how the activity of radiation changes with distance.

The radiation moves from the source to the detector.

He measures the counts per minute from a radioactive source.



The table shows the results from the experiment.

Distance between the source and the detector (cm)	**Count rate (counts per minute)**
10	1024
20	256
40	64
80	16

(a) Describe using the data in the table how the count rate changes as the detector is moved away from the source.

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……………………………………………………………………………………………… **[2]**

(b) Matt does two further readings at 160 cm and 320 cm.

His results are in the table below.

Distance between the source and the detector (cm)	**Count rate (counts per minute)**
10	1024
20	256
40	64
80	16
160	**6**
320	**0**

As the distance is increased to 160 cm and 320 cm the results do not follow the same pattern as the other results.

What do you think these results should have been?

Explain the anomalies in the last two results.

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.... **[3]**

(c) Gamma radiation is used to irradiate cancers in the brain.

Treatment is given for 15 minutes every 4 days.

Each patient receives a certain dose of radiation.

gamma source is rotated 360^0 around the head.

patient remains still during treatment.

Explain how this treatment reduces damage to healthy cells.

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.... **[4]**

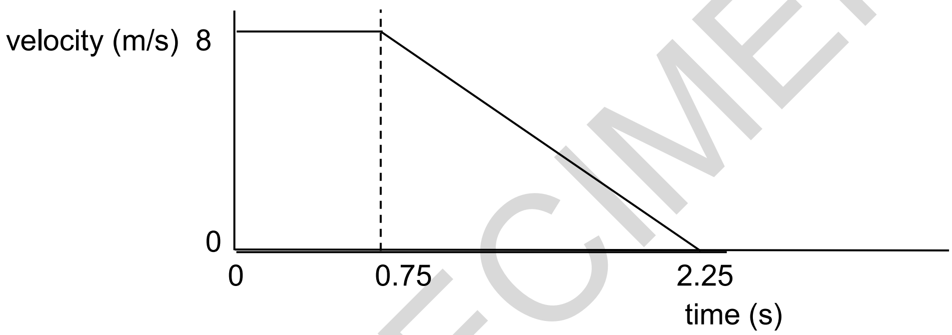
25 The table shows the stopping distances for a car.

Speed of car (m/s)	Thinking distance (m)	Braking distance (m)	Total stopping distance (m)
4	3	1.5	4.5
8	6	6	12
16	12	24	36
32	24		

(a) Use the data given to fill in the information missing at a speed of 32 m/s. **[2]**

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

Look at the graph of the car as it starts to brake and then stopping.



Use the graph to show that the braking distance is 6 m.

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………………………………………………………………………………………… **[2]**

(c) The formula to work out kinetic energy is:

kinetic energy = 0.5 x mass x (velocity^2)

A car has 30 000 J of energy and a mass of 1 tonne (1 tonne = 1 000 kg).

Calculate the velocity of the car and show your working.

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answer: ……………… m/s **[2]**

(d) Cars and lorries have different brakes.

Brakes absorb the energy of the vehicle before it comes to rest.

The brakes on lorries have larger brake discs and brake pads than cars.

Brakes are designed for increased air flow.

Explain why this is more important for lorries than cars.

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.... **[4]**

END OF QUESTION PAPER

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…day June 20XX – Morning/Afternoon

GCSE (9–1) Physics A (Gateway Science)
J249/04 Paper 4 (Higher Tier)

SAMPLE MARK SCHEME

Duration: 1 hour 45 minutes

H

MAXIMUM MARK 90

DRAFT

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

SECTION B

Question			Answer	Marks	AO element	Guidance
16	(a)		Arms move at 90^0 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 (1) 12/4 = 3 s (1)	3	1.2 2.1 2.1	**ALLOW** use of speed = distance/time to calculate final answer
	(c)		Any one from: Reflections return at different times / **AW** 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
17	(a)		Re-arrange and substitute into WD = F x D: 217 000 / 6 500 (1) 33.4 (m) (1)	2	2 x 2.1	
	(b)		Reduce the friction between the car and track/lubrication (1) Make the shape of the car more streamlined to reduce drag (1)	2	2 x 3.3b	
18	(a)		Any one from: Gamma can get out of body / least amount of time to do damage to the body / reasonable half-life (1)	1	3.1b	
	(b)		Any two from: Alpha has short range (1) Highest ionising power (1) Longer half-life than D (1)	2	2 x 3.1b	
	(c)		To check the activity / intensity / strength of the isotope (1) Idea that the activity will be continually falling so needs to be monitored (1)	2	2 x 2.2	

Question			Answer	Marks	AO element	Guidance
19*			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)** **Interpretation of the diagram and how it provides evidence for an expanding universe and the Big Bang model** *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)** **Description of red shift AND recognition of what the red shift diagram indicates relating to the Big Bang model** *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 description of the Big Bang model OR redshift** *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* **0 marks** *No response or no response worthy of credit*.	6	3 x 3.2b 3 x 1.1	**AO3.2b: Analyse the diagram to conclude how it provides evidence for an expanding universe and the Big Bang model** • The further away a galaxy is the more red shifted it is indicating an expanding universe • If galaxies are moving away then the universe must be expanding • If whole universe is expanding then it must have started from a certain point – the singular point where the Big Bang occurred • More distant galaxies are more red shifted than stars that are closer • Distant galaxies show the lines moving towards the red end of the spectrum • Dark bands are moving towards the red end of the spectrum **AO1.1: Description of evidence linking red shift to the Big Bang model** • Red shift is caused by a change in frequency/wavelength of light • Description of the changes in frequency and wavelength of light from distant galaxies • Red shift shows galaxies moving away.

Question			Answer	Marks	AO element	Guidance
20	(a)		28 (1)	1	3.1a	
	(b)		(Josh's is only) 50% efficient / AW (1) And any one from: (Kate's) red is 76% efficient (1) Blue is 61% efficient (1) White is 85% efficient (1)	2	2 x 3.1b	
	(c)		Idea there is fixed energy in system/can't be (more than) 100% efficient (1) Idea that extra energy is heeded for this to happen (1)	2	1.1 2.2	
21	(a)		Energy for oil is 672 000 (J) (1) Energy for water is 1 680 000 (J) (1) Recall P=E/t (1) Calculation to show: 672 000 / 400 = 1680 AND 1680000 / 1000 = 1680 (1)	4	2.2 2.2 1.1 2.1	
	(b)		Half of the (previously) wasted power or energy / 0.5 kW is being used to heat water (1) Less energy needed from other sources to heat water (1) Fire X is (4/5 x 100% =) 80% efficient (1) Fire Y is (4.5/5 x 100% =) 90% efficient (1)	4	2.2 2.2 1.2 1.2	**ALLOW** some energy from fire now used to heat water scores (1)

Question			Answer	Marks	AO element	Guidance
22	(a)		Any two features from: Polar orbit travels over both poles (1) Travels faster than a geostationary satellite (1) Multiple orbits in a day (1) Lower orbit than geostationary satellites(1) Any one use from: Mapping/weather/surveillance (1)	**3**	**3 x 1.1**	
	(b)	(i)	Velocity is speed in a given / known direction / straight line (1) Direction continuously changing (1)	**2**	**2 x 1.1**	**ALLOW** higher level answers e.g. changing velocity denotes acceleration (1) Always accelerating to the centre (1)
		(ii)	Higher orbit (1) Less (force of) gravity / acceleration (1)	**2**	**2 x 1.1**	

Question			Answer	Marks	AO element	Guidance
23	(a)		Fewer coils in the secondary coil (1) Means it induces less potential difference in secondary coil (1) More current induced as power in constant (1)	3	3 x 1.1	
	(b)		$\frac{230}{27600} = \frac{12}{X}$ (1) **OR** $\frac{230 \times 12}{27600}$ / **AW** (1) 1 440 (turns) (1)	2	1.2 2.1	
	(c)	(i)	Simple use of P = V x I / idea of ratios using transformer equations (1) Current reduced by 16 times (1)	2	1.2 2.1	**ALLOW** current reduced (1)
		(ii)	Very large decrease in power loss (1) Power loss is related to the square of the current / **AW** (1)	2	3.1b 2.1	

Question			Answer	Marks	AO element	Guidance
24	(a)		Distance doubles count rate is 4 x less / count rate is inversely proportional to the square of the distance / as distance triples activity is 9 x less / **AW** (2)	2	2 x 3.1b	**ALLOW** distance doubles count rate per minute is reduced by more than half (1)
	(b)		If the pattern was followed, 160 cm (ideally) should be 4 / 320 cm (ideally) should be 1 (1) Radiation / activity is random (1) Randomness is amplified at low readings / **AW** (1)	3	3.2a 3.2b 3.2b	
	(c)		Any four from: 4 days between treatments allows healthy cells to be repaired or replaced (1) Size of dose related to the mass of the patient / age of patient / size of tumour / nature of tumour (1) Rotation of source reduces damage to healthy cells (1) BUT rotation of source reduces damage to healthy as time of exposure is shorter (1) Patient remaining still will reduce the damage to healthy cells (1)	4	4 x 2.2	

Question			Answer	Marks	AO element	Guidance
25	(a)		(32) 24 **96** (1) **120** (1)	2	1.2 3.1b	
	(b)		Correct reference or attempt to use area under sloping part of graph (1) $\frac{8 \times 1.5}{2} = 6$ (1)	2	2 x 1.2	**ALLOW** full marks for correct calculation as this implies correct use of area under sloping part of graph.
	(c)		KE formula re-arranged and numbers substituted correctly / √30 000/ (0.5 x 1 000) (1) 7.75 (m/s) (1)	2	2 x 2.1	
	(d)		Lorry has more KE than a car at the same velocity (1) More absorption of energy by larger brake discs (1) Higher rate of dissipation of energy to surrounding air (1) Brakes less likely to overheat (1)	4	4 x 2.1	