OCR
Oxford Cambridge and RSA

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Friday 14 June 2019 – Morning

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

J250/12 Paper 12 (Higher Tier)

Time allowed: 1 hour 10 minutes

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You must have:
- a ruler (cm/mm)
- the Data Sheet (inserted for GCSE Combined Science (Physics) A)

You may use:
- a scientific or graphical calculator
- an HB pencil

J250120

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- The Data Sheet will be found inside this document.
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Answer **all** the questions.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided. If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.

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.

Write your answer to each question in the box provided.

1 Radioactive elements can contaminate or irradiate objects.

Which statement describes irradiation?

A Radiation from outside your body travels into your body.

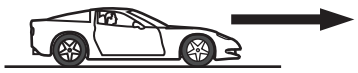
B Radioactive material is on the skin.

C Radioactive material is breathed in.

D Radioactive material is eaten.

Your answer ☐ **[1]**

2 A car is accelerated by a constant force on a level road.



Which row of the table describes how energy is transferred as the car accelerates?

	Store that empties	Stores that fill
A	chemical	kinetic and elastic
B	chemical	kinetic and thermal
C	gravitational	thermal and kinetic
D	kinetic	thermal and chemical

Your answer ☐ **[1]**

3 A car goes faster.

What effect does this have on thinking distance and braking distance?

	Thinking distance	Braking distance
A	increases	increases
B	increases	no effect
C	no effect	increases
D	no effect	no effect

Your answer ☐ **[1]**

4 A student uses a stopwatch to time water waves. The stopwatch always starts from 0.5 s and does not go back to zero.

What is this type of error called?

A Hypothesis error

B Precision error

C Random error

D Systematic error

Your answer ☐ **[1]**

5 A hairdryer is connected to the mains with only two wires.

Why will this hairdryer operate and be safe to use?

A The wires are earth and neutral and the hairdryer is insulated.

B The wires are earth and neutral and the plug has a fuse.

C The wires are live and earth and the plug has a fuse.

D The wires are live and neutral and the hairdryer is insulated.

Your answer ☐ **[1]**

6 Which statement is **true** for isotopes of the same element?

N_p = number of protons and N_n = number of neutrons.

A $N_p = N_n$

B N_p is the same but N_n is different

C N_p is always greater than N_n

D The total ($N_p + N_n$) is always the same

Your answer ☐ **[1]**

7 For how long can you use a 2 kW electrical heater with 1 kWh of energy?

A 0.0005 hours

B 0.5 hours

C 2 hours

D 2000 hours

Your answer ☐ **[1]**

8 An astronaut lifts a 0.3 kg hammer 1.7 m above the surface of the Moon.

The hammer gains 0.82 J of potential energy.

Calculate the gravitational field strength on the Moon.

Use the equation: potential energy = mass × height × gravitational field strength

A 0.0016 N / kg

B 0.22 N / kg

C 0.42 N / kg

D 1.61 N / kg

Your answer ☐ **[1]**

9 Beryllium-13 ($^{13}_{4}Be$) is a radioactive isotope.

This is the equation for the decay of beryllium-13.

$^{13}_{4}Be \longrightarrow {}^{12}_{4}Be + \mathbf{X}$

What is **X**?

A An alpha particle

B A beta particle

C A gamma ray

D A neutron

Your answer ☐ **[1]**

10 A car travels at 80 km / h. The stopping distance is 50 metres.

Calculate the deceleration of the car.

A $2\,m/s^2$

B $5\,m/s^2$

C $10\,m/s^2$

D $16\,m/s^2$

Your answer ☐ **[1]**

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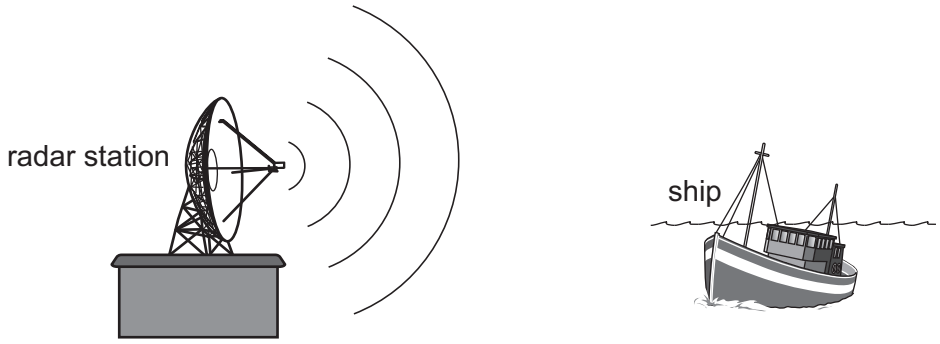
SECTION B

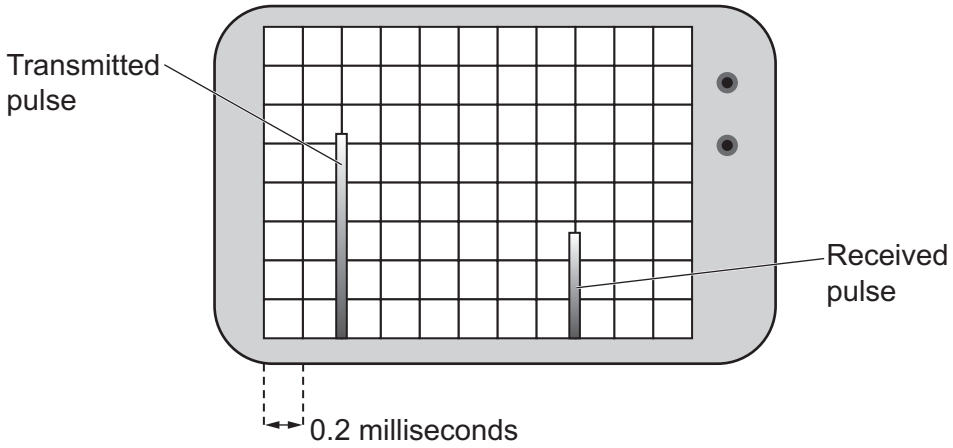
Answer **all** the questions.

11 Radar stations can be used to find out where ships are.



At a radar station:
- a radar transmitter transmits pulses of microwaves
- the pulses are reflected by the ship
- a radar receiver detects the pulses.

(a) The diagram shows the radar signals on an oscilloscope screen:



(i) Calculate the time taken between the pulse being transmitted and received.

Time taken = ... ms **[1]**

(ii) A radar signal is sent from the radar station. The signal reflects off the ship and is detected 0.0006 s later.

The speed of the microwaves is 3.0×10^8 m / s.

Calculate the distance of the ship from the radar station.

Use the equation: distance travelled = speed × time

Distance = ... m **[2]**

(iii) The amplitude of the received pulse is lower than the transmitted pulse.

Suggest why.

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

(b) Radar stations use microwaves with a frequency of 200 MHz.

The speed of the waves is 3.0×10^8 m / s.

Calculate the wavelength of these waves.

Wavelength = ... m **[4]**

12 This question is about radioactive decay.

A teacher models radioactive decay using 100 dice:

- she shakes a beaker containing 100 dice and empties the dice into a tray
- every time a number "6" lands face up, she removes that dice
- she places the remaining dice in the beaker and repeats the process.

Here are some of the results from this experiment.

Number of throws	Number of dice removed				Number of dice remaining
	Attempt 1	Attempt 2	Attempt 3	Mean	
1	16	18	17	17	83
2	15	14	14	14	69
3	10	12	11	11	58
4	10	9	10	10	48
5	8	9	7	8	40

(a) Describe the difference between **mean**, **mode** and **median**.

In your answer use data from the second throw in the table (shaded in grey).

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

(b) Use the table to estimate the half-life of the dice.

Give your answer to the **nearest whole number**.

Half-life = ... throws **[1]**

13 This question is about different types of radiation.

(a) An isotope emits one type of radiation. It could be alpha, beta or gamma.

Describe how a teacher could show the type of radiation emitted using school equipment.

You may include a diagram in your answer.

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

(b) Sometimes atoms emit radiation even if they are **not** radioactive. This radiation does **not** come from the nucleus.

(i) Describe how these atoms can emit radiation.

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

(ii) What type of radiation is emitted?

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

14 Electricity can be produced in a power station.

(a) Explain the difference between **renewable** and **non-renewable** energy sources.

Give **one** example of each energy source to help explain your answer.

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

(b) The national grid transfers energy from power stations to consumers.

Explain how the national grid transfers energy in an efficient way.

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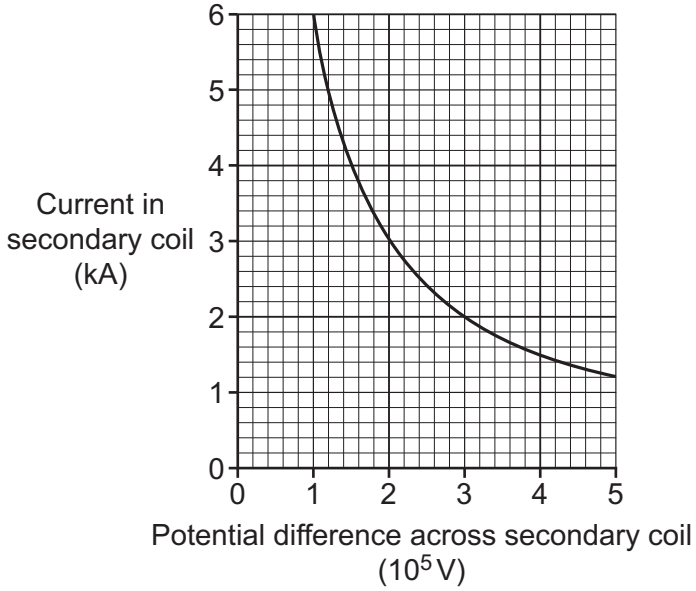
(c) This graph shows current and potential difference for the secondary coil of a transformer.



The potential difference across the primary coil is 160 000 V.
The current in the secondary coil is 2400 A.

Calculate the current in the primary coil of the transformer.

Use data from the graph in your calculations.

Current in primary coil = ... A **[3]**

15 A student refracts light with a rectangular glass block.

He looks for a relationship between angle of incidence and angle of refraction.

(a) Suggest how the student completes this experiment and the apparatus he uses.

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

(b) The student needs to write a risk assessment for the experiment.

Complete the table to give **one** risk, the hazard it could cause and a control measure for the risk.

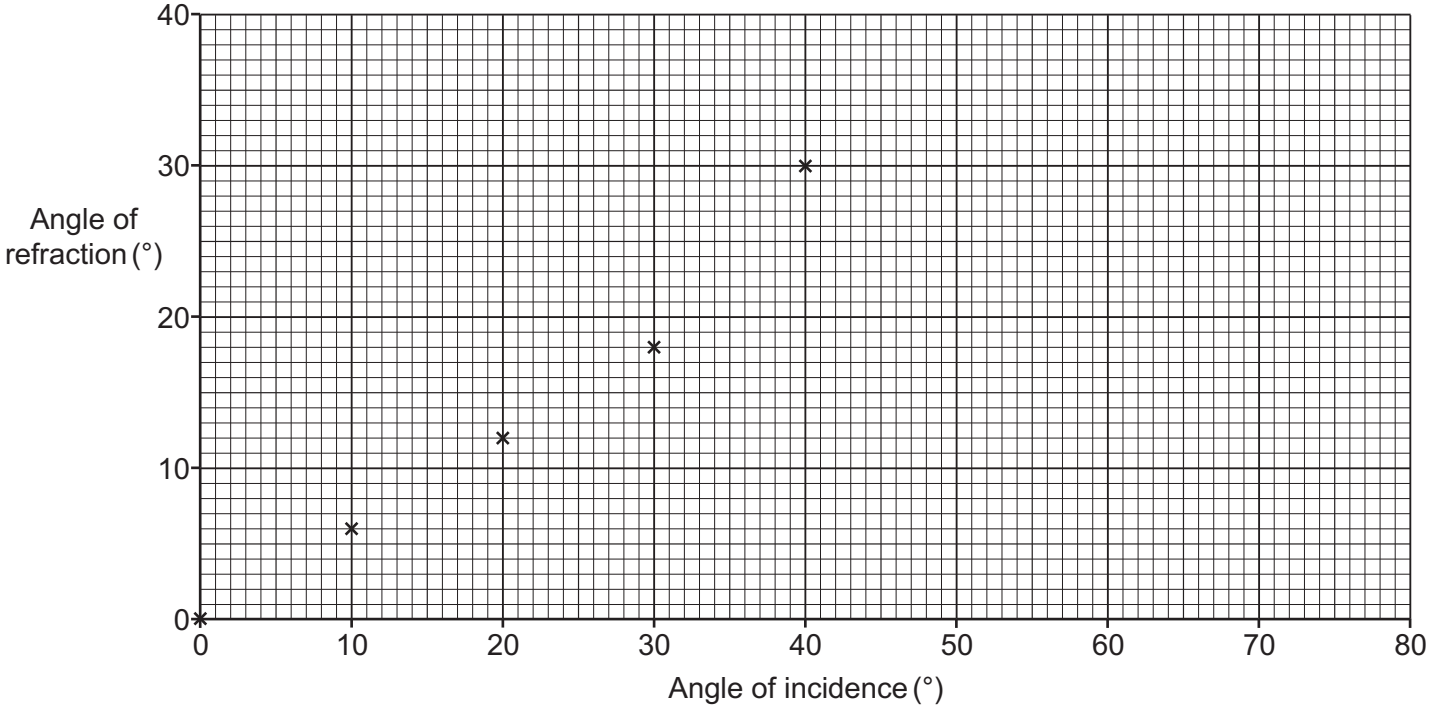
Risk	Hazard	Control measure

[2]

(c) The table shows the results from the experiment.

Angle of incidence (°)	Angle of refraction (°)
0	0
10	6
20	12
30	18
40	30
50	28
60	32
70	35

(i) Plot the results from the table on the axes below and draw a curve of best fit.
The first five points have already been plotted for you.



[2]

(ii) What could the student conclude from the graph?

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

(iii) The angle of refraction at 40° is incorrect.

Use the curve of best fit on the graph to estimate the actual angle of refraction at 40°.

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

(d) Another student uses red light in the experiment.

She then repeats the experiment with blue light.

Describe and explain the difference in the refraction of the red light and blue light.

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

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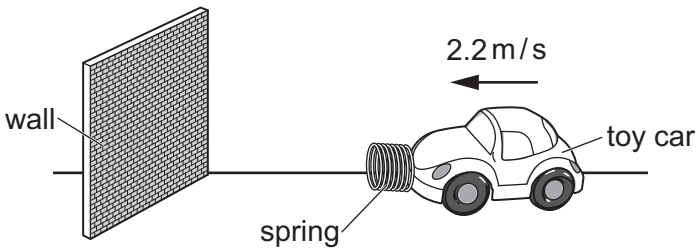
16 This question is about modelling crumple zones in cars.

A student models a crumple zone by adding a spring to the front of a toy car.
The spring compresses when the toy car hits a wall.



(a) Before the toy car hits the wall, its speed is 2.2 m / s.
The total mass of the toy car and spring is 500 g.

Show that the kinetic energy of the toy car and spring is about 1.2 J.

[3]

(b) The spring constant of the spring is 4200 N / m.

Calculate the change in the length of the spring when the toy car hits the wall.

Give your answer to **2** significant figures.

Change in length = ... m **[4]**

(c)* Evaluate the student's model of the crumple zone.

Include ideas about how crumple zones make cars safer in your answer.

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END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).