

1.

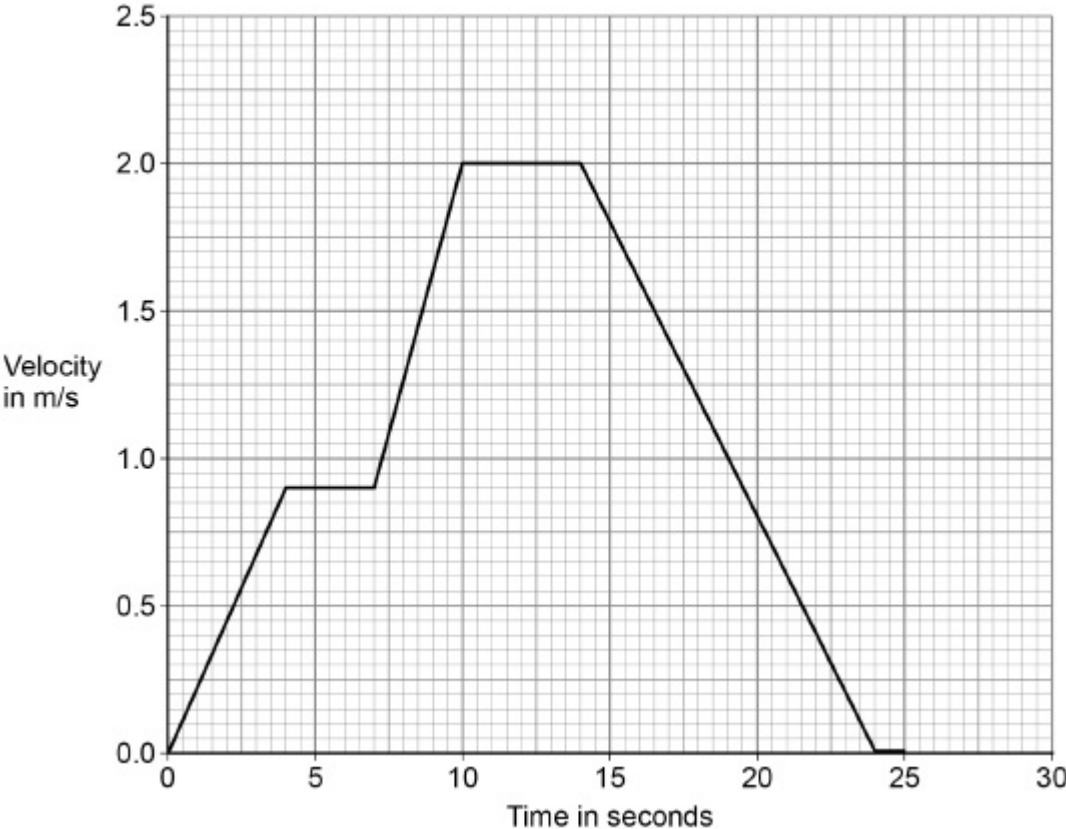
Figure 1 shows a runner using a smart watch and a mobile phone to monitor her run.

Figure 1



Figure 2 is a velocity–time graph for part of the runner’s warm-up.

Figure 2



(a) Determine the total time for which the velocity of the runner was increasing.

Time = _____ s

(2)

(b) Determine the deceleration of the runner.

Deceleration = _____ m/s²

(2)

The smart watch and mobile phone are connected to each other by a system called Bluetooth.

Bluetooth is wireless and uses electromagnetic waves for communication.

(c) Suggest why the phone and watch being connected by a wireless system is an advantage when running.

(1)

(d) Write down the equation that links frequency, wave speed and wavelength.

(1)

(e) The electromagnetic waves have a frequency of 2 400 000 000 Hz

The speed of electromagnetic waves is 300 000 000 m/s

Calculate the wavelength of the electromagnetic waves.

Wavelength = _____ m

(3)

(f) The table shows some information about four types of Bluetooth.

Type	Power in milliwatts	Range in metres
1	100	100
2	2.50	10.0
3	1.00	1.00
4	0.50	0.50

Mobile phones use type **2** Bluetooth to communicate with other devices.

Suggest **two** reasons why.

1 _____

2 _____

(2)

(Total 11 marks)

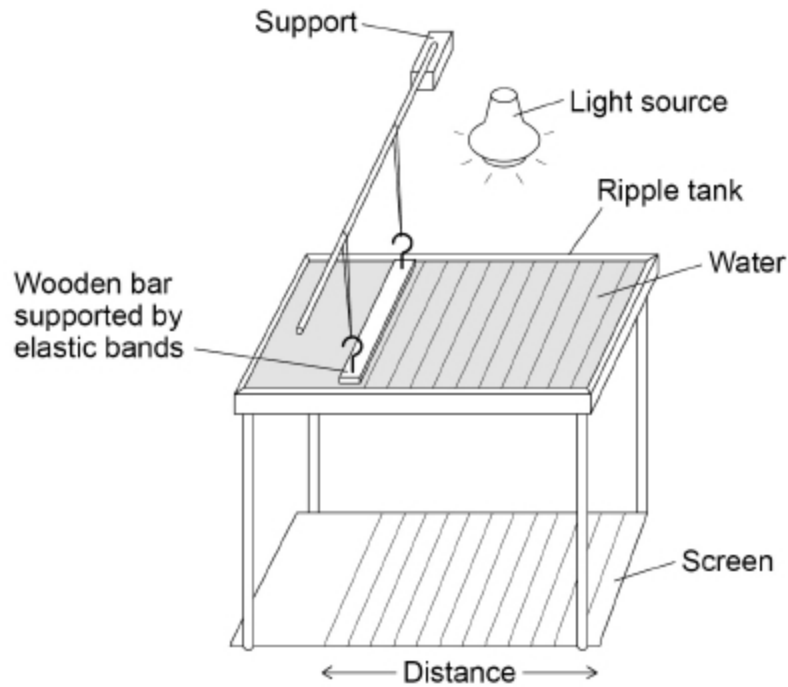
2.

Figure 1 below shows the equipment a teacher used to determine the speed of a water wave.

The equipment includes:

- a ripple tank filled with water
- a wooden bar that creates ripples on the surface of the water
- a light source which causes a shadow of the ripples on the screen.

Figure 1



- (c) The teacher measured the maximum height and the minimum height of the plastic duck above the screen as the wave passed.

The teacher repeated his measurements.

The table shows the teacher's measurements.

Maximum height in mm	509	513	511
Minimum height in mm	503	498	499

Calculate the mean amplitude of the water wave.

Mean amplitude = _____ mm

(3)

(Total 10 marks)

3.

Some quantities are scalars and some are vectors.

- (a) Which of the following quantities are scalars?

Tick (✓) **two** boxes.

Displacement

Distance

Force

Speed

Velocity

(2)

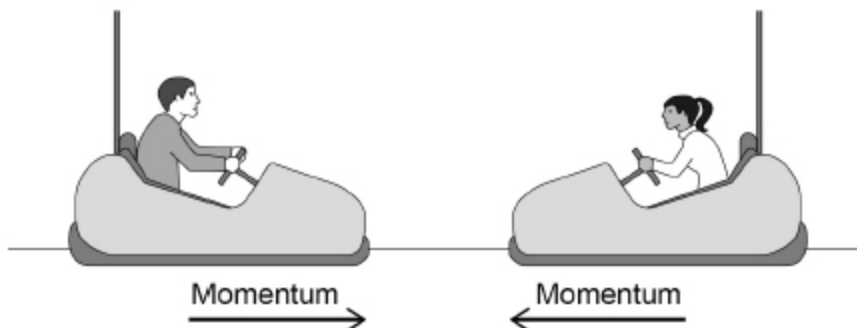
(b) Give the difference between a vector quantity and a scalar quantity.

(1)

Bumper cars are a fairground ride and are designed to bump into each other.

The diagram below shows two bumper cars moving towards each other.

The momentum of each bumper car is shown by an arrow.



(c) Give **two** factors that affect the momentum of each bumper car.

1 _____

2 _____

(2)

(d) The bumper cars crash into each other and stop.

Explain why both bumper cars stop after the crash.

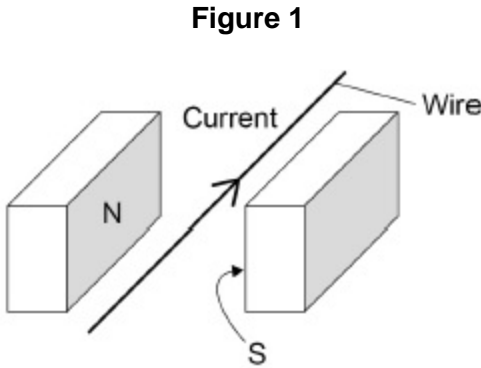
(4)

(Total 9 marks)

4.

Figure 1 shows a wire in a magnetic field.

The direction of the current in the wire is shown.



(a) There is a force on the wire due to the current in the magnetic field.

In which direction is the force on the wire?

Tick (✓) **one** box.

→	↓	←	↑
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

(1)

(b) Give **two** ways that the direction of the force on the wire could be reversed.

1 _____

2 _____

(2)

(c) The length of the wire in the magnetic field is 0.050 m

The force on the wire is 0.072 N

magnetic flux density = 360 mT

Calculate the current in the wire.

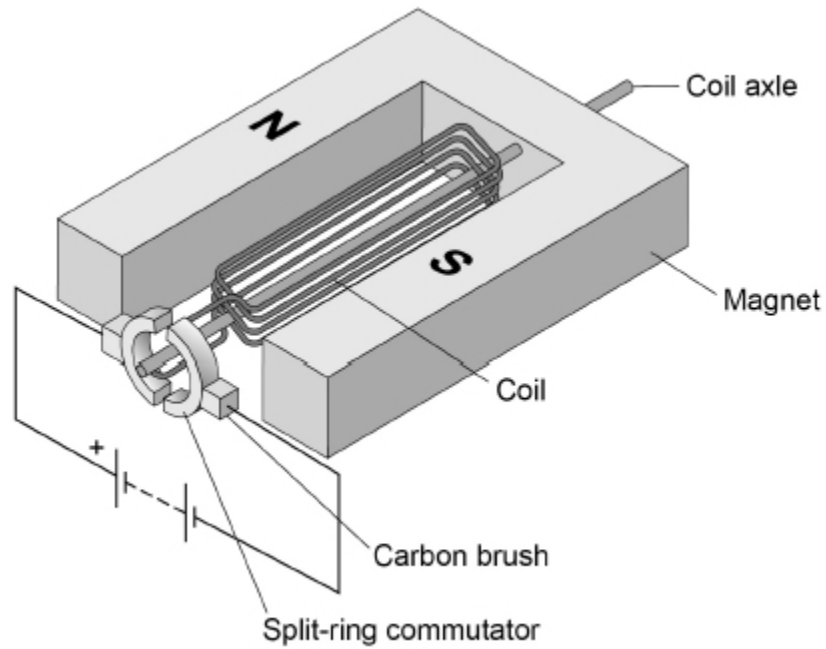
Use the Physics Equations Sheet.

Current = _____ A

(4)

(d) **Figure 2** shows a simple motor.

Figure 2



Explain why the coil rotates when there is a current in the coil.

(4)

(Total 11 marks)

5.

The electromagnetic spectrum is made up of waves with different wavelengths and frequencies.

(a) Give the type of electromagnetic wave with the lowest frequency.

(1)

(b) A wave has a wavelength of 2.5 km and a velocity of 300 000 000 m/s

Calculate the frequency of the wave.

Frequency = _____ Hz

(4)

(d) Which colour of surface will emit infrared radiation at the greatest rate?

Tick (✓) **one** box.

Black	<input type="checkbox"/>
Blue	<input type="checkbox"/>
Orange	<input type="checkbox"/>
White	<input type="checkbox"/>

(1)

(e) It is important to identify people at airports who may have infectious diseases, such as measles.

Explain how cameras that detect the rate of infrared emission can identify people with infectious diseases such as measles.

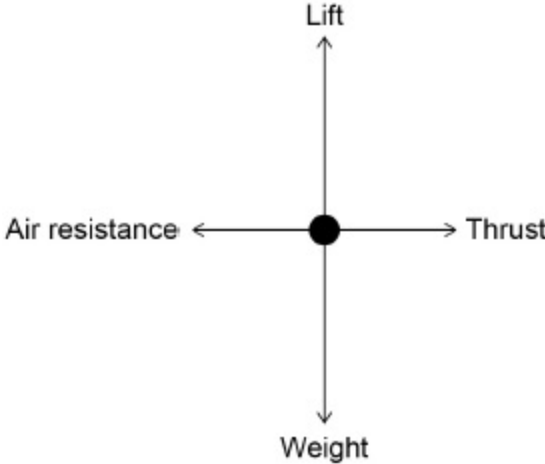
(2)

(Total 12 marks)

6.

Below is a free body diagram for an aeroplane flying at a constant speed and at a constant height.

The speed of the aeroplane is much greater than the speed at which the aeroplane lands.



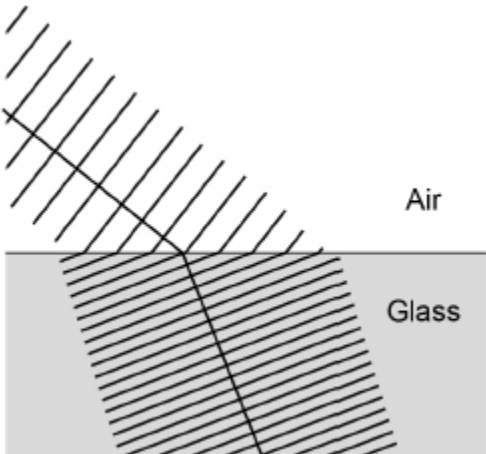
(a) Explain how the forces need to change so the aeroplane can land.

(4)

7.

Wave front diagrams are used to explain why light refracts when it passes from air into glass.

Figure 1

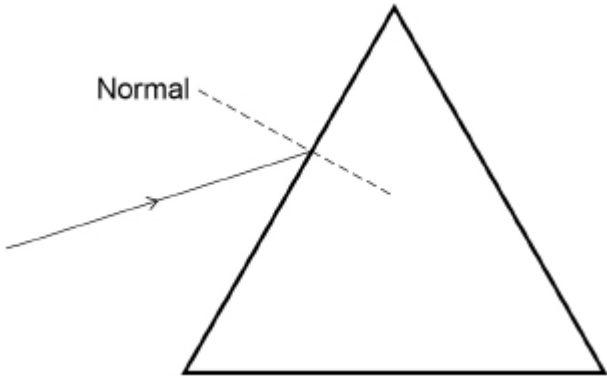


(a) Explain why the light refracts as it passes from air into glass.

(3)

(b) Figure 2 shows a ray of red light entering a glass prism.

Figure 2



Complete the ray diagram to show the ray emerging from the glass prism.

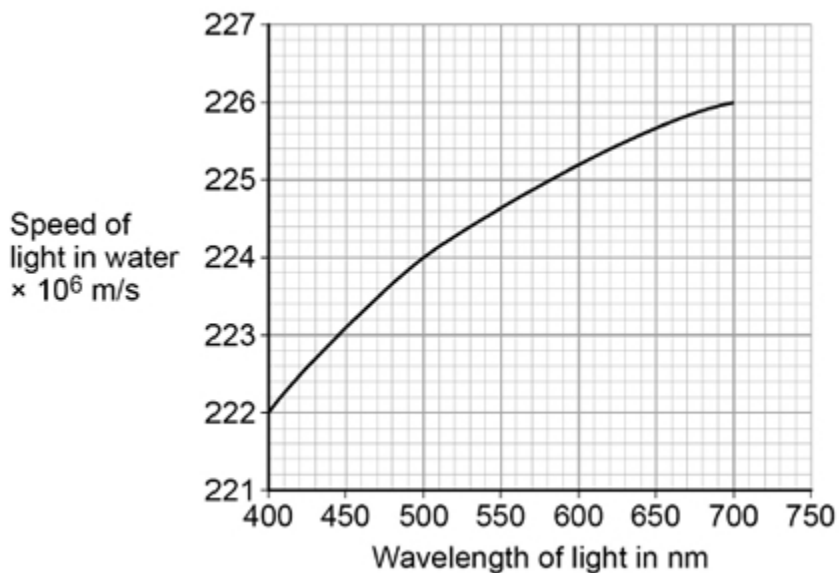
(3)

- (c) White light is made up of a continuous spectrum of different wavelengths that all travel at 3×10^8 m/s in air.

Rainbows are produced because different wavelengths of light travel at different speeds in water.

Figure 3 shows the speed of different wavelengths of light in water.

Figure 3



Explain why violet light is refracted the most as it enters water.

(3)
(Total 9 marks)