GCSE
PHYSICS

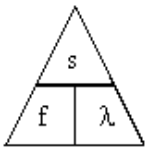
Topic Paper: 6.1 Waves in air, fluids and solids (longitudinal and transverse waves)
Part 1 & 2 Mark Scheme

MARK SCHEME

74 Marks

M1. (i) speed = frequency ×wavelength

accept the equation rearranged
*accept v **or** s = f × λ*
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 × λ*
***or** answer of 330000(m) **or** 330033(m)*

2

[3]

M2. (i) (wave) speed = frequency ×wavelength

***or** any correctly transposed version*
accept v = f × λ
***or** transposed version*
accept m/s = 1 / s ×m
***or** transposed version*

or  **or** 

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) 1.2×10^{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

*allow **1** mark for correct transformation and substitution*
*allow **1** mark for changing frequency to Hz*
*answer 600 gains **1** mark*

2

(c) creates an alternating current

accept 'ac' for alternating current
accept alternating voltage

1

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

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]

M7. (a) C or 0.18 mm

1

(b) 0.6 (m)

*allow **1** mark for correct substitution and/or transformation **or 1** mark for changing frequency to Hz*
*answer 600 gains **1** mark*

2

(c) creates an alternating current

accept 'ac' for alternating current
accept alternating voltage

1

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*
ie $\frac{300000000}{0.125}$ ***or*** $\frac{300000000}{12.5}$
*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

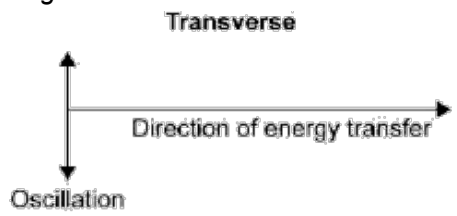
for a transverse wave is perpendicular to the direction of energy transfer

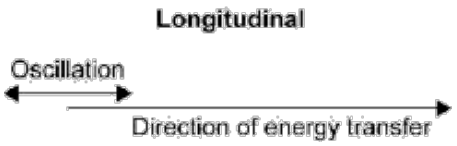
*answers given in terms of direction of wave travel and not energy transfer for both types of wave, score **1** mark for these **two** mark points*

1

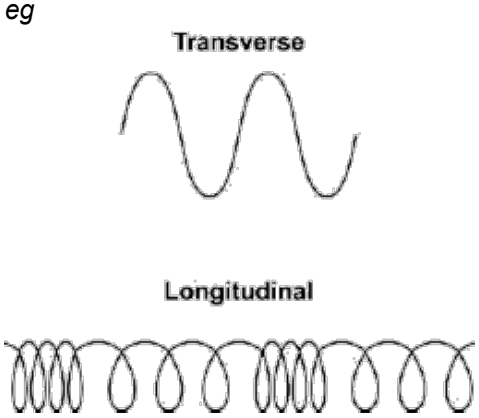
and for a longitudinal wave is parallel to the direction of energy transfer

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) <u>diffract</u> 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*

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) $v = f \times \lambda$

1.2×10^{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]