GCSE
PHYSICS
AQA - COMBINED SCIENCE

Materials
For this paper you must have:
• Ruler
• Pencil, Rubber, Protractor and Compass
• Scientific calculator, which you are expected to use when appropriate

Instructions
• Answer all questions
• Answer questions in the space provided
• All working must be shown
• Do all rough work in this book. Cross out any rough work you don't want to be marked

Information
• The marks for the questions are shown in brackets
Figure 1 shows the forces acting on a car moving at a constant speed.

(a) Which force would have to increase to make the car accelerate?

Tick one box.

A

B

C

D

(1)

(b) The car travels a distance of 2040 metres in 2 minutes.

Use the following equation to calculate the mean speed of the car.

\[
\text{mean speed} = \frac{\text{distance}}{\text{time}}
\]

Mean speed = _______________ m / s

(2)
(c) The car makes an emergency stop.

**Figure 2** shows the thinking distance and braking distance of the car.

![Figure 2](image)

What is the stopping distance?

___________________________________________________________________

(1)

(d) The person driving the car is tired.

What effect will this have on the thinking distance and braking distance?

Tick *one* box for thinking distance.

Tick *one* box for braking distance.

<table>
<thead>
<tr>
<th></th>
<th>decreases</th>
<th>increases</th>
<th>stays the same</th>
</tr>
</thead>
<tbody>
<tr>
<td>thinking distance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>braking distance</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(2)

(Total 6 marks)
(a) Which of these is a scalar quantity?

Tick one box.

- displacement
- distance
- force
- velocity

(b) A woman cycled along a straight flat road.

The graph below shows how the woman’s velocity changed with time.

Which part of the graph shows the woman moving at constant velocity?

Tick one box.

- BC
- CD
- DE
(c) Which part of the graph shows the woman stationary?

BC [ ] CD [ ] DE [ ]

Between points A and B the woman was accelerating.

(d) Use the graph above to determine the total time for which she was accelerating.

___________________________________________________________________

Time = _____________________ s

(1)

(e) Use the graph above to determine her increase in velocity between points A and B.

___________________________________________________________________

Increase in velocity = _____________________ m/s

(1)

(f) Calculate her acceleration between points A and B.

Use the equation:

\[
\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}
\]

___________________________________________________________________

___________________________________________________________________

Acceleration = _____________________ m/s^2

(2)
(g) Estimate how a typical cycling speed of 6 m/s compares with a typical walking speed.

Tick one box.

- about twice as fast
- about four times faster
- about eight times faster

(Total 8 marks)

The diagram below shows a man doing two stages of a pull up. In both diagrams the man is stationary.

(a) Complete the sentence.

Choose the answers from the box.

| equal to | less than | more than |

In stage 1 the downwards force of the man on the bar is _____________________
the upwards force of the bar on the man.

(1)
(b) The man has a mass of 85 kg
Gravitational field strength = 9.8 N/kg
Calculate the weight of the man.
Use the equation:

\[ \text{weight} = \text{mass} \times \text{gravitational field strength} \]

___________________________________________________________________
___________________________________________________________________

Weight = ___________________ N

(2)

(c) The man raises his body a vertical distance of 0.63 m to go from stage 1 to stage 2
Calculate the work done by the man.
Use your answer to part (b)
Use the equation:

\[ \text{work done} = \text{force} \times \text{distance} \]

___________________________________________________________________
___________________________________________________________________

Work done = ___________________ J

(2)

(d) The man was **not** moving at stage 2
How much work is done by the man at stage 2?

Work done = ___________________ J

(1)
(e) A woman uses the bar to do a pull up.

The woman has a mass of 62 kg

She accelerates at 11 m/s\(^2\)

Calculate the resultant force on the woman.

Use the equation:

\[
\text{force} = \text{mass} \times \text{acceleration}
\]

\[
\text{Force} = \underline{299.18} \text{ N}
\]

(Figure 1) shows a man using a resistance band when exercising.

The resistance band behaves elastically.

(a) What happens to the store of elastic potential energy of the resistance band when the band is stretched?
(b) Explain what happens to the resistance band as it is released.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(2)

(c) **Figure 2** shows how the extension of the resistance band changes as the force applied changes.

![Figure 2](image1)

Describe the trend shown in the graph.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(2)
Figure 3 shows a chest expander.

Figure 3

(d) Sketch a graph on Figure 4 to show how the extension of a spring in the chest expander changes as the force applied changes.

Figure 4

When a force is applied to a spring, the spring extends by 7.5 cm

(e) Write down the equation that links extension, force and spring constant.

___________________________________________________________________

(1)
(f) Calculate the force applied to the spring.

The spring has a spring constant of 1 600 N/m

Use your equation from part (e)

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Force = ___________________ N

(Total 11 marks)

(a) The brakes of the lorry are in a poor condition.

What effect will the condition of the brakes have on thinking distance and the braking distance of the lorry?

Thinking distance ____________________________________________________
___________________________________________________________________
___________________________________________________________________

Braking distance _____________________________________________________
___________________________________________________________________
___________________________________________________________________

(2)
(b) Using a hand-held mobile phone while driving is illegal in the United Kingdom.

The table below shows the effect of using a mobile phone on thinking distance.

<table>
<thead>
<tr>
<th></th>
<th>Thinking distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not using a mobile phone</td>
<td>19 m</td>
</tr>
<tr>
<td>Using a mobile phone with hands-free kit</td>
<td>23 m</td>
</tr>
<tr>
<td>Using a hand-held mobile phone</td>
<td>27 m</td>
</tr>
</tbody>
</table>

Explain why driving while using a hand-held mobile phone is more dangerous than using a mobile phone with a hands-free kit.

Use data from the table above.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(4)
(Total 6 marks)
**Figure 1** shows a rollercoaster train as it is pulled up a slope on the track.

The arrows, A, B, C and D, represent the forces acting on the rollercoaster train.

(a) Give two ways that the force arrows show that forces are vector quantities.

1. _________________________________________________________________
2. _________________________________________________________________

(b) Which arrow shows the weight of the rollercoaster train?

Tick one box.

A  B  C  D

(1)

(c) Which arrow shows the normal contact force?

Tick one box.

A  B  C  D

(1)
Figure 2 shows the magnitude of the acceleration of the rollercoaster train during the ride.

**Figure 2**

![Graph showing magnitude of acceleration over time.]

(d) Why has a line graph been drawn instead of a bar chart?

Tick one box.

- Acceleration is a control variable.
- Both variables are continuous.
- Line graphs are easier to read.
- Time is a categoric variable.

(1)

(e) What conclusion can be made from Figure 2 about the motion of the rollercoaster train between 10 and 15 seconds?

Tick one box.

- It is moving at a constant velocity.
- Its velocity is decreasing.
- Its velocity is increasing.

(1)
(f) What is the maximum acceleration of the rollercoaster train?

Use Figure 2.

Acceleration = ____________________ m/s\(^2\)  

(1)

(g) The maximum safe acceleration for most people is 5 times the acceleration due to gravity.

Acceleration due to gravity = 9.8 m/s\(^2\)

Explain whether the acceleration of this rollercoaster train is safe for most people

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(3)

(h) One of the passengers on the rollercoaster train has a mass of 58 kg

Calculate the maximum force experienced by the passenger during the ride.

Use the equation:

\[
\text{force} = \text{mass} \times \text{acceleration}
\]

Give the unit.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Maximum force = ____________________ Unit ____________________  

(3)  

(Total 13 marks)
Four students tested their reaction times using a computer program. When a green light appeared on the screen the students had to press a key. 

**Table 1** shows their results.

<table>
<thead>
<tr>
<th>Student</th>
<th>Reaction time in s</th>
<th>Mean reaction time in s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test 1</td>
<td>Test 2</td>
</tr>
<tr>
<td>Boy 1</td>
<td>0.28</td>
<td>0.27</td>
</tr>
<tr>
<td>Boy 2</td>
<td>0.28</td>
<td>0.47</td>
</tr>
<tr>
<td>Girl 1</td>
<td>0.31</td>
<td>0.29</td>
</tr>
<tr>
<td>Girl 2</td>
<td>0.32</td>
<td>0.30</td>
</tr>
</tbody>
</table>

(a) What is meant by ‘reaction time’ in this experiment?

___________________________________________________________________
___________________________________________________________________

(1)

(b) Boy 2 had an anomalous result in **Test 2**.

Suggest a reason why.

___________________________________________________________________
___________________________________________________________________

(1)

(c) Give **one** conclusion that can be made from the results in **Table 1**.

___________________________________________________________________
___________________________________________________________________

(1)

(d) Suggest further evidence that you could collect to support your conclusion.

___________________________________________________________________
___________________________________________________________________

(1)
(e) Reaction time is important at the start of a race.

Table 2 shows the time taken by a boy to run different distances.

<table>
<thead>
<tr>
<th>Distance in m</th>
<th>Time in s</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>12.74</td>
</tr>
<tr>
<td>200</td>
<td>25.63</td>
</tr>
<tr>
<td>800</td>
<td>139.46</td>
</tr>
</tbody>
</table>

Reaction time is more important in a 100 m race than in an 800 m race.

Explain why.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(2)
Two girls, A and B, ran an 800 m race.

The figure below shows how the distance changed with time.
A student investigated acceleration using gliders, an air track and light gates.

The air track reduces friction between the glider and the track to zero.

**Figure 1** shows the apparatus.

The glider was released from rest and moved along the track.

The mass holder hit the ground before the card passed through the second light gate.
(a) Which **two** statements describe the effect this would have on the glider?

Tick **two** boxes.

- Its acceleration would decrease to zero.
- Its acceleration would increase.
- The resultant force on it would decrease to zero.
- The resultant force on it would increase.
- Its speed would increase.

(b) The mass holder should **not** hit the ground before the card passes through the second light gate.

Suggest **one** way that the student could stop this happening.

___________________________________________________________________
___________________________________________________________________

(2)
The student increased the resultant force acting on the glider by adding more masses to the mass holder.

She calculated the acceleration of the glider for each resultant force.

Each test was done three times.

**Table 1** shows the results.

<table>
<thead>
<tr>
<th>Resultant force in N</th>
<th>Acceleration in m/s²</th>
<th>Mean acceleration in m/s²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test 1</td>
<td>Test 2</td>
</tr>
<tr>
<td>0.20</td>
<td>1.3</td>
<td>1.2</td>
</tr>
<tr>
<td>0.39</td>
<td>2.6</td>
<td>2.5</td>
</tr>
<tr>
<td>0.59</td>
<td>3.8</td>
<td>3.8</td>
</tr>
<tr>
<td>0.78</td>
<td>5.1</td>
<td>5.1</td>
</tr>
<tr>
<td>0.98</td>
<td>6.4</td>
<td>7.2</td>
</tr>
</tbody>
</table>

(c) The student made two mistakes in the mean acceleration column.

Identify the mistakes the student made.

Suggest how each mistake can be corrected.

Mistake ____________________________________________________________
___________________________________________________________________
Correction __________________________________________________________
___________________________________________________________________

Mistake ____________________________________________________________
___________________________________________________________________
Correction __________________________________________________________
___________________________________________________________________

(4)
(d) Write a conclusion for this investigation.

Use the data in Table 1.

<table>
<thead>
<tr>
<th>Mass of the glider in kg</th>
<th>Acceleration in m/s²</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.060</td>
<td>3.5</td>
</tr>
<tr>
<td>0.080</td>
<td>2.6</td>
</tr>
<tr>
<td>0.10</td>
<td>2.0</td>
</tr>
<tr>
<td>0.12</td>
<td>1.7</td>
</tr>
<tr>
<td>0.14</td>
<td>1.4</td>
</tr>
</tbody>
</table>

(e) The student used a constant resultant force to accelerate the glider.

The student changed the mass of the glider and calculated the new acceleration.

She repeated this for different masses of the glider, keeping the resultant force constant.

The results are shown in Table 2.

Table 2
Plot the results on Figure 2

Draw a line of best fit.

Figure 2

<table>
<thead>
<tr>
<th>Acceleration in m/s²</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0</td>
</tr>
<tr>
<td>3.0</td>
</tr>
<tr>
<td>2.0</td>
</tr>
<tr>
<td>1.0</td>
</tr>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mass in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.04</td>
</tr>
<tr>
<td>0.06</td>
</tr>
<tr>
<td>0.08</td>
</tr>
<tr>
<td>0.10</td>
</tr>
<tr>
<td>0.12</td>
</tr>
<tr>
<td>0.14</td>
</tr>
</tbody>
</table>

(f) Describe the relationship between mass and acceleration.

___________________________________________________________________
___________________________________________________________________

(Total 12 marks)

The diagram below shows an ice skater, Skater A.
(a) Write down the equation that links mass, momentum and velocity.

___________________________________________________________________

(1)

(b) Skater A travels with a velocity of 3.2 m/s and has a momentum of 200 kg m/s

Calculate the mass of Skater A.

___________________________________________________________________

Mass = ______________________ kg

(3)

(c) Skater A bumps into another skater, Skater B. Skater B is stationary.

The skaters move off together in a straight line.

Explain what happens to the velocity of each of the skaters.

Use the idea of conservation of momentum.

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

(3)

(Total 7 marks)

Figure 1 shows the horizontal forces acting on a man swimming in the sea.

Figure 1

(a) Describe the movement of the man when the resultant horizontal force is 0 N

___________________________________________________________________

(1)
(b) The man increases Force A.

Explain what happens to Force B and to the movement of the man.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(4)

(c) A boat moves through the sea.

There is a 3000 N force to the west on the boat.

There is a 1000 N force to the south on the boat.

Determine the magnitude and direction of the resultant force on the boat.

Draw a vector diagram of these forces to scale on Figure 2

Figure 2

Magnitude of resultant force = _________________________ N

Direction of resultant force = _________________________ °

(3)
(d) The force to the south on the boat increases.

What effect does this have on the resultant force on the boat?

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(2)
(Total 10 marks)