WHA

CP4 and CP5 Calculations

EXAM BOOKLET

MCKELVIE. S

(b) Some microwaves have a frequency of 1.5×10^{10} Hz.
They travel at a speed of 3.0×10^{8} m/s.

Calculate their wavelength.

(3)

wavelength = ... m

(d) The telescope is used to look at the planet Venus.
Assume that the distance from Venus to the Earth is 39 000 000 km.
The speed of light is 300 000 000 m/s.

Calculate the time it takes for light to travel from Venus to the Earth.

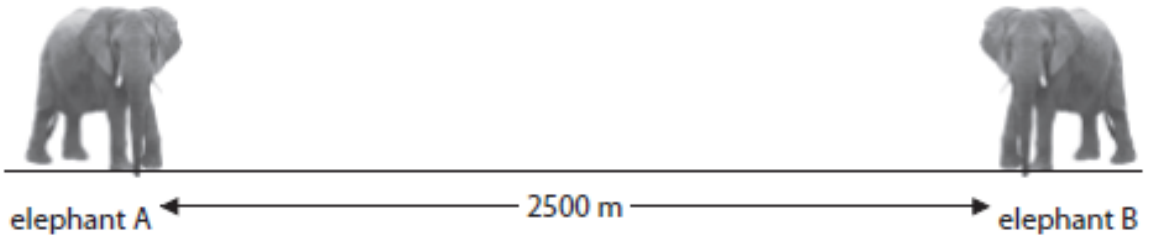
(3)

time = ... s

(c) Both infrasound waves and ultrasound waves are types of sound waves.
They are used by animals to communicate.

Two elephants use infrasound waves for long distance communication.
The distance between these two elephants is 2500 m.

not to scale



Elephant A emits an infrasound call.
When elephant B hears the infrasound, it calls back.
Elephant A hears the answering call from elephant B.
The speed of infrasound is 340 m/s.

(i) Show that the minimum time for elephant A to call and hear an answer from elephant B is about 15 s.

(3)

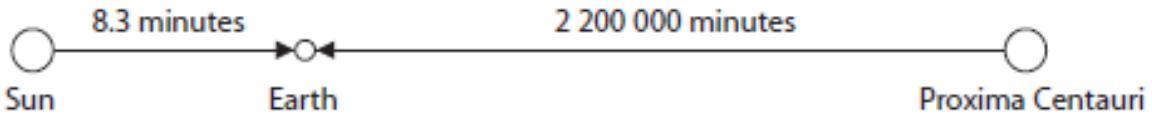
(ii) An elephant's infrasound call has a range of 4000 m.
Each infrasound call lasts between 2 s and 10 s.
Each elephant usually waits about 30 s before it calls again.

Suggest a reason why elephants wait 30 s before calling again.

(1)

(c) Outside our Solar System, the star closest to Earth is called Proxima Centauri.
Light from this star takes 2 200 000 minutes to reach the Earth.
Light from the Sun takes 8.3 minutes to reach the Earth.
The speed of light is 18 000 000 km/minute.

not to scale



(i) By calculation, compare the distance of Proxima Centauri from the Earth with the distance of the Sun from the Earth.

(2)

(iii) The average speed of a P-wave in the mantle is 12 km/s.
A P-wave travels vertically down from the surface and reflects from the core–mantle boundary back to the surface.
It travels a total distance of 5800 km.

Calculate the total time of travel for the wave.

(3)

time = ... s

(b) The velocity of the waves in deep water is 25 m/s.
The wavelength is 120 m.

Calculate the frequency of the waves.

(3)

frequency = ... Hz

(d) An X-ray of wavelength 2.0 nm has a frequency of 1.5×10^{17} Hz.

$1.0\ nm = 1.0 \times 10^{-9}\ m$

Calculate the speed of the wave.

(2)

speed = ... m/s

(c) Light travels the 150 million km from the Sun to the Earth in about 500 s.
It takes about 2100 s for light to reach the Earth from Jupiter.
Using this information, calculate the approximate distance of Jupiter from the Earth.

(2)

distance of Jupiter from the Earth = ... million km

(b) An electromagnetic wave has a frequency of 7×10^9 Hz.
The speed of the wave is 3×10^8 m/s.
Calculate the wavelength of the wave.

(3)

wavelength = ... m

(b) The earthquake causes seismic waves.

(i) S waves are one type of seismic wave. They travel at 0.65 km/s.
There is a seismometer 80 km away from point E.
Show that it takes about 2 minutes for the S waves from the earthquake to reach the seismometer.

(2)

(c) The telescope collects light reflected from Jupiter.
The light has a frequency of 4.30×10^{14} Hz and a speed of 3.00×10^{8} m/s.
Calculate the wavelength of the light.

(3)

wavelength = ... m

4 A note was played on an electric keyboard.

The frequency of the note was 440 Hz.

4 (a) (i) What does a frequency of 440 Hz mean?

[1 mark]

.....

.....

4 (a) (ii) The sound waves produced by the keyboard travel at a speed of 340 m/s.

Calculate the wavelength of the note.

Use the correct equation from the Physics Equations Sheet.

Give your answer to **three** significant figures.

[3 marks]

.....

.....

.....

Wavelength = ... metres

(b) The foghorn emits sound waves with a frequency of 160 Hz.

The speed of sound is 340 m/s.

(i) State the equation linking wave speed, frequency and wavelength.

(1)

(ii) Calculate the wavelength of these sound waves.

(2)

wavelength = ... m

6 Echo sounding is used to detect fish in the sea.

Sound waves are emitted from a fishing boat. Some of the sound waves are reflected by fish and detected back at the boat.

(a) The shortest time between the sound waves being emitted and detected is 0.26 s.

The speed of sound in water is 1.5 km/s.

Calculate the distance between the boat and the nearest fish.

(4)

distance = ... m

(c) Visible light from Mars reaches the Earth.

The speed of light is 300 000 km/s.

(i) Show that when the planets are 170 000 000 km apart, it takes about 600 s for light to travel this distance.

(3)

(c) A radio station broadcasts at a frequency of 200 kHz.

The wavelength of the radio waves is 1500 m.

(i) State the equation linking wave speed, frequency and wavelength.

(1)

(ii) Calculate the speed of these radio waves and give the unit.

(3)

speed = ... unit .....

(c) (i) State the equation linking wave speed, frequency and wavelength.

(1)

(ii) The speed of radio waves is 300 000 000 m/s.

A radio wave has a frequency of 31 MHz.

Calculate the wavelength of this radio wave.

(3)

wavelength = ... m

(d) A sound wave travels with a velocity of 1530 m/s.

The frequency of the wave is 1.20 kHz.

Calculate the wavelength of the wave.

(3)

wavelength = ... m