



Exampro GCSE Physics

P1 Waves Self Study Questions - Higher tier

Name:

Class:

Author:

Date:

Time: 74

Marks: 74

Comments:

Q1. All radio waves travel at 300 000 000 m/s in air.

(i) Give the equation that links the frequency, speed and wavelength of a wave.

.....

(1)

(ii) Calculate the wavelength, in metres, of a radio wave which is broadcast at a frequency of 909 kHz. Show clearly how you work out your answer.

.....

.....

.....

Wavelength = metres

(2)

(Total 3 marks)

Q2. (i) Use the words frequency, wavelength and wave speed to write an equation which shows the relationship between them.

.....

(1)

(ii) Calculate the speed of a sound wave with a frequency of 250 Hz and a wavelength of 1.3 m.

Show how you get to your answer and give the unit.

.....

.....

Speed =

(2)

(Total 3 marks)

Q3. (a) Electromagnetic waves form a continuous spectrum with a range of wavelengths.

What is the approximate range of wavelengths of electromagnetic waves?

Tick (✓) **one** box.

10^{-15} metres to 10^4 metres

10^{-4} metres to 10^{15} metres

10^{-6} metres to 10^6 metres

(1)

(b) Infrared waves and microwaves are used for communications.

(i) Give **one** example of infrared waves being used for communication.

.....
.....

(1)

(ii) A mobile phone network uses microwaves to transmit signals through the air. The microwaves have a frequency of 1.8×10^9 Hz and travel at a speed of 3.0×10^8 m/s.

Calculate the wavelength of the microwaves.

Use the correct equation from the Physics Equations Sheet.

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

.....
.....
.....

Wavelength = m

(3)

- (c) Some scientists suggest there is a possible link between using a mobile phone and male fertility.

The results of their study are given in the table.

Mobile phone use in hours per day	Sperm count in millions of sperm cells per cm ³ of semen
0	86
less than 2	69
2 – 4	59
more than 4	50

The results show a negative correlation: the more hours a mobile phone is used each day, the lower the sperm count. However, the results do **not** necessarily mean using a mobile phone causes the reduced sperm count.

Suggest **one** reason why.

.....

(1)
 (Total 6 marks)

Q4. Galaxies emit all types of electromagnetic wave.

- (a) (i) Which type of electromagnetic wave has the shortest wavelength?

.....

(1)

- (ii) State **one** difference between an ultraviolet wave and a visible light wave.

.....

(1)

- (b) Electromagnetic waves travel through space at a speed of 3.0×10^8 m/s.

The radio waves emitted from a distant galaxy have a wavelength of 25 metres.

Calculate the frequency of the radio waves emitted from the galaxy and give the unit.

Use the correct equation from the Physics Equations Sheet.

.....

Frequency =

(3)

(c) Scientists use a radio telescope to measure the wavelength of the radio waves emitted from the galaxy in part (b) as the waves reach the Earth. The scientists measure the wavelength as 25.2 metres. The effect causing this observed increase in wavelength is called red-shift.

(i) The waves emitted from most galaxies show red-shift.

What does red-shift tell scientists about the direction most galaxies are moving?

.....
.....

(1)

(ii) The size of the red-shift is **not** the same for all galaxies.

What information can scientists find out about a galaxy when they measure the size of the red-shift the galaxy produces?

.....
.....
.....
.....

(2)

(iii) What does the observation of red-shift suggest is happening to the Universe?

.....
.....

(1)

(Total 9 marks)

Q5. (a) Microwaves are one type of electromagnetic wave.

(i) Which type of electromagnetic wave has a lower frequency than microwaves?

.....

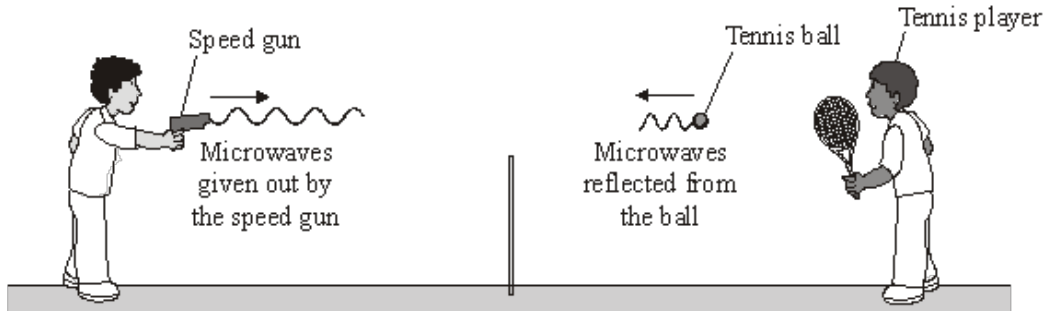
(1)

(ii) What do all types of electromagnetic wave transfer from one place to another?

.....

(1)

- (b) The picture shows a tennis coach using a speed gun to measure how fast the player serves the ball.



- (i) The microwaves transmitted by the speed gun have a frequency of 24 000 000 000 Hz and travel through the air at 300 000 000 m/s.

Use the equation in the box to calculate the wavelength of the microwaves emitted from the speed gun.

$\text{wave speed} = \text{frequency} \times \text{wavelength}$

Show clearly how you work out your answer.

.....

Wavelength = m

(2)

- (ii) Some of the microwaves transmitted by the speed gun are absorbed by the ball.

What effect will the absorbed microwaves have on the ball?

.....

(1)

- (iii) Some of the microwaves transmitted by the speed gun are reflected from the moving ball back towards the speed gun.

Describe how the wavelength and frequency of the microwaves change as they are reflected from the moving ball.

.....

(2)

(Total 7 marks)

##

- (a) The wavelengths of four different types of electromagnetic wave, including visible light waves, are given in the table.

Type of wave	Wavelength
Visible light	0.0005 mm
A	1.1 km
B	100 mm
C	0.18 mm

Which of the waves, **A**, **B** or **C**, is an infra red wave?

(1)

- (b) A TV station broadcasts at 500 000 kHz. The waves travel through the air at 300 000 000 m/s.

Use the equation in the box to calculate the wavelength of the waves broadcast by this station.

$\text{wave speed} = \text{frequency} \times \text{wavelength}$

Show clearly how you work out your answer.

.....
.....

Wavelength = m

(2)

- (c) What happens when a metal aerial absorbs radio waves?

.....
.....
.....
.....

(2)

- (d) Stars emit all types of electromagnetic waves. Telescopes that monitor X-rays are mounted on satellites in space.

Why would an X-ray telescope based on Earth not be able to detect X-rays emitted from distant stars?

.....

(1)
 (Total 6 marks)

- Q7.** (a) The wavelengths of four different types of electromagnetic wave, including visible light waves, are given in the table.

Type of wave	Wavelength
Visible light	0.0005 mm
A	1.1 km
B	100 mm
C	0.18 mm

Which of the waves, **A**, **B**, or **C**, is an infra red wave?

.....

(1)

- (b) A TV station broadcasts at 500 000 kHz. The waves travel through the air at 300 000 000 m/s.

Use the equation in the box to calculate the wavelength of the waves broadcast by this station.

$\text{wave speed} = \text{frequency} \times \text{wavelength}$

Show clearly how you work out your answer.

.....

Wavelength = m

(2)

(c) What happens when a metal aerial absorbs radio waves?

.....
.....
.....
.....

(2)

(d) Stars emit all types of electromagnetic waves. Telescopes that monitor X-rays are mounted on satellites in space.

Why would an X-ray telescope based on Earth **not** be able to detect X-rays emitted from distant stars?

.....
.....

(1)

(Total 6 marks)

Q8. (a) Microwaves and visible light are two types of electromagnetic wave. Both can be used for communications.

(i) Give **two** properties that are common to both visible light and microwaves.

1

.....

2

.....

(2)

(ii) Name **two** more types of electromagnetic wave that can be used for communications.

..... and

(1)

- (b) Wi-Fi is a system that joins computers to the internet without using wires. Microwaves, with a wavelength of 12.5 cm, are used to link a computer to a device called a router. Microwaves travel through the air at 300 000 000 m/s.

Use the equation in the box to calculate the frequency of the microwaves used to link the computer to the router.

$\text{wave speed} = \text{frequency} \times \text{wavelength}$

Show clearly how you work out your answer and give the unit.

.....

.....

.....

Frequency =

(3)

- (c) Wi-Fi is used widely in schools. However, not everyone thinks that this is a good idea.

A politician commented on the increasing use of Wi-Fi. He said: 'I believe that these systems may be harmful to children.'

However, one group of scientists said that there is no reason why Wi-Fi should not be used in schools. These scientists also suggested that there is a need for further research.

- (i) Suggest what the politician could have done to persuade people that what he said was not just an opinion.

.....

.....

(1)

- (ii) Why did the group of scientists suggest that there is a need for further research?

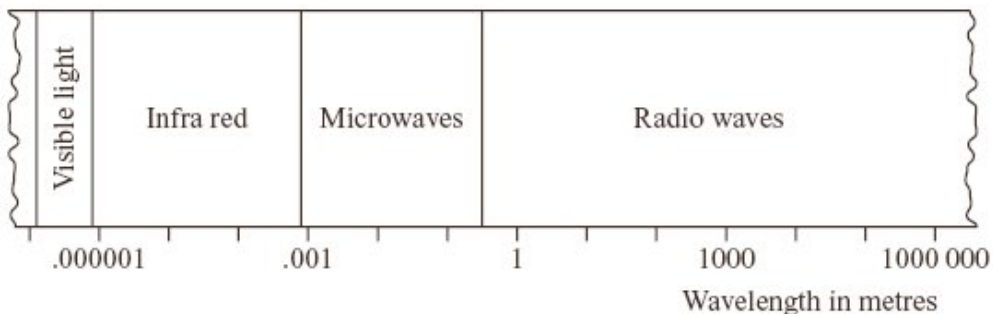
.....

.....

(1)

(Total 8 marks)

Q9. The diagram represents part of the electromagnetic spectrum.



- (i) Visible light travels through air at 300 000 000 m/s.

Why can we assume that radio waves travel through air at the same speed as light?

.....

(1)

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

Use the following equation to calculate the wavelength of the waves broadcast by this radio station. Show clearly how you work out your answer.

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

.....

.....

$$\text{Wavelength} = \dots\dots\dots \text{ m}$$

(2)

- (iii) Draw a vertical line on the diagram above to show the position of this radio wave in the electromagnetic spectrum.

(1)

(Total 4 marks)

- Q10.** (a) Water waves are transverse waves. Sound waves are longitudinal waves.

- (i) Explain the difference between a transverse wave and a longitudinal wave.

You may include labelled diagrams in your answer.

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.....
.....
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.....
.....
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.....

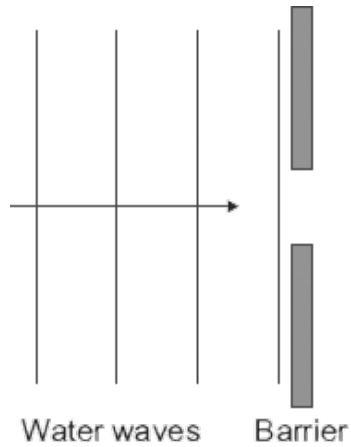
(3)

- (ii) Name **one** type of wave that may be either transverse or longitudinal.

.....

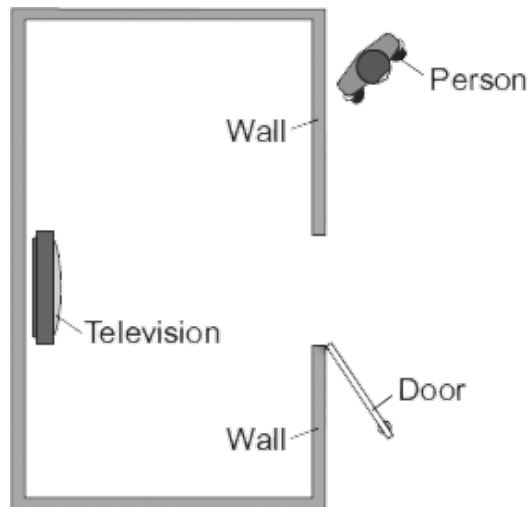
(1)

- (b) The diagram shows water waves in a ripple tank moving towards a gap in a barrier. The water waves diffract as they pass through the gap. Complete the diagram to show the diffracted water waves.



(1)

- (c) A television is switched on inside a room. A person outside the room can hear the television, but only when the door is open.



When the door is open, the person can hear the sound but cannot see the television.

Explain why.

.....

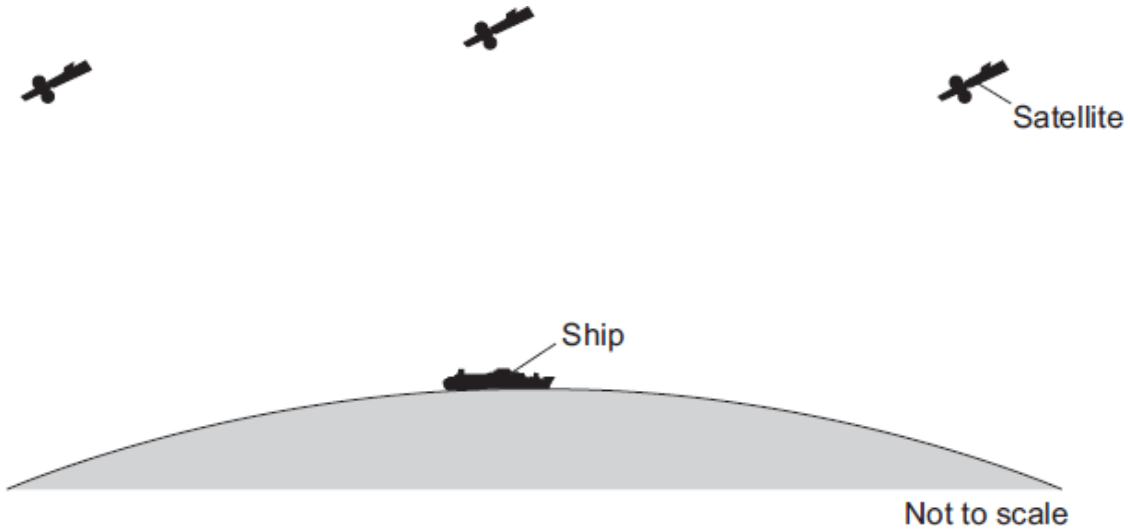
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.....

.....

(2)
(Total 7 marks)

Q11. The ship in the diagram is fitted with a navigation system. The navigation system works out the location of the ship by timing the microwave signals transmitted from at least three satellites.



(a) Microwaves are one type of electromagnetic wave.

Give **two** properties that all electromagnetic waves have.

- 1
-
- 2
-

(2)

(b) The microwaves used in the navigation system are transmitted at a frequency of 1575 MHz.

Use the equation and information in the box to calculate the wavelength of the microwaves used in the navigation system.

$\text{wave speed} = \text{frequency} \times \text{wavelength}$ <p>microwaves travel at 300 000 000 m/s 1 MHz = 1 000 000 Hz</p>

Show clearly how you work out your answer.

-
-
-
-

Wavelength = m

(3)

- (c) The ship is fitted with a metal aerial that receives the microwave signals from the satellites.

For the navigation system to work, what effect must the microwave signals have on the aerial?

.....
.....

(1)
(Total 6 marks)

Q12. Radio waves and microwaves are two types of electromagnetic wave.

Both waves:

- can be used for communications
- travel at the same speed through air.

- (a) Give **two** more properties that are the same for both radio waves and microwaves.

1

.....

2

.....

(2)

- (b) Some satellites are used to transmit television programmes. Signals are sent to, and transmitted from, the satellites using microwaves.

What is the property of microwaves that allows them to be used for satellite communications?

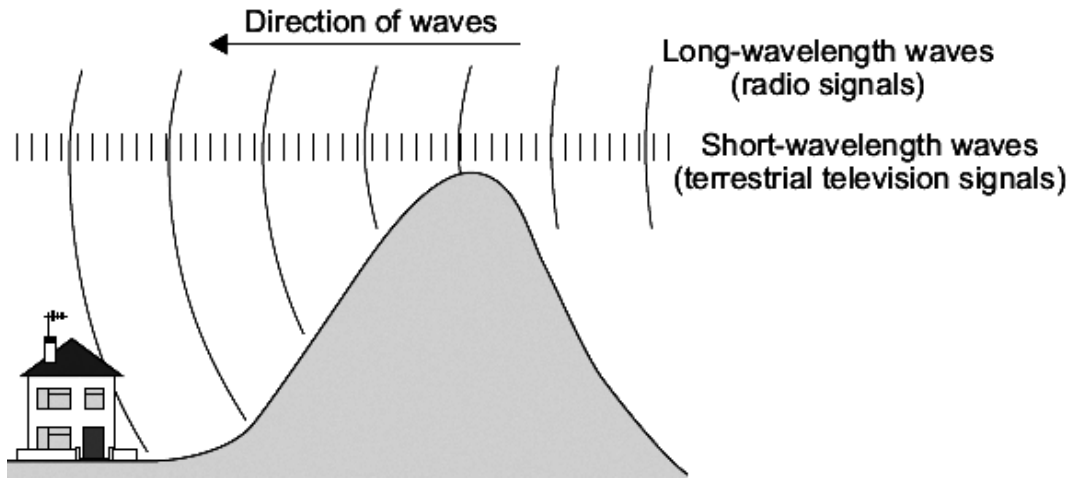
.....
.....

(1)

(c) Terrestrial television does not use satellites.

Terrestrial television signals and radio signals both use radio waves.

Radio signals are transmitted at a longer wavelength than terrestrial television signals.



My Revision Notes AQA GCSE Physics for A* – C, Steve Witney, © Philip Allan UK

In hilly areas it may be possible to receive radio signals but not receive terrestrial television signals.

Explain why.

.....

.....

.....

.....

.....

.....

(3)

(d) Electromagnetic waves travel at a speed of 3.0×10^8 m/s.

A radio station transmits waves with a wavelength of 2.5×10^2 m.

Calculate the frequency of the radio waves.

Use the correct equation from the Physics Equations Sheet.

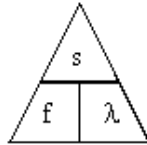
Show clearly how you work out your answer and give the unit.

.....
.....
.....

Frequency =

(3)
(Total 9 marks)

- M1.** (i) speed = frequency \times wavelength
accept the equation rearranged
accept v or $s = f \times \lambda$
do not allow w for wavelength
do not accept



unless subsequent calculation correct

1

- (ii) 330 (m)

allow 1 mark for

$$\lambda = \frac{300\,000\,000}{909\,000}$$

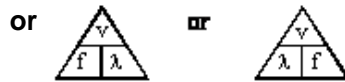
or $300\,000\,000 = 909\,000 \times \lambda$

or answer of 330000(m) or 330033(m)

2

[3]

- M2.** (i) (wave) speed = frequency \times wavelength
or any correctly transposed version
accept $v = f \times \lambda$
or transposed version
accept $m/s = 1 / s \times m$
or transposed version



but only if subsequently used correctly

1

- (i) 325

1

metres per second

or m / s or 0.325 km/s for 2 marks

1

[3]

- M3.** (a) 10^{-15} metres to 10^4 metres 1
- (b) (i) any **one** from:
- (TV / video / DVD) remote controls
mobile phones is insufficient
 - (short range) data transmission
accept specific example, eg linking computer peripherals
 - optical fibre (signals)
*do **not** accept Bluetooth*
- 1
- (ii) 0.17
an answer 17 cm gains 3 marks
an answer given to more than 2 significant figures that rounds to 0.17 gains 2 marks
allow 1 mark for correct substitution, ie $3 \times 10^8 = 1.8 \times 10^9 \times \lambda$
- 3
- (c) (maybe) other factors involved
accept a named 'sensible' factor, eg higher stress / sedentary lifestyle / overweight / smoking more / diet / hot office / age
not testing enough people is insufficient
unreliable data is insufficient
- 1
- [6]**
- M4.** (a) (i) gamma
accept correct symbol
- 1
- (ii) any **one** from:
- (ultraviolet has a) higher frequency
ultraviolet cannot be seen is insufficient
 - (ultraviolet has a) greater energy
 - (ultraviolet has a) shorter wavelength
ignore ultraviolet causes cancer etc
- 1
- (b) $1.2 \times 10^7 / 12\,000\,000$
allow 1 mark for correct substitution, ie $3 \times 10^8 = f \times 25$
- 2

hertz / Hz / kHz / MHz

do **not** accept hz **or** HZ

answers 12 000 kHz **or** 12 MHz gain **3** marks

for full credit the numerical answer and unit must be consistent

1

- (c) (i) away (from each other)
accept away (from the Earth)
accept receding

1

- (ii) distance (from the Earth)
accept how far away (it is)

1

speed galaxy is moving

1

- (iii) (Universe is) expanding

1

[9]

- M5.** (a) (i) radio(waves)

1

- (ii) energy
correct answer only

1

- (b) (i) 0.0125 (m)
allow **1** mark for correct transformation and substitution

2

- (ii) make it hot(ter)
do **not** accept cook it
accept (air) particles inside ball will move faster
accept water in the ball gets hotter

1

- (iii) wavelength decreases
ignore reference to speed

1

frequency increases

1

[7]

- M6.** (a) C or 0.18 mm 1
- (b) 0.6 m 2
allow 1 mark for correct transformation and substitution
allow 1 mark for changing frequency to Hz
answer 600 gains 1 mark
- (c) creates an alternating current 1
accept 'ac' for alternating current
accept alternating voltage
- with the same frequency as the radio wave
accept signal for radio wave
- or** it gets hotter 1
- (d) X-rays cannot penetrate the atmosphere 1
accept atmosphere stops X-rays
*do **not** accept atmosphere in the way*
- or** X-rays are absorbed (by the atmosphere)
before reaching Earth
ignore explanations
- [6]**

- M7.** (a) C or 0.18 mm 1
- (b) 0.6 (m) 2
*allow 1 mark for correct substitution and/or transformation **or** 1*
mark for changing frequency to Hz
answer 600 gains 1 mark
- (c) creates an alternating current 1
accept 'ac' for alternating current
accept alternating voltage
- with the same frequency as the radio wave
accept signal for radio wave
accept it gets hotter for 1 mark provided no other marks scored
- 1**

- (d) X-rays cannot penetrate the atmosphere
accept atmosphere stops X-rays
*do **not** accept atmosphere in the way*

or

X-rays are absorbed (by the atmosphere) before reaching Earth
ignore explanations

1

[6]

M8. (a) (i) any **two** from:

- travel at the same speed (through a vacuum)
accept travel at the speed of light
accept air for vacuum
- can travel through a vacuum / space
*do **not** accept air for vacuum*
- transfer energy
- can be reflected
- can be refracted
- can be diffracted
- can be absorbed
- can be transmitted
- transverse
accept any other property common to electromagnetic waves
accept travel at the same speed through a vacuum for both marks
*do **not** accept both radiated from the Sun*

2

(ii) infra red
both required for the mark

radio(waves)
accept IR for infra red

1

(b) 2 400 000 000
correct transformation and substitution gains 1 mark

$$\text{ie } \frac{300000000}{0.125} \quad \text{or} \quad \frac{300000000}{12.5}$$

an answer of 24 000 000 gains 1 mark

either 2 400 000 kHz

or 2 400 MHz scores **3** marks but the symbol only scores the 3rd mark if it is correct in every detail

2

hertz

accept Hz
*do **not** accept hz*

1

(c) (i) presented (scientific) evidence / data
do an experiment / investigation is insufficient

1

(ii) to find out if there is a hazard (or not)
accept to find out if it is safe
accept not enough evidence to make a decision
not enough evidence is insufficient

1

[8]

M9. (i) all electromagnetic waves travel at the same speed through a vacuum, (so assume same speed in air)

accept 'all parts of spectrum' for electromagnetic waves

1

(ii) 1500 (m)

allow 1 mark for correct transformation and substitution
allow 1 mark for using 200 000 Hz
answers 1 500 000 = 1 mark

2

(iii) line drawn at correct position
anywhere between 1000 and next section (10 000)
accept their value for (a)(ii) drawn in
the correct position

1

[4]

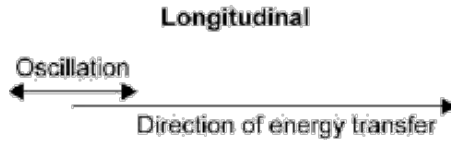
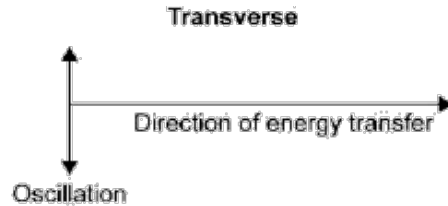
M10. (a) (i) the oscillation / vibration (causing the wave)
a movement causes the wave is insufficient

1

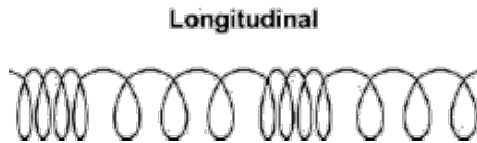
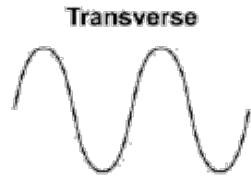
for a transverse wave is perpendicular to the direction of energy transfer
*answers given in terms of direction of wave travel and not energy transfer for both types of wave, score 1 mark for these **two** mark points*

1

and for a longitudinal wave is parallel to the direction of energy transfer
the marks may be scored by the drawing of two correctly labelled diagrams ie



two labelled diagrams showing the general form of a transverse and longitudinal wave gain 1 mark if no other mark has been awarded eg



1

(ii) mechanical wave

accept specific examples, eg waves on a spring / slinky / seismic / earthquake waves

accept water waves

*do **not** accept shock waves*

1

(b) semicircular waves drawn

judged by eye

do not need to be full semicircles

ignore any rays

1

(c) sound (waves) will diffract (towards the person)

1

or

light (waves) do not diffract (towards the person)

(because) width of door way similar to / less than wavelength of sound (waves)

or

(because) width of doorway much greater than wavelength of light (waves)

a general statement that waves (only) diffract when the width of a gap is similar to the wavelength of the waves can be awarded 1 mark

1

[7]

M11. (a) any **two** from:

- travel at the same speed (through a vacuum)
if a value is given it must be correct
accept air for vacuum
accept travel at the speed of light
- can travel through a vacuum / space
*do **not** accept air for vacuum*
- transfer energy
- can be reflected
- can be refracted
- can be diffracted
- can be absorbed
- transverse
- travel in straight lines
accept any other property common to electromagnetic waves
*accept travel at the same speed through a vacuum for **both** marks*
both radiated from the Sun is insufficient

2

(b) 0.19 (0)

accept any answer that rounds to 0.19

accept 0.2 for all 3 marks provided working is shown

0.2 without working gains 2 marks

allow 2 marks for a correct substitution and transformation using frequency in hertz

$$\text{ie wavelength} = \frac{300\,000\,000}{1575\,000\,000}$$

or

allow 1 mark for changing MHz to Hz

allow 1 mark for correct substitution using 1575 or incorrectly converted frequency

answers 190476 and 190000 gain 2 marks

3

(c) create an alternating current with the same frequency
(as the microwaves / signals / 1575 (MHz))

ignore reference to change in temperature

1

[6]

M12. (a) any **two** from:

- travel (at same speed) through a vacuum / space
do not accept air for vacuum
- transverse
- transfer energy
- can be reflected
- can be refracted
- can be diffracted
- can be absorbed
- travel in straight lines

2

(b) can pass through the ionosphere

accept atmosphere for ionosphere

do not accept air for ionosphere

accept travel in straight lines

accept not refracted / reflected / absorbed by the ionosphere

1

(c) diffraction (of waves around hills)

1

wavelength needs to be similar size to the obstacle / gap

1

radio has a long enough wavelength **or** TV doesn't have a long enough wavelength
an answer TV (waves / signals) have short wavelengths so do not diffract (around the hill) scores 2 marks

1

(d) $v = f \times \lambda$

$1.2 \times 10^6 / 1200\ 000$

allow 1 mark for correct substitution

ie $3.0 \times 10^8 = f \times 2.5 \times 10^2$

2

hertz / Hz

*do **not** accept hz **or** HZ*

*accept kHz **or** MHz*

*answers 1.2 MHz **or** 1200 kHz gain all 3 marks*

for full credit the unit and numerical value must be consistent

1

[9]

