Paper Reference(s) 1SC0/1PH
Pearson Edexcel Level 1/Level 2 GCSE (9–1)

Combined Science

Paper 3
Higher Tier

Total Marks

Wednesday 20 May 2020 – Afternoon

Time: 1 hour 10 minutes plus your additional time allowance

In the boxes below, write your name, centre number and candidate number.

Surname					
Other names					
Centre Number					
Candidate Number					

Pearson

YOU MUST HAVE

Calculator, ruler

YOU WILL BE GIVEN

Equations Booklet

Diagram Booklet

INSTRUCTIONS

Answer ALL questions.

Answer the questions in the spaces provided – there may be more space than you need.

Calculators may be used.

Any diagrams may NOT be accurately drawn, unless otherwise indicated.

You must show all your working out with your answer clearly identified at the end of your solution.

INFORMATION

The total mark for this paper is 60.

The marks for EACH question are shown in brackets – use this as a guide as to how much time to spend on each question.

In questions marked with an ASTERISK (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

A list of equations is provided.

ADVICE

Read each question carefully before you start to answer it.

Try to answer every question.

Check your answers if you have time at the end.

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Look at Figure 1 for Question 1 in the Diagram Booklet.

A student lifts a toy car from a bench and places the toy car at the top of a slope as shown in Figure 1.

(a) Describe an energy transfer that occurs when the student lifts the toy car from the bench and places the toy car at the top of the slope. (2 marks)

(continued on the next page)

1 continued.

(b) The student lets the toy car roll down the slope.

Describe how the student could find, by experiment, the speed of the toy car at the bottom of the slope. (4 marks)

(continued on the next page)

1 continued.

(c) The student needs to develop the experiment to determine the loss in potential energy and the gain in kinetic energy as the toy car is rolling down the slope.

State the other measurements the student must make. (2 marks)

(continued on the next page)

1 continued.

(d) When the toy car rolls down the slope, some energy is transferred to the surroundings as thermal energy.

State how the student could calculate the amount of energy transferred to the surroundings.
(1 mark)

_____

_____

_____

(TOTAL FOR QUESTION 1 = 9 MARKS)

2 (a) Which of these is a vector? (1 mark)

☐ A energy

☐ B force

☐ C mass

☐ D work

(b) (i) State the equation that relates acceleration to change in velocity and time taken. (1 mark)

(continued on the next page)

2 continued.

(ii) A van accelerates from a velocity of 2 m/s to a velocity of 20 m/s in 12 s.

Calculate the acceleration of the van.
(2 marks)

acceleration = _____ m/s^2

(continued on the next page)

2 continued.

(c) Look at Figure 2 for Question 2(c) in the Diagram Booklet. Figure 2 is a velocity/time graph for 15 s of a cyclist's journey.

(i) Calculate the distance the cyclist travels in the 15 s. (3 marks)

distance = _____ m

(continued on the next page)

2 continued.

(ii) Another cyclist starts from rest, but his acceleration decreases as time increases.

Sketch the velocity / time graph for this cyclist on Figure 2. (2 marks)

(TOTAL FOR QUESTION 2 = 9 MARKS)

3 (a) A radio station transmits on 97·4 MHz.

To receive the waves an aerial needs a length equal to half the wavelength of the radio waves being transmitted.

Calculate the length of the aerial needed.

The speed of the radio waves is $3{\cdot}00 \times 10^8$ m/s.
(3 marks)

length of aerial = _____ m

(continued on the next page)

3 continued.

(b) Look at Figure 3 for Question 3 in the Diagram Booklet.

To investigate refraction in a rectangular glass block a student uses the apparatus shown in Figure 3.

Describe how the student should measure the angle of refraction. (2 marks)

(continued on the next page)

3 continued.

(c) Look at Figure 4 for Question 3(c) in the Diagram Booklet.

Figure 4 is a simplified diagram to show radio waves from a transmitter moving upwards, then meeting a boundary between lower and upper layers of the atmosphere.

Explain what happens to the radio waves after they meet the boundary between the lower and upper layers as shown in Figure 4.

Your explanation should refer to changes in direction and speed of the waves. (4 marks)

(continued on the next page)

3 continued.

(TOTAL FOR QUESTION 3 = 9 MARKS)

4 (a) Look at Figure 5 for Question 4(a) in the Diagram Booklet.

Four students and their teacher do an experiment to measure the speed of sound in air.

The teacher stands at a distance and fires a starting pistol into the air.

The students see the flash when the pistol is fired.

They measure the time from when they see the flash to when they hear the bang.

A student drew a diagram of the arrangement as shown in Figure 5.

The students obtained a value of 240 m/s for the speed of sound.

The accepted value, in a science data book, is 343 m/s.

(continued on the next page)

4 continued.

(i) Calculate the difference between the students' value and the accepted value as a percentage of the accepted value. (2 marks)

percentage difference = _____ %

(continued on the next page)

4 continued.

(ii) When the distance was 100 m, the students measured the following times:

0·43 s 0·35 s 0·50 s 0·38 s

Explain why their times vary so much.
(2 marks)

(continued on the next page)

4 continued.

(iii) Explain ONE way the students might improve this experiment. (2 marks)

(continued on the next page)

4 continued.

(b) Look at Figure 6 for Question 4(b) in the Diagram Booklet.

Figure 6 represents a sound wave coming from a loudspeaker and shows the effects on particles of the air at one instant in time.

(i) Draw and label a distance of one wavelength in Figure 6. (1 mark)

(ii) Describe the motion of the particles as the wave travels through the air. (2 marks)

(TOTAL FOR QUESTION 4 = 9 MARKS)

5 (a) Which of these describes isotopes of an element? (1 mark)

☐ A	same atomic number	different number of neutrons
☐ B	same atomic number	different number of protons
☐ C	same mass number	different number of neutrons
☐ D	same mass number	different number of protons

(b) Look at Figure 7 for Question 5(b) in the Diagram Booklet.

Figure 7 represents a decay that can happen inside the nucleus of an atom.

Which decay is represented in Figure 7? (1 mark)

☐ A alpha

☐ B beta minus

☐ C beta plus

☐ D gamma

(continued on the next page)

5 continued.

(c) The half-life of cobalt-60 is 5 years.

A school cobalt source had an activity of 38·5 kBq in the year 2000.

Estimate the activity of this source in the year 2020. (3 marks)

activity = _____ kBq

(continued on the next page)

5 continued.

(d) Explain what can happen to the body if a person has a prolonged exposure to gamma rays.
(2 marks)

(continued on the next page)

5 continued.

(e) Look at Figure 8 for Question 5(e) in the Diagram Booklet.

A G-M tube is connected to a counter.

A teacher places the G-M tube near to a radioactive source.

A student starts the counter and clock at the same time and writes down the readings shown on the counter every 15 s.

The student plots the readings with a line of best fit, as shown in Figure 8.

(i) Calculate the average count rate, in counts / s, from the graph.

Show your working on the graph. (2 marks)

average count rate = _____ counts / s

(continued on the next page)

5 continued.

(ii) The student says that the experiment must have been done carelessly because the data seemed quite scattered away from the best fit line.

The teacher claims such results should be expected in radioactivity experiments.

Justify the teacher's claim. (2 marks)

(TOTAL FOR QUESTION 5 = 11 MARKS)

6 (a) Look at Figure 9 for Question 6(a) in the Diagram Booklet.

Figure 9 is a diagram showing a rocket that is sent into space to try and change the path of a small asteroid.

(i) The rocket has a mass of $5{\cdot}5 \times 10^5$ kg and is travelling to the right at 14 km/s.

Which of these is a correct calculation of the momentum of the rocket in kg m/s? (1 mark)

Use the equation

$$p = m \times v$$

☐ A $7{\cdot}7 \times 10^3$ kg m/s

☐ B $7{\cdot}7 \times 10^6$ kg m/s

☐ C $7{\cdot}7 \times 10^9$ kg m/s

☐ D $7{\cdot}7 \times 10^{12}$ kg m/s

(continued on the next page)

6 continued.

(ii) The asteroid has a momentum of $7{\cdot}5 \times 10^{10}$ kg m/s and a mass of $8{\cdot}0 \times 10^{6}$ kg.

Calculate the speed of the asteroid. (2 marks)

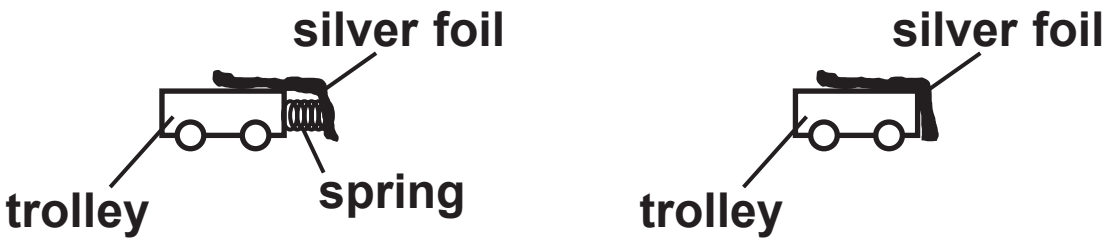
speed of the asteroid = _____ m/s

(continued on the next page)

6 continued.

*(b) A student investigates the effect of a crumple zone on the force exerted during a collision.

The student has one trolley with a spring at the front and another trolley without a spring.



Look at Figure 10 for Question 6(b) in the Diagram Booklet.

The student uses the arrangement in Figure 10.

After a trolley is released, it accelerates down a slope and bounces off a rigid wall.

The speed of a trolley can be measured just before a collision with the wall and just after a collision with the wall.

The silver foils are connected to a millisecond timer.

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6 continued.

The silver foils make contact with each other during the collision, so the time they are in contact can be read from the millisecond timer.

Explain how the student could investigate the effect of a crumple zone on the average force exerted during the collision.

Your explanation should include:

- how to determine the force (you may wish to refer to an equation from the list of equations at the end of this paper)
- how the effect of crumple zones may be shown in the investigation
- precautions that may be necessary to achieve accurate results.

(6 marks)

(continued on the next page)

6 continued.

(continued on the next page)

6 continued.

(continued on the next page)

6 continued.

(continued on the next page)

6 continued.

(c) Newton's third law, when applied to the collision of the rocket and the asteroid as shown in Figure 9, can be stated as follows:

The force exerted by the rocket on the asteroid is equal and opposite to the force exerted by the asteroid on the rocket.

Explain how this statement links to the conservation of momentum in the collision.
(4 marks)

(continued on the next page)

6 continued.

(TOTAL FOR QUESTION 6 = 13 MARKS)

TOTAL FOR PAPER = 60 MARKS

END