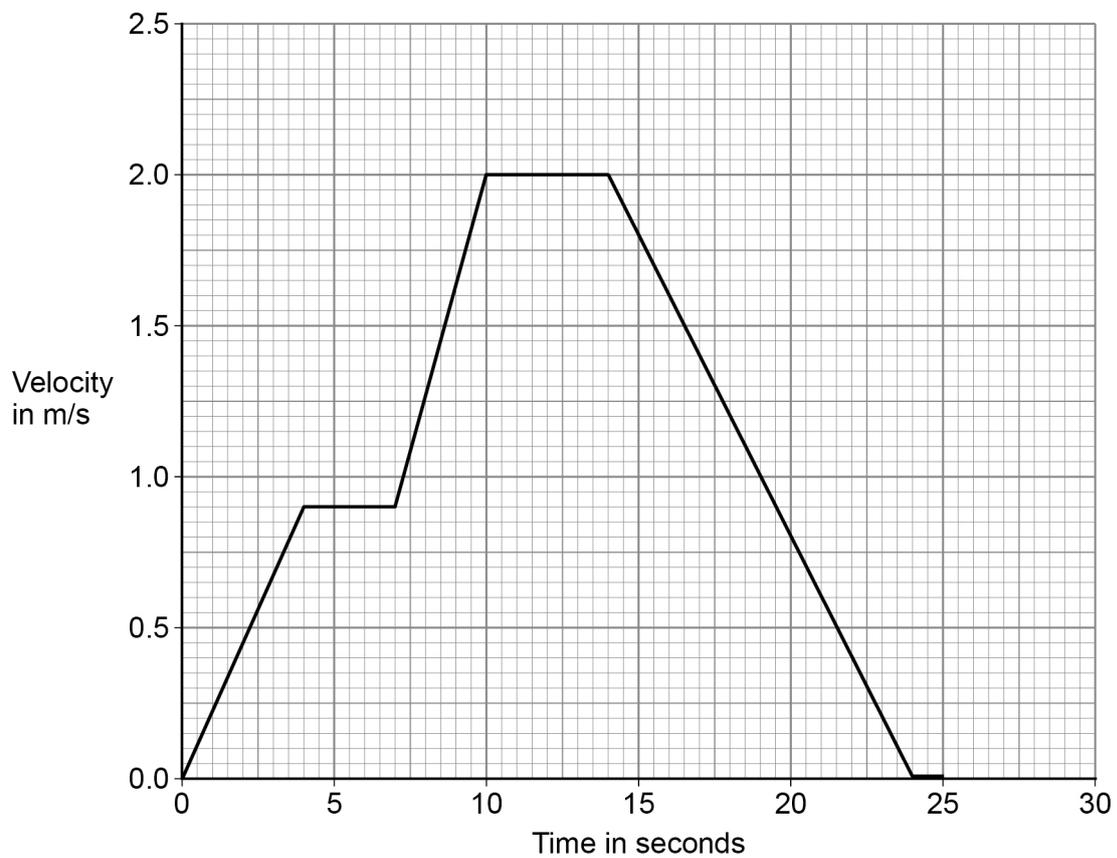**0 6**   **Figure 9** shows a runner using a smart watch and a mobile phone to monitor her run.

Figure 9

Figure 10 is a velocity–time graph for part of the runner's warm-up.

Figure 10

0 6 . 1 Determine the total time for which the velocity of the runner was increasing.

[2 marks]

Time = _____ s

0 6 . 2 Determine the deceleration of the runner.

[2 marks]

Deceleration = _____ m/s^2

Question 6 continues on the next page

Turn over ▶

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.

0 6 . 3 Suggest why the phone and watch being connected by a wireless system is an advantage when running.

[1 mark]

_____

_____

0 6 . 4 Write down the equation that links frequency, wave speed and wavelength.

[1 mark]

_____

0 6 . 5 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.

[3 marks]

_____

_____

_____

_____

_____

Wavelength = _____ m

0 6 . 6 **Table 3** shows some information about four types of Bluetooth.

Table 3

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.

[2 marks]

1 _____

_____

2 _____

_____

11

Turn over for the next question

Turn over ▶

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.1	(4 - 0) + (10 - 7) **or** 4 + 3 **or** 10 - 3 7 (s)	an answer of 7 (s) gains **2** marks	1 1	AO2 6.5.4.1.5	E
06.2	gradient = $\frac{0-2}{24-14}$ (-) 0.2 (m/s^2)	an answer of 0.2 (m/s^2) gains **2** marks allow readings from any two points correctly substituted allow correct use of $a = \frac{\Delta v}{t}$	1 1	AO2 6.5.4.1.5	E
06.3	(there are no wires) to get tangled / disconnected	allow easier to move arms allow wires are inconvenient allow easier to transfer data	1	AO3 6.6.2.4	E
06.4	wave speed = frequency × wavelength	allow v = f λ allow any correct re-arrangement	1	AO1 6.6.1.2	E
06.5	300 000 000 = 2 400 000 000 × λ λ = $\frac{300\ 000\ 000}{2\ 400\ 000\ 000}$ λ = 0.125 (m)	an answer of 0.125 (m) or 0.13 (m) scores **3** marks allow λ = 0.13 (m)	1 1 1	AO2 6.6.1.2	E
06.6	range is far enough (for most uses) power is not too great so the battery will not drain quickly	allow power not too great so the phone will not overheat allow the range per milliwatt is greatest or 4 metres	1 1	AO3 6.6.2.4	E