AQA

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE
COMBINED SCIENCE: TRILOGY

H

Higher Tier
Physics Paper 2H

Time allowed: 1 hour 15 minutes

Materials

For this paper you must have:
- a protractor
- a ruler
- a scientific calculator
- the Physics Equations Sheet (enclosed).

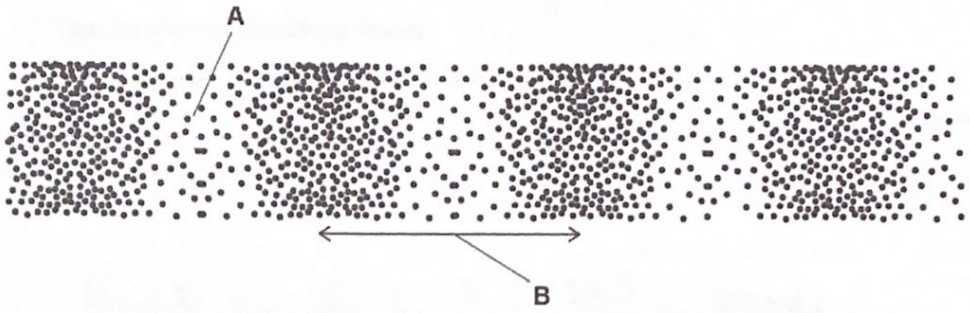
Instructions
- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

Information
- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

0 1 **Figure 1** shows a longitudinal wave.

Figure 1



0 1 . 1 What do the labels **A** and **B** on **Figure 1** represent?

Choose answers from the box.

[2 marks]

amplitude	frequency	rarefaction	reflection	wavelength

A rarefaction

B wavelength

Do not w outside t box

0 1 . 2 The wave shown in **Figure 1** has a frequency of 4.0 kHz

Calculate the period of the wave.

Use the Physics Equations Sheet.

Give the unit.

[4 marks]

$f = 4.0 \text{ k Hz} = 4.0 \times 10^3 \text{ Hz} = 4000 \text{ Hz}$

$T = \frac{1}{f} = \frac{1}{4000} = 0.00025$ seconds

Period = 0.00025 Unit S

Question 1 continues on the next page

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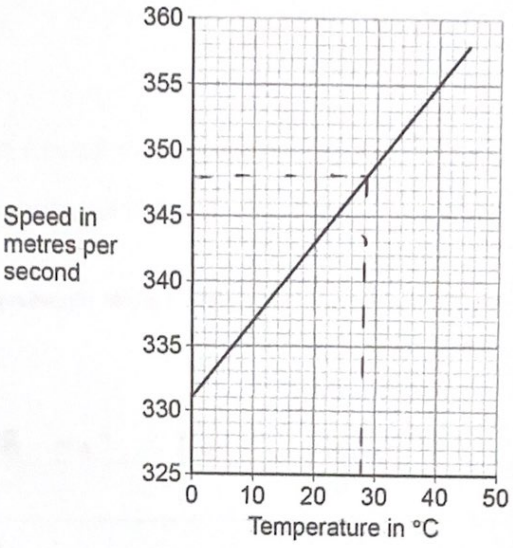
box

Sound waves are longitudinal.

Figure 2 shows how the speed of sound varies with the temperature of the air.

Figure 2



Use the Physics Equations Sheet to answer questions **01.3** and **01.4**.

0 1 . 3 Write down the equation that links frequency (f), wavelength (λ) and wave speed (v).

[1 mark]

$v = f\lambda$

0 1 . 4 A sound wave with a frequency of 300 Hz travels through the air.

The air has a temperature of 28.0 °C

Determine the wavelength of the sound wave.

Use **Figure 2**.

[4 marks]

$v = 348\ ms^{-1}$ from figure 2.

$v = f\lambda$

rearrange $\lambda = \frac{v}{f} = \frac{348}{300} = 1.16\ m$

Wavelength = 1.16 m

11

Turn over for the next question

0 2 **Figure 3** shows competitors in the wheelchair race at the London Marathon.

The distance of the London Marathon is 42 000 m

Figure 3

Do not w outside t box »

Use the Physics Equations Sheet to answer questions **02.1** and **02.2**.

0 2 . 1 Write down the equation that links distance (*s*), force (*F*) and work done (*W*).

[1 mark]

$W = Fs$

0 2 . 2 During the race competitors work against air resistance.

The work done against air resistance by the winner of the race was 3 360 000 J

Calculate the average air resistance acting on the winner of the race.

[3 marks]

$W = Fs$

$F = \frac{W}{s} = \frac{3\ 360\ 000}{42\ 000} = 80\ N$

Average air resistance = 80 N

Question 2 continues on the next page

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Use the Physics Equations Sheet to answer questions **02.3** and **02.4**.

0 2 . 3 Which equation links distance travelled, speed and time?

[1 mark]

Tick (✓) **one** box.

distance travelled = speed × time ☑

time = distance travelled × speed ☐

speed = distance travelled × time ☐

0 2 . 4 The distance of the London Marathon is 42 000 m

The winning time for the race was 5600 seconds.

Calculate the average speed of the winner of the race.

[3 marks]

distance = speed × time

$d = v \times t$

$v = \frac{d}{t} = \frac{42000}{5600} = 7.5$

Average speed = 7.5 m/s

0 2 . 5 Explain why the speed of a competitor changes during the race.

[4 marks]

At different points during the race, the speed of the competitor will change. For example, at the start the competitor will accelerate, increasing their speed. Also, at any point during the race the competitor may tire, meaning their speed decreases. The roads may not be flat, meaning the competitors' speed may increase going downhill. They also may get a puncture, so their speed will decrease.

12

Turn over for the next question

Do not write outside the box

0 3 **Figure 4** shows a child playing with a toy train.

The train is on a bridge.

Figure 4

When the child lets go of the train, the train rolls down the bridge.

0 3 . 1 The momentum of the train at the bottom of the bridge is 0.216 kg m/s

mass of the train = 180 g

Calculate the velocity of the train at the bottom of the bridge.

Use the Physics Equations Sheet.

[4 marks]

$m = 180\,g = 0.180\,kg$

$p = mv$ momentum = mass × velocity

$v = \frac{p}{m} = \frac{0.216}{0.180} = 1.2\ m/s$

Velocity = 1.2 m/s

Do not w outside box

0 3 . 2 The train collides with a stationary carriage on the track.

Explain why the velocity of the train after the collision is less than it was before the collision.

Use ideas about momentum in your answer.

[4 marks]

The total momentum in the collision between the train and carriage is conserved, as per the conservation of momentum. During the collision, the momentum of the carriage increases. Therefore, the momentum of the train decreases. Because momentum = mass x velocity, the velocity of the train decreases.

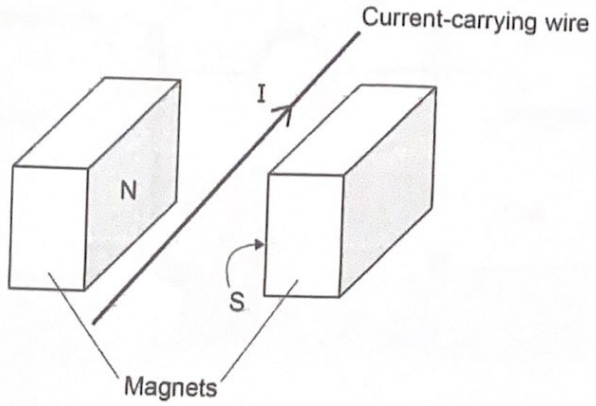
8

Turn over for the next question

0 4 A teacher demonstrated the motor effect.

Figure 5 shows the equipment used.

Figure 5



0 4 . 1 Explain why there is a force on the wire when there is a current in the wire.

[2 marks]

There is a magnetic field due to the permanent magnets. There is also a magnetic field produced by the current in the wire. These 2 magnetic fields interact, causing a force.

0 4 . 2 Explain how the direction of the force on the wire can be predicted.

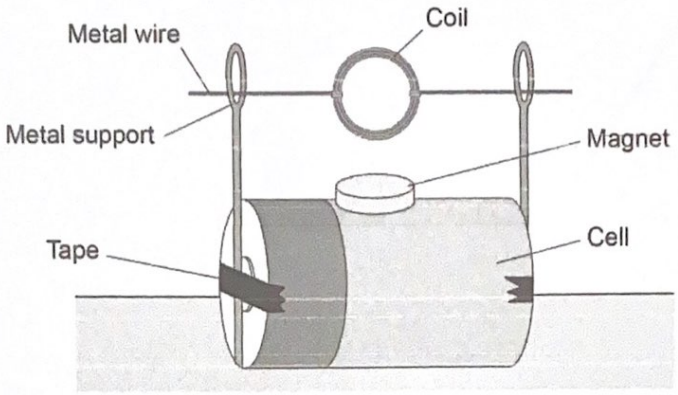
[3 marks]

We must use Fleming's left hand rule. place your finger in the direction of the field lines and place your second finger in the direction of the current. The thumb will show the direction of the force.

Do not write outside the box

0 4 . 3 **Figure 6** shows a simple electric motor.

Figure 6



Explain **one** way that the motor could be changed to increase the rate at which the coil rotates.

[2 marks]

We could increase the current in the coil. This would increase the force on the coil, due to the motor effect

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Turn over for the next question

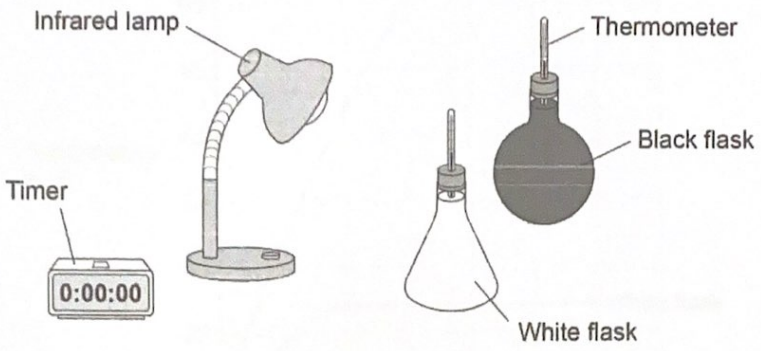
Do not write outside the box

0 5 A student investigated how the colour of a surface affects the amount of infrared radiation the surface absorbs.

Figure 7 shows the equipment used.

The two flasks are painted different colours.

Figure 7



This is the method used.

1. Pour water at 20 °C into each flask.
2. Place a bung and thermometer into each flask.
3. Place each flask in front of the infrared lamp.
4. Measure the temperature of the water every 30 seconds for 10 minutes.

0 5 . 1 Explain **two** improvements to the method the student used.

[4 marks]

1 One improvement the student could do would be to place each flask the same distance from the lamp. This means the intensity of infrared radiation incident on each flask is the same.

2 Another improvement would be to use equal volumes of water. This is because the volume affects the rate at which the water temperature increases.

Turn over ▶

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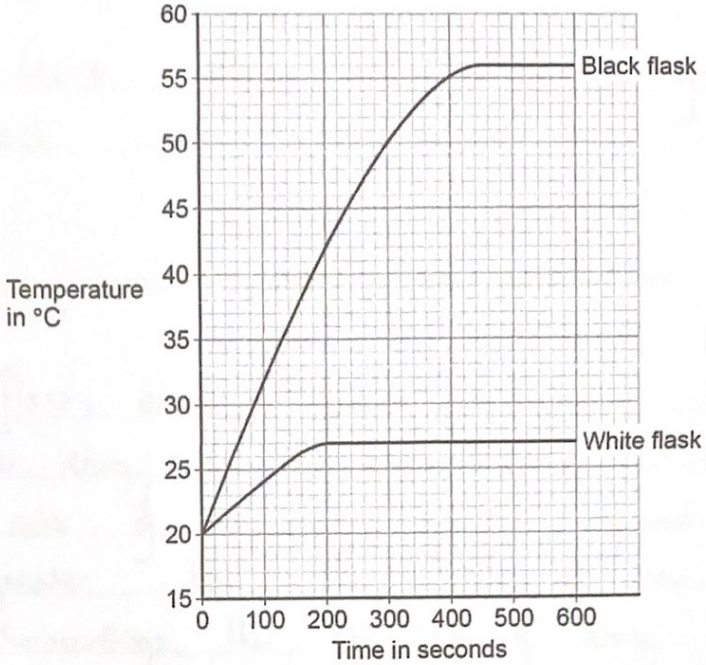
Figure 8 shows the results for each flask.

Figure 8



0 5 . 2 Complete the sentences.

[2 marks]

After 100 seconds the temperature difference between the black flask and the white flask was 7.5 °C

The temperature of the white flask stopped increasing. The temperature inside the black flask continued to increase for a further 240 seconds.

Do not write outside the box

0 5 . 3 The initial rate of absorption of infrared radiation by the black flask was greater than the initial rate of absorption by the white flask.

How does **Figure 8** show this?

[1 mark]

The black flask line has a greater gradient.

0 5 . 4 Explain why the temperature of the water in the flasks increased and then became constant.

[4 marks]

The flasks absorb infrared radiation, and transfer energy to the surroundings. Initially, the rate of absorption of the infrared radiation is greater than the rate of energy transfer to surroundings. Then, the rate of energy transfer increases with the temperature of the flask, until the rate of energy transfer to the surroundings is equal to the rate of transfer to the flasks. The temperature remains constant from this point.

11

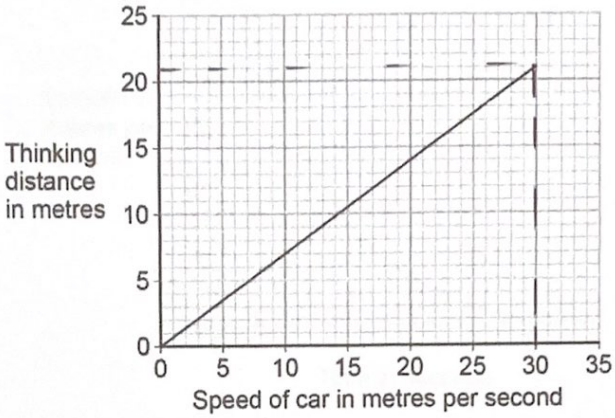
Turn over for the next question

Do not write outside the box

0 6 The distance a car travels during the driver's reaction time is called the thinking distance.

0 6 . 1 **Figure 9** shows how thinking distance depends on speed for a car.

Figure 9



Determine the driver's reaction time.

Use the Physics Equations Sheet.

[3 marks]

Distance = Speed × time

21 m = ~~Speed~~ 30 m/s × time

$t = \frac{30}{21} =$ $t = \frac{21}{30} = 0.7$ s

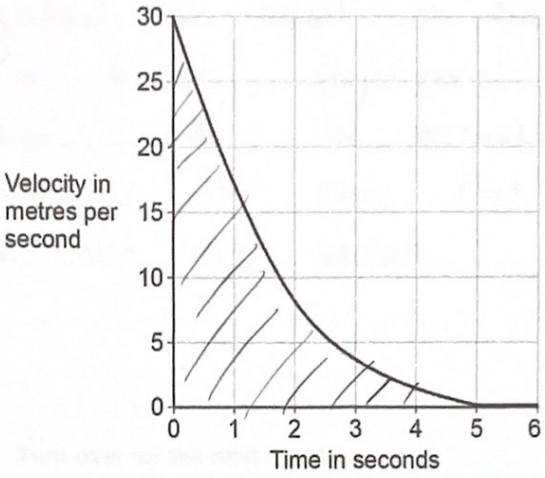
Reaction time = 0.7 s

Question 6 continues on the next page

Do not write outside the box

0 6 . 2 **Figure 10** shows how the velocity of a car changes during braking.

Figure 10



Determine the braking distance of the car.

[3 marks]

One Square = 5 metres

need to find area under graph

Approximately 9 Squares

9 x 5 = 45 m

Braking distance = 45 m

Do not write outside the box

0 6 . 3 Explain how the gradient of the line on **Figure 10** shows that the resultant force on the car was **not** constant.

[3 marks]

The gradient is equal to acceleration. Force is directly proportional to acceleration, and the acceleration is not constant. This means that the force is also not constant.

9

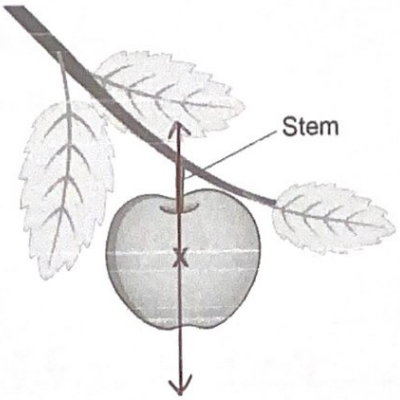
Turn over for the next question

Do not write outside the box

0 7 **Figure 11** shows a stationary apple hanging from a tree.

The **X** marks the centre of mass of the apple.

Figure 11



0 7 . 1 Draw **two** arrows on **Figure 11** to show the forces acting on the apple.

[2 marks]

Question 7 continues on the next page

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0 7 . 2 It takes 0.50 s for the apple to fall to the ground.

The initial velocity of the apple is 0 m/s

acceleration due to gravity = 9.8 m/s^2

Calculate the distance fallen by the apple.

Use the Physics Equations Sheet.

[6 marks]

$a = \frac{\Delta V}{t}$

$\Delta V = a \times t$

$\Delta V = 9.8 \times 0.5 = 4.9$ m/s

$\Delta V = V - u$ $u = 0$ m/s $V = 4.9$ m/s

~~$\Delta V = 4.9 - 0 = 4.9$ m/s~~

$V^2 - u^2 = 2as$

$4.9^2 - 0^2 = 2 \times 9.8 \times s$

~~$s = \frac{2 \times 9.8}{4.9^2}$~~ $s = 4.9^2 / 2 \times 9.8 = 1.2$m

Distance = 1.2 m

Do not write outside the box

0 7 . 3 In Question **07.2** it was assumed that the acceleration was a constant 9.8 m/s^2

Evaluate this assumption.

[4 marks]

As the apple falls, the air resistance on it increases. Therefore the resultant force downwards on the apple increases. This means the acceleration will also decrease. Therefore acceleration is not constant, so it is not a good assumption.

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END OF QUESTIONS