1. Magnetic force is a non-contact force.

(a) Which **two** of these are also non-contact forces?

Tick (✓) **two** boxes.

Air resistance ☐

Electrostatic ☐

Friction ☐

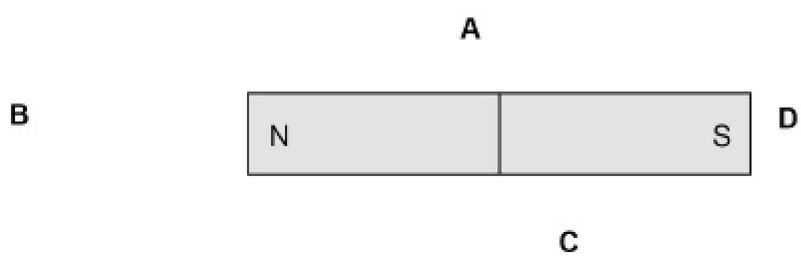
Gravitational ☐

Tension ☐

(2)

(b) **Figure 1** shows a bar magnet.

Figure 1



Which letter shows the position where the magnetic field around the bar magnet is strongest?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(c) When two magnets are brought close to each other they exert a force on each other.

Describe how two bar magnets can be used to demonstrate a force of attraction and a force of repulsion.

Force of attraction ____

____

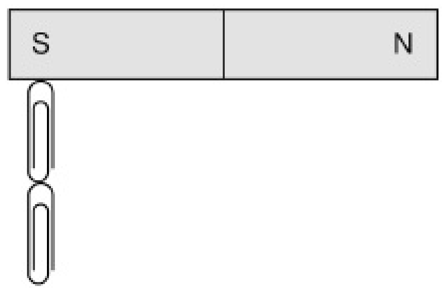
Force of repulsion ____

____

(2)

Figure 2 shows some paper clips that are attracted to a permanent magnet.

Figure 2



(d) The paperclips become magnetised when they are close to the permanent magnet.

What is the name of this type of magnetism?

Tick (✓) **one** box.

Forced magnetism ☐

Induced magnetism ☐

Strong magnetism ☐

(1)

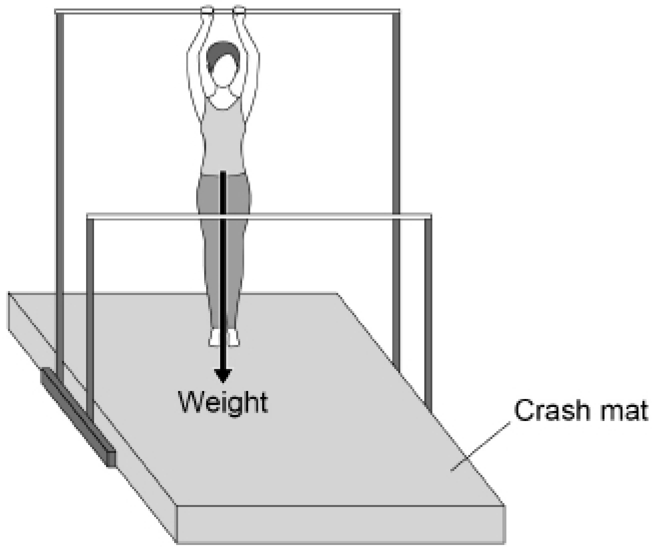
(e) Label the north and south poles of the two magnetised paper clips in **Figure 2**.

(2)

(Total 8 marks)

2. The diagram shows a gymnast on a piece of gymnastic equipment.

The equipment consists of two bars at different heights.



(a) The gymnast exerts a downward force on the bar.

What is the size of the upward force acting on the gymnast from the bar?

Tick (✓) **one** box.

It is greater than the downward force.	☐
It is less than the downward force.	☐
It is the same size as the downward force.	☐

(1)

(b) Why is the weight of the gymnast represented by an arrow?

Tick (✓) **one** box.

Weight is a constant. ☐

Weight is a scalar. ☐

Weight is a unit. ☐

Weight is a vector. ☐

(1)

(c) The diagram above shows the weight of the gymnast acting from a point.

What name is given to this point?

Tick (✓) **one** box.

Centre of force ☐

Centre of mass ☐

Centre of tension ☐

Centre of weight ☐

(1)

(d) The gymnast has a mass of 45 kg

gravitational field strength = 9.8 N/kg

Calculate the weight of the gymnast.

Use the equation:

weight = mass × gravitational field strength

____

____

____

____

Weight = ____________________ N

(2)

(e) The gymnast swings from one bar to the other bar several times.

Describe how the gravitational potential energy store and the kinetic energy store of the gymnast change as she moves between the bars.

____

____

____

____

____

____

____

____

(4)

(f) Falling on the crash mat reduces the average deceleration of the gymnast compared with falling on a hard surface.

Explain why reducing the deceleration is important to the gymnast.

____

____

____

____

____

____

(2)
(Total 11 marks)

3. **Figure 1** shows two children playing table tennis.

The boy hits the ball from one end of the table.

Figure 1

(a) Why does the velocity of the ball change when the boy hits it?

Tick (✓) **one** box.

The direction of the ball does not change.	☐
There is a resultant force on the ball.	☐
The mass of the ball increases.	☐
The speed of the ball is constant.	☐

(1)

(b) The ball has an average speed of 11 m/s

The ball takes 0.25 s to travel the same distance as the length of the table.

Calculate the length of the table.

Use the equation:

distance travelled = speed × time

____

____

____

____

Length of table = ____________________ m

(2)

(c) A table tennis ball should only be used if it bounces to at least 75% of the height it was dropped from.

A manufacturer tested a table tennis ball.

The table shows the results.

Height ball was dropped from in cm	**Height of bounce in cm**
30.0	25.1

Determine whether the ball can be used.

Use the data from the table above.

____

____

____

____

____

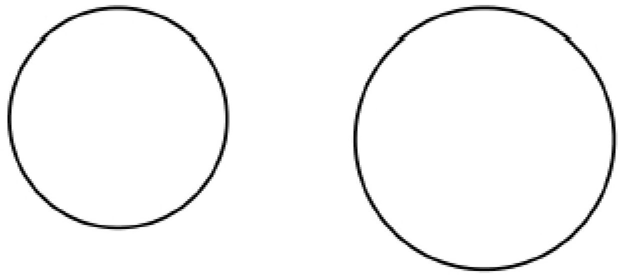
____

(3)

(d) **Figure 2** shows two table tennis balls.

The balls are different sizes but have the same mass.

Figure 2



Both balls were dropped onto the table from the same height.

After they were dropped, the resultant force on the smaller ball was greater than the resultant force on the larger ball.

Explain why.

____

____

____

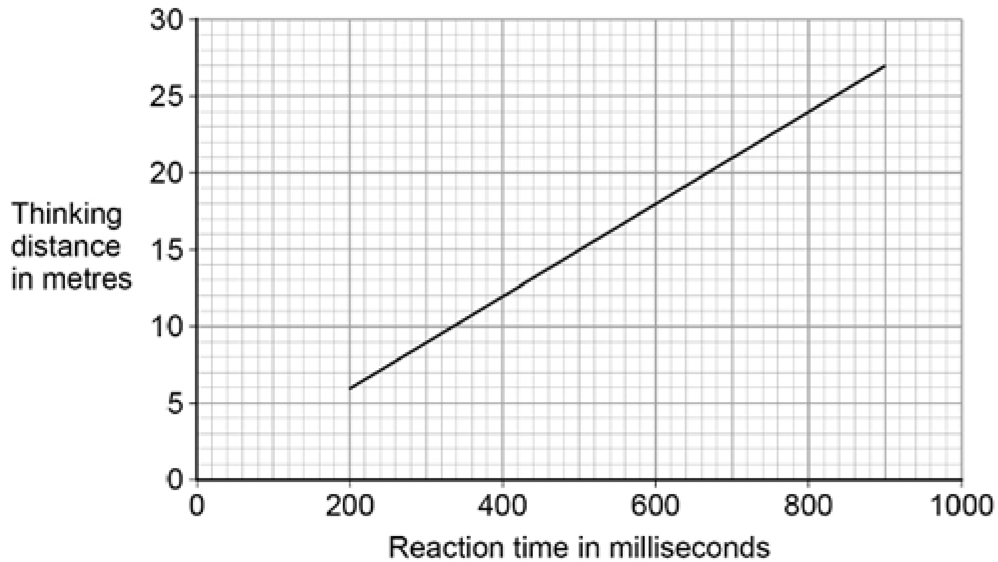
____

(2)

(Total 8 marks)

4. The thinking distance of a car depends on the reaction time of the driver.

The graph shows how thinking distance varies with reaction time for a car travelling at 30 m/s



(a) The reaction time of a driver can double if the driver is distracted.

Explain the effect doubling the reaction time has on the thinking distance.

Use data from the graph above.

____

____

____

____

(2)

(b) Give the reason why there are no values of thinking distance for reaction times less than 200 milliseconds.

____

____

(1)

A driver measured her reaction time using an online test. She did the test five times.

The table shows the results.

Reaction time in milliseconds				
258	265	302	248	327

(c) How does the data in the table show that it was important that the driver did the test five times?

____

____

(1)

(d) Calculate the mean reaction time of the driver.

____

____

____

____

Mean reaction time = ____________________ ms

(2)

(e) The driver is driving her car at 30 m/s

Determine the thinking distance.

Use the graph and your answer from part **(d)**.

Thinking distance = ____________________ m

(1)

(f) The driver applies the brakes and the car comes to a stop.

The force exerted by the brakes affects the braking distance.

Give **two** other factors that affect the braking distance.

1 ____

2 ____

(2)

(g) Write down the equation that links distance, force and work done.

____

(1)

(h) When the driver applies the brakes, there is a constant resultant force of 6.0 kN on the car.

The car travels a distance of 75 m before stopping.

Calculate the work done in stopping the car.

____

____

____

____

____

____

Work done = ____________________ J

(3)

(Total 13 marks)

5. The Sun emits all types of electromagnetic waves.

Figure 1 shows the electromagnetic spectrum.

Figure 1

Radio waves	Microwaves	Infrared	Visible light	Ultraviolet	X-rays	Gamma rays

(a) Complete the sentences.

Choose answers from the box.

frequency	**mass**	**power**
velocity		**wavelength**

In a vacuum, all electromagnetic waves travel at the same ________________ .

Gamma waves have the greatest ________________ .

Radio waves have the greatest ________________ .

(3)

(b) Explain why it is important that the Earth's atmosphere absorbs gamma rays emitted by the Sun.

___

___

___

___

(2)

(c) Some microwaves are **not** absorbed by the Earth's atmosphere.

Why is this useful?

___

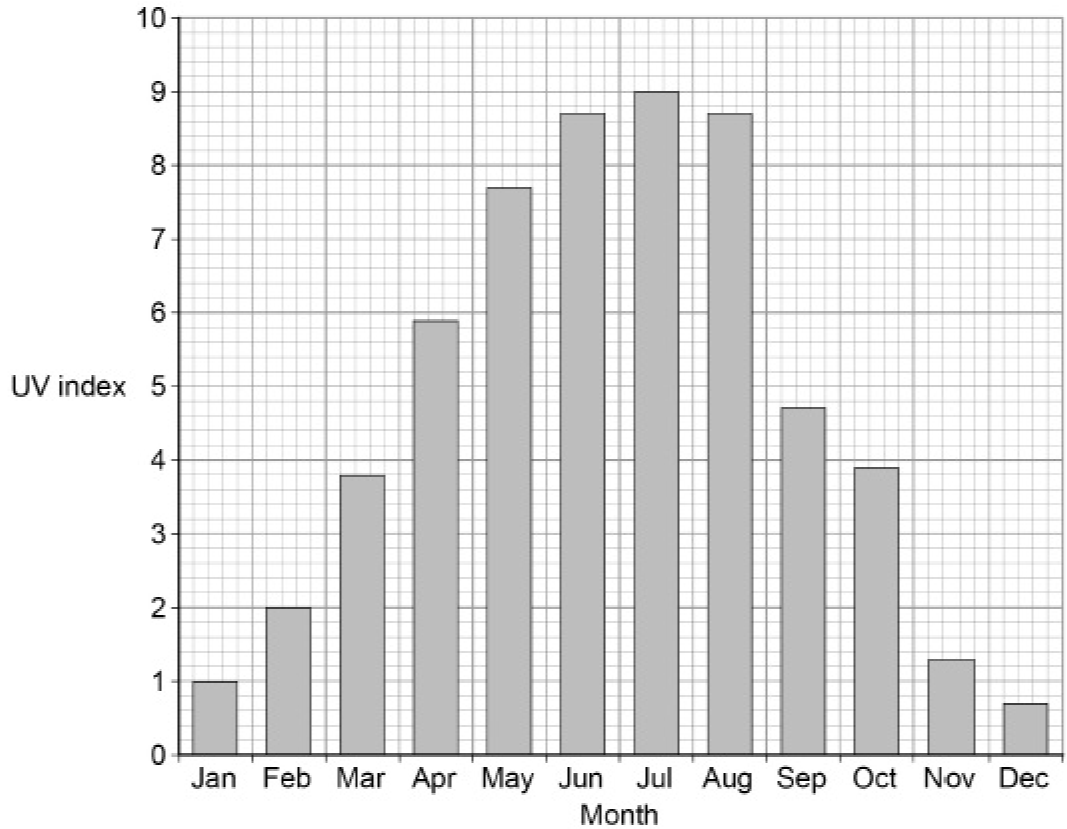
(1)

Some ultraviolet (UV) radiation from the Sun passes through the atmosphere and reaches the surface of the Earth.

The amount of UV radiation that reaches the surface of the Earth can be measured on a scale called the UV index.

Figure 2 shows the average midday UV index in the UK for 1 year.

Figure 2



(d) Why is exposure to UV radiation harmful to humans?

____

____

(1)

(e) Compare the risk from UV radiation at different times of year in the UK.

Use data from **Figure 2**.

____

____

____

____

(2)

(Total 9 marks)

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

(a) Draw **one** line from each type of electromagnetic wave to a use of that type of wave.

Electromagnetic wave	**Use**
	Cooking food
Radio waves	Detecting broken bones
Visible light	Fibre optic communications
X-rays	Transmitting TV programmes

(3)

A student investigated how the type of surface affects the amount of infrared the surface radiates.

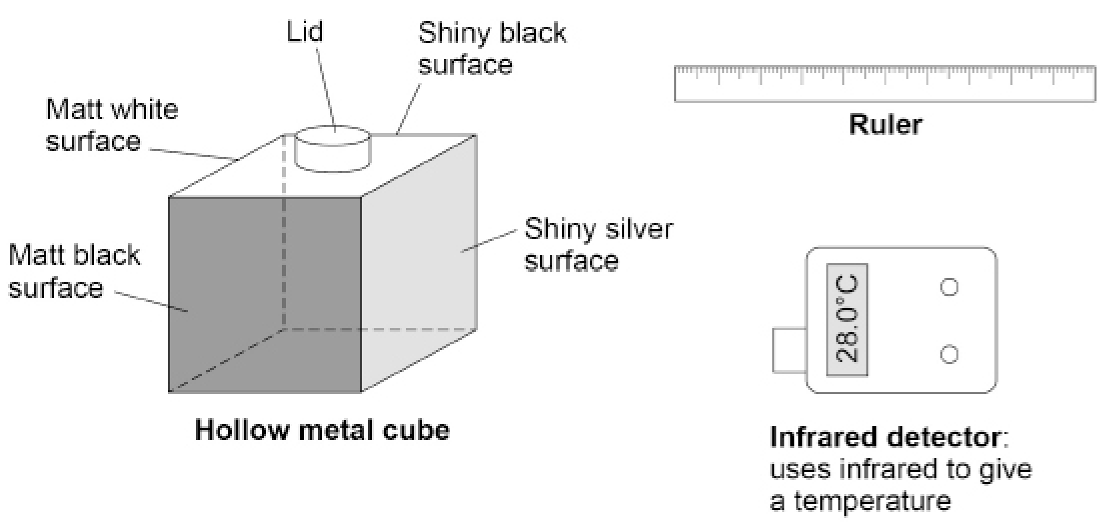
The student used a hollow metal cube.

Four of the surfaces of the cube were different.

This is the method used.

1. Fill the cube with hot water and seal it with a lid.
2. Measure the infrared radiation emitted from each surface using an infrared detector.

The diagram below shows the equipment used.



(b) **Table 1** shows some of the variables in this investigation.

Table 1

Variable	**Independent**	**Dependent**	**Control**
Distance between infrared detector and surface of cube			✓
Starting temperature of water inside cube			
Temperature measured by infrared detector			
Type of surface			

Identify each variable as an independent, dependent or control variable.

Tick (✓) **one** box in each row on **Table 1**.

One row has been completed for you.

(3)

Table 2 shows the results.

Table 2

Type of surface	**Temperature in °C**
Shiny black	66.5
Matt white	61.0
Matt black	69.0
Shiny silver	26.0

(c) What was the resolution of the infrared detector?

Tick (✓) **one** box.

0.5 °C	☐
1.0 °C	☐
26.0 °C	☐
66.5 °C	☐

(1)

(d) What was the range of temperatures recorded?

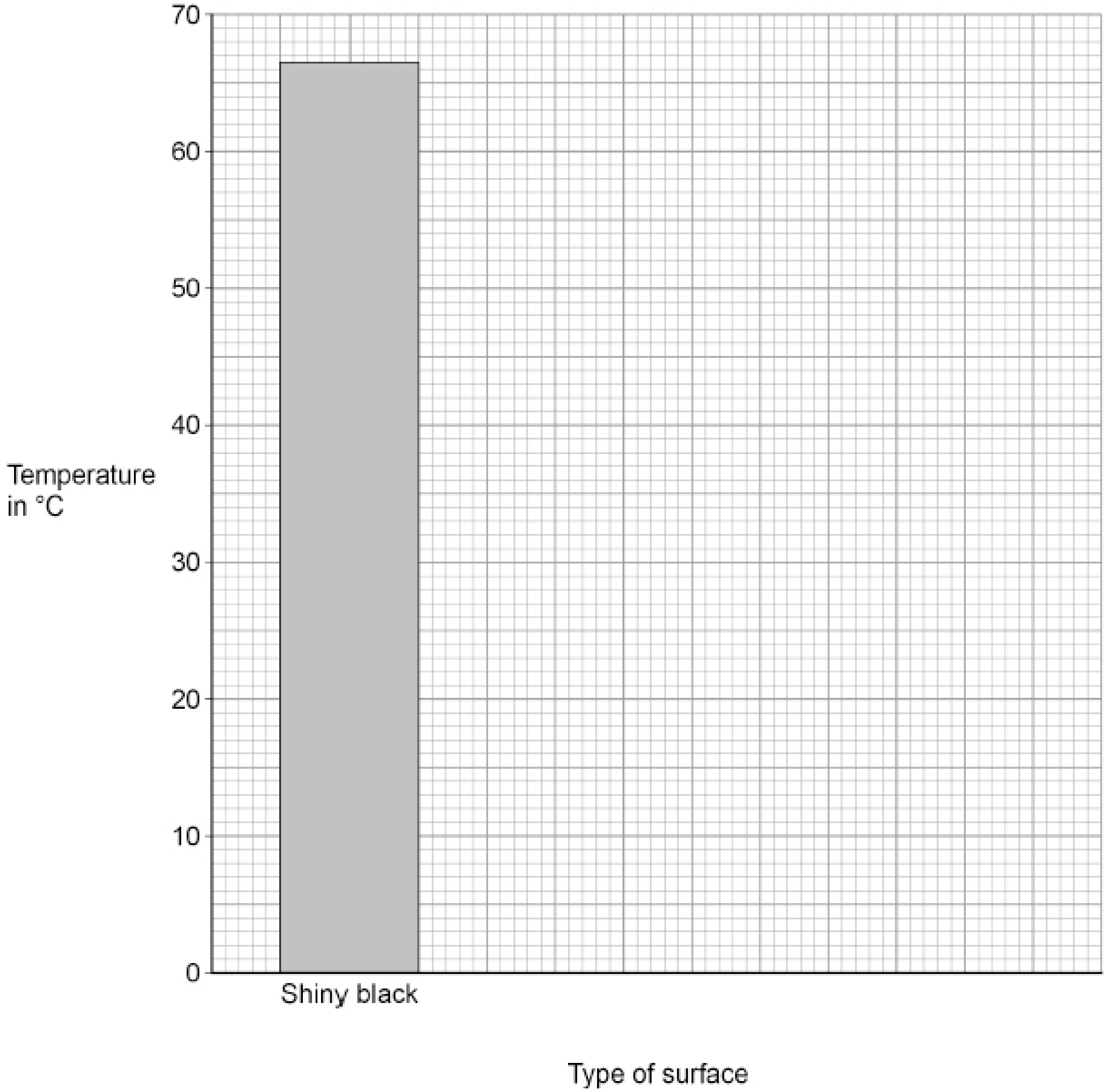
Range = ________________ °C to ________________ °C

(1)

(e) Complete the chart below.

You should:

- plot the data from **Table 2** as a bar chart
- label each bar.



(3)

(f) Give **one** conclusion that can be made from the results in **Table 2**.

____

____

(1)

(g) Which equation links frequency (*f*), wavelength (λ) and wave speed (*v*)?

Tick (✓) **one** box.

$f = v \times \lambda$ ☐

$v = f \times \lambda$ ☐

$v = \frac{f}{\lambda}$ ☐

(1)

(h) A radio wave has:

- a speed of 300 000 000 m/s
- a wavelength of 500 m

Calculate the frequency of the radio wave.

Give the unit.

Choose the unit from the box.

hertz	**kilograms**	**metres**	**seconds**

____

____

____

____

____

Frequency = ________________ Unit ________________

(4)

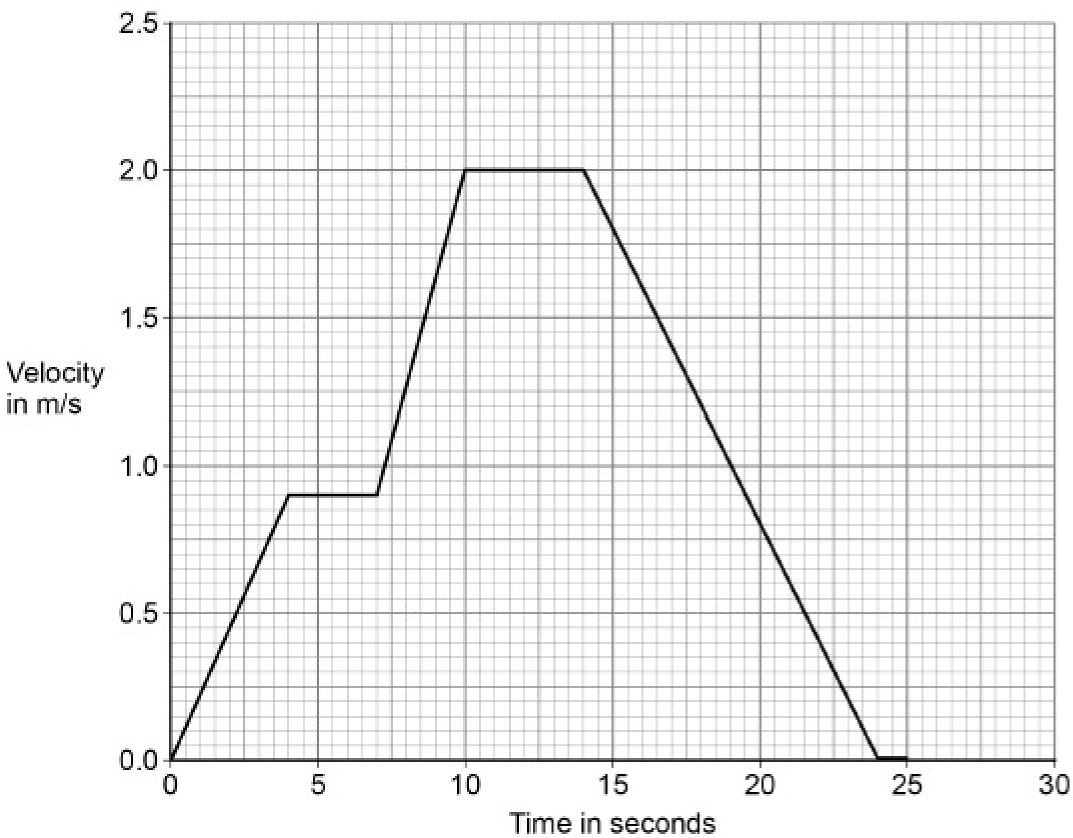
(Total 17 marks)

7. **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/s^2

(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)