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

F

Foundation Tier
Physics Paper 2F

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 Forces are either contact forces or non-contact forces.

0 1 . 1 Which of the following is a non-contact force?

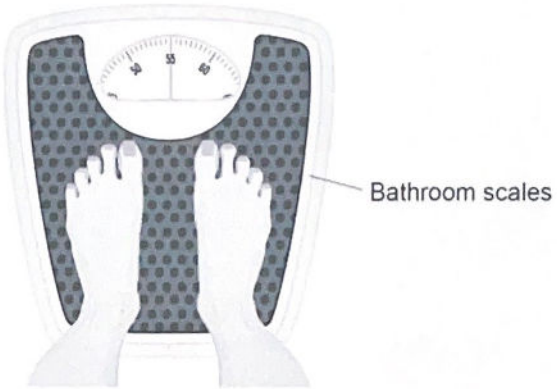
[1 mark]

Tick (✓) **one** box.

- Electrostatic force ✓
- Friction force
- Tension force

Figure 1 shows a person standing on some bathroom scales.

Figure 1



The person exerts a downward force on the scales and the scales exert an upward force on the person.

0 1 . 2 Which sentence about the forces is true?

[1 mark]

Tick (✓) **one** box.

- The downward force is less than the upward force. ☐
- The downward force is the same size as the upward force. ☑
- The downward force is greater than the upward force. ☐

0 1 . 3 What is the name of the upward force on the person?

[1 mark]

Tick (✓) **one** box.

- Air resistance ☐
- Normal contact force ☑
- Weight ☐

0 1 . 4 The person on the scales has a mass of 55 kg.

gravitational field strength = 9.8 N/kg

Calculate the weight of the person.

Use the equation:

weight = mass × gravitational field strength

[2 marks]

W = mass x gravitational field strength

W = 55 x 9.8 = 539 N

Weight = 539 N

0 1 . 5 The gravitational field strength is **not** the same at all points on the surface of the Earth.

The gravitational field strength is weakest at the equator.

A person travelled from the UK to the equator.

What happened to the weight of the person?

[1 mark]

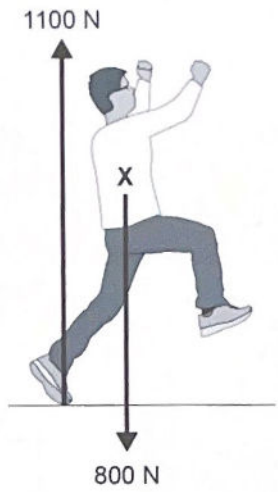
Tick (✓) **one** box.

- [x] The weight decreased.
- [ ] The weight remained the same.
- [ ] The weight increased.

Figure 2 shows the forces acting on a person.

The person is about to jump.

Figure 2



0 1 . 6 The arrow representing the weight of the person is drawn from point **X**.

What is the name given to point **X**?

[1 mark]

Tick (✓) **one** box.

Centre of force ☐

Centre of mass ☑

Centre of weight ☐

0 1 . 7 Determine the size of the resultant force on the person in **Figure 2**.

[1 mark]

1100 - 800 = 300 N

Resultant force = 300 N

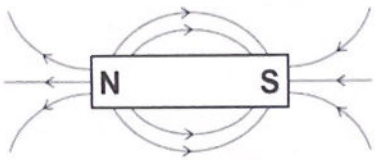
8

0 2 Magnets attract some metals.

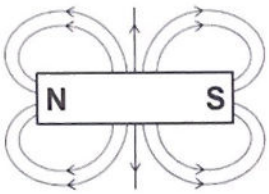
0 2 . 1 Which diagram shows the correct magnetic field pattern for a bar magnet?

[1 mark]

Tick (✓) **one** box.



☑



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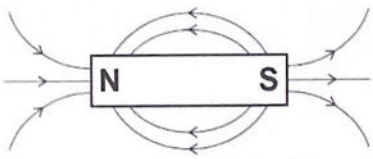

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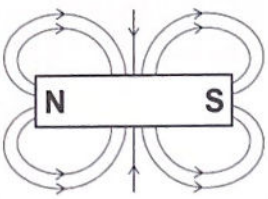


☐

Figure 3 shows an iron bar near a permanent magnet.

Figure 3

The iron bar becomes an induced magnet.

0 2 . 2 Label the poles on the iron bar.

[1 mark]

0 2 . 3 The magnet is turned around so that the north pole is closest to the iron bar.

Which statement about the iron bar is true?

[1 mark]

Tick (✓) **one** box.

The iron bar does not experience a magnetic force. ☐

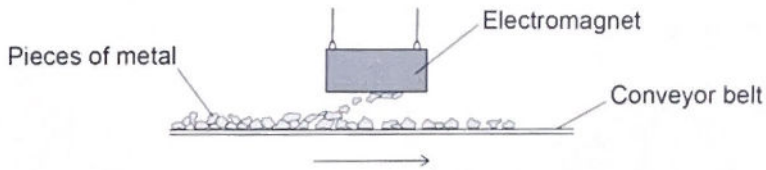
The iron bar experiences a magnetic force of attraction. ☑

The iron bar experiences a magnetic force of repulsion. ☐

Question 2 continues on the next page

Figure 4 shows an electromagnet being used to separate pieces of different types of metal on a conveyor belt.

Figure 4



0 2 . 4 Which **two** of the following types of metal would be attracted to the electromagnet?

[2 marks]

Tick (✓) **two** boxes.

- Aluminium ☐
- Copper ☐
- Magnesium ☐
- Nickel ☑
- Steel ☑

0 2 . 5 What is an advantage of using an electromagnet instead of a permanent magnet to separate the types of metal?

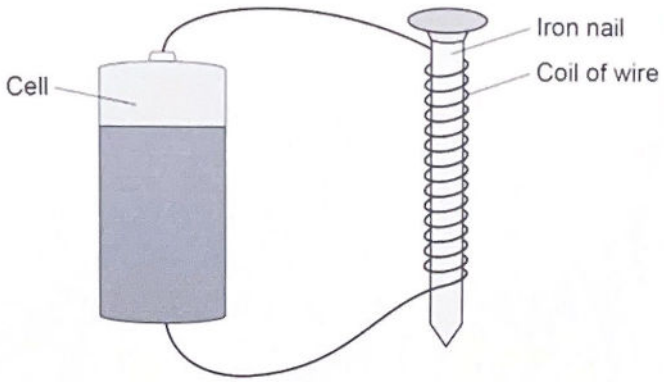
[1 mark]

Tick (✓) **one** box.

- An electromagnet attracts more types of metal than a permanent magnet. ☐
- An electromagnet can be switched on and off. ☑
- An electromagnet transfers less energy than a permanent magnet. ☐

Figure 5 shows a simple electromagnet.

Figure 5



0 2 . 6 What is the purpose of the iron nail inside the coil of wire?

[1 mark]

Tick (✓) **one** box.

The iron nail makes the magnetic field stronger. ☑

The iron nail reduces the magnetic field to zero. ☐

The iron nail reverses the magnetic field. ☐

0 2 . 7 Which of the following would increase the strength of the electromagnet?

[1 mark]

Tick (✓) **one** box.

Use a greater current. ☑

Use a shorter nail. ☐

Use a thinner wire. ☐

8

0 3 The stopping distance of a car is the sum of the thinking distance and the braking distance.

0 3 . 1 The thinking distance is affected by the reaction time of the driver.

Which **two** of the following can affect the reaction time of the driver?

[2 marks]

Tick (✓) **two** boxes.

- Damaged brakes ☐
- Taking drugs ☑
- Tiredness ☑
- Wet roads ☐
- Worn tyres ☐

Scientists measured the reaction time for drivers of different ages.

Figure 6 shows the results.

Figure 6

0 3 . 2 At what age did the drivers have the lowest mean reaction time?

[1 mark]

Age = 24 years

0 3 . 3 What was the lowest mean reaction time?

[1 mark]

Time = 0.55 seconds

Question 3 continues on the next page

The braking distance of a car is the distance travelled between the driver applying the brakes and the car stopping.

0 3 . 4 Complete the sentences.

Choose answers from the box.

Each answer may be used once, more than once or not at all.

[2 marks]

decreases	**stays the same**	**increases**

When the brakes are applied, the kinetic energy of the

car decreases .

The temperature of the brakes increases .

0 3 . 5 A car is travelling at a speed of 12 m/s.

The driver applies the brakes and the car decelerates at a constant 3.0 m/s^2.

Calculate the braking distance of the car.

Use the equation:

$$\text{braking distance} = \frac{(\text{speed})^2}{2 \times \text{deceleration}}$$

Choose the unit from the box.

[3 marks]

m	kg	s

braking distance = $\frac{(12)^2}{(2 \times 3)}$

braking distance = 24

unit = m

Braking distance = 24 Unit m

0 3 . 6 To pass the UK driving test, people must know the typical stopping distance of a car at certain speeds.

Suggest **one** reason why.

[1 mark]

So they know how far behind another car they should drive.

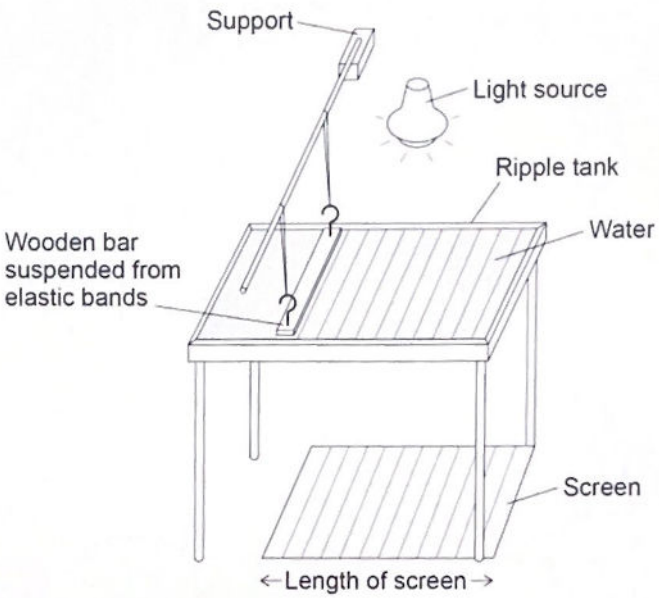
10

0 4 **Figure 7** shows a ripple tank.

The wooden bar vibrates up and down producing waves on the water.

The light source produces shadows of the water waves on the screen.

Figure 7



0 4 . 1 Describe how the student can measure the frequency and wavelength of the waves.

You should refer to any equipment the student needs in your answer.

[4 marks]

To measure wavelength, place a metre rule at the side of the screen perpendicular to the wave fronts and use it to measure the length of the screen. Take a photograph of the ~~screen~~ shadow on the screen and count the number of complete waves on the screen. Divide the length of the screen by the number of complete waves to calculate wavelength. To measure frequency, count the number of waves that pass a given point, and time how long it takes using a stop clock. Frequency is number of waves divided by time taken.

A student measured the frequency and wavelength of the waves produced.

Table 1 shows some of the results.

Table 1

Reading	1	2	3	Mean
Frequency in hertz	12.8	12.4	12.3	X

0 4 . 2 Calculate value **X** in **Table 1**.

[1 mark]

12.8 + 12.4 + 12.3 = 37.5 37.5 ÷ 3 = 12.5

X = 12.5 Hz

0 4 . 3 Why is it a good idea to take repeat readings and then calculate a mean?

[1 mark]

Tick (✓) **one** box.

To reduce the effect of random errors. ✓

To reduce the effect of systematic errors.

To reduce the effect of zero errors.

Question 4 continues on the next page

0 4 . 4 The student changed the frequency of the waves in the ripple tank to 20 Hz.

Calculate the period of the waves.

Use the equation:

$$\text{period} = \frac{1}{\text{frequency}}$$

[2 marks]

period = $\frac{1}{20}$ = 0.05 s

Period = 0.05 s

0 4 . 5 At a frequency of 20 Hz the wavelength of the waves was 0.012 m.

Calculate the wave speed.

Use the equation:

wave speed = frequency × wavelength

[2 marks]

wavespeed = 20 × 0.012

Wavespeed = 0.24 (m/s)

Wave speed = 0.24 m/s

10

0 5 Scientists are developing a rocket aeroplane designed to travel much faster than jet aeroplanes.

0 5 . 1 The rocket aeroplane must accelerate along a runway to take off.

What would happen to the air resistance acting on the rocket aeroplane as it accelerates?

[1 mark]

Air resistance increases.

0 5 . 2 An upward force called lift will act on the wings of the rocket aeroplane when it moves.

Complete the sentence.

Choose the answer from the box.

[1 mark]

less than	the same as	greater than

As the rocket aeroplane starts to accelerate along the runway, the lift force on the wings will be less than the weight of the rocket aeroplane.

Question 5 continues on the next page

0 5 . 3 During the first 14 seconds the average speed of the rocket aeroplane on the runway will be 35 m/s.

Calculate the distance that the rocket aeroplane will travel during the first 14 seconds.

Use the equation:

distance travelled = average speed × time

[2 marks]

Distance travelled = 490 m

0 5 . 4 Write down the equation which links distance (s), force (F) and work done (W).

[1 mark]

Work done = force × distance

0 5 . 5 When the rocket aeroplane travels a distance of 270 m on the runway the engines will do 54 000 000 J of work.

Calculate the average force exerted by the engines.

[3 marks]

Work done = force × distance

$54,000,000 = F \times 270$

$F = \frac{54,000,000}{270} = 200,000$ N

Average force = 200,000 N

0 5 . 6 The rocket aeroplane will fly at a greater height than a jet aeroplane.

The height that an aeroplane flies at affects the radiation dose a passenger will receive each hour.

Table 2 shows the speed of each aeroplane and the radiation dose a passenger will receive each hour.

Table 2

Aeroplane	Speed in metres per second	Radiation dose each hour in millisieverts
Rocket aeroplane	8000	0.006
Jet aeroplane	250	0.003

Exposure to ionising radiation has risks and possible consequences.

Evaluate the risks and possible consequences of flying in a rocket aeroplane and in a jet aeroplane.

Assume the same journey is made in each aeroplane.

Use values from **Table 2**.

[6 marks]

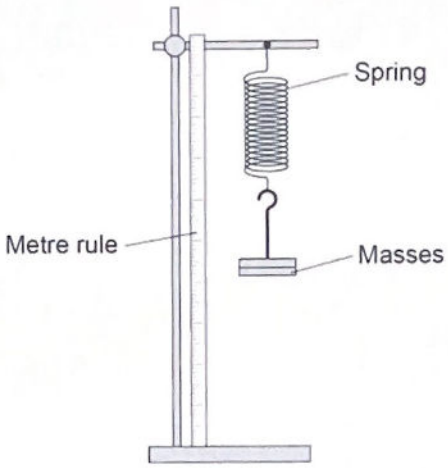
If the distance travelled is the same for each aeroplane, the time in the air is much greater for the jet aeroplane. $\frac{8000}{250} = 32$. Therefore the rocket plane is 32 times faster. However, the radiation dose in the rocket aeroplane is 2 times greater each hour. Therefore, for the same distance, the dose in the jet aeroplane is, $32/2 = 16$, 16 times greater overall. So there is much higher risk in the jet aeroplane. This means an increased risk of skin cancer and gene mutation.

14

0 6 **Figure 8** shows a stretched spring.

The spring is elastically deformed.

Figure 8



0 6 . 1 What is meant by 'elastically deformed'?

[1 mark]

Tick (✓) **one** box.

- As the force on the spring increases the length of the spring increases. ☐
- Only a very small force is needed to stretch the spring. ☐
- The force on the spring causes it to change shape. ☐
- The spring will return to its original length when the force is removed. ☑

0 6 . 2 Describe a method to determine the extension of the spring.

[2 marks]

Using a meter ruler, measure the original length of the spring and the extended length of the spring. Then use:

extension = extended length − original length

0 6 . 3 The extension of the spring is 80 mm.

spring constant = 40 N/m

Calculate the elastic potential energy of the spring.

Use the Physics Equations Sheet.

[3 marks]

extension = 80 mm = 0.080 m

$E_e = \frac{1}{2} \times k \times (\text{extension})^2$

$E_e = 0.5 \times 40 \times (0.080)^2 = 0.128\ \text{J}$

Elastic potential energy = 0.128 J

Question 6 continues on the next page

0 6 . 4 Write down the equation which links extension (e), force (F) and spring constant (k).

[1 mark]

force = Spring Constant x extension

0 6 . 5 A force of 300 N acts on a different spring.

The force causes the spring to extend by 0.40 m.

Calculate the spring constant of the spring.

[3 marks]

$300 = k \times 0.40$

$k = \frac{300}{0.40}$

$k = 750 \text{ (N/M)}$

Spring constant = 750 N/m

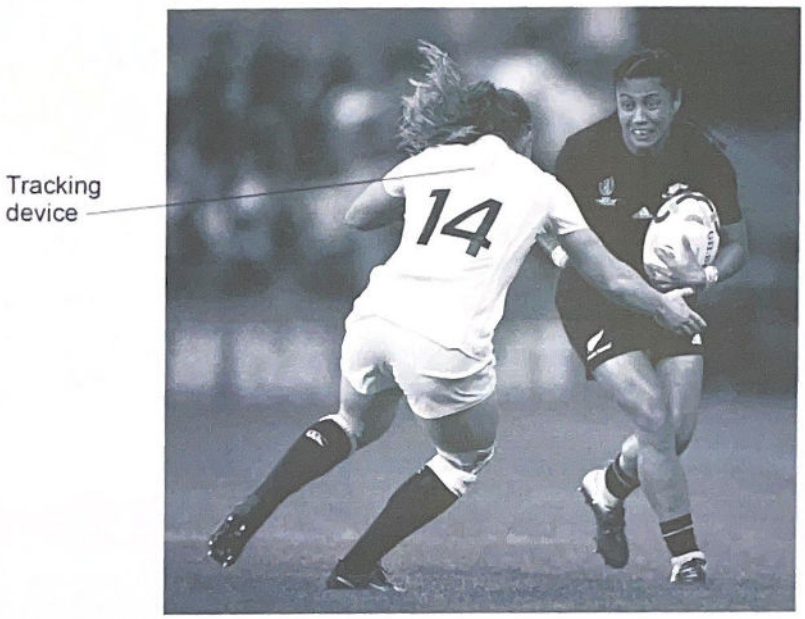
10

0 7 Professional rugby players wear a tracking device that measures their velocity and acceleration.

Figure 9 shows a player wearing a tracking device.

The player is tackling another player who is running with the ball.

Figure 9



0 7 . 1 Velocity and acceleration are both vector quantities.

What is a vector quantity?

[1 mark]

Tick (✓) **one** box.

A quantity with both magnitude and direction ☑

A quantity with direction only ☐

A quantity with magnitude only ☐

0 7 . 2 Which of the following is a vector quantity?

[1 mark]

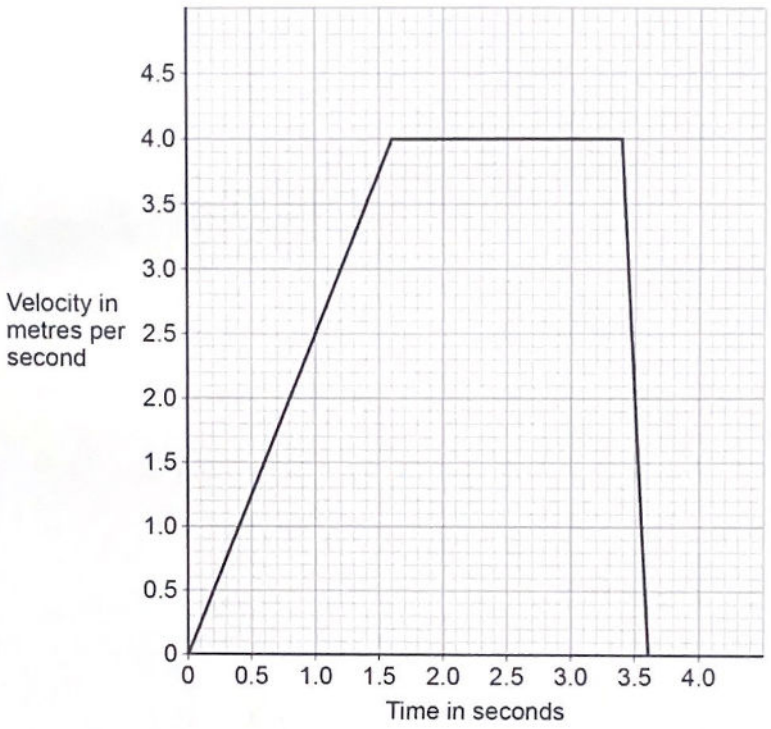
Tick (✓) **one** box.

- Displacement ☑
- Distance ☐
- Time ☐
- Work done ☐

Question 7 continues on the next page

Figure 10 shows a velocity–time graph for the player running with the ball.

Figure 10



0 7 . 3 Determine the acceleration of the player between 0 and 1.6 s.

[2 marks]

gradient = $\frac{(4-0)}{(1.6-0)}$

acceleration = 2.5 m/s^2

Acceleration = 2.5 m/s^2

0 7 . 4 Describe the motion of the player between 3.4 s and 3.6 s.

[1 mark]

Constant deceleration

The force exerted on the player when she is tackled causes her to accelerate.

0 7 . 5 Write down the equation which links acceleration (a), mass (m) and resultant force (F).

[1 mark]

resultant force = mass x acceleration

OR $F = ma$

0 7 . 6 The player accelerates at 25 m/s^2 when a resultant force of 1800 N acts on her.

Calculate the mass of the player.

[3 marks]

$F = ma$

$1800\ N = m \times 25$

$m = \frac{1800}{25}$

$m = 72\ kg$

Mass = 72 kg

0 7 . 7 The tracking device sends data to a computer during the game.

Suggest **one** advantage of the data being sent during the game.

[1 mark]

The players performance can be monitored during the game.

10

END OF QUESTIONS