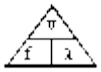
Mark schemes

1 (i) wave speed = frequency × wavelength

accept correct transformation
accept $v = f \times \lambda$
accept s for speed
accept m/s = Hz x m

accept  *if subsequent use of*  *is correct*

1

(ii) 500 000 000

*credit for **1** mark correct transformation in words **or** numbers **or** correct substitution*

2

Hertz

***3** marks for 500 000k Hz **or** 500 MHz*

numerical answer **and** *unit must be consistent for full credit*

1

[4]

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

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

[6]

3

(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

<u>ignore</u> explanations

1

[6]

4

(for both fibres) increasing the <u>wavelength</u> of light decreases and then increases the percentage / amount of light transmitted

*accept for **1** mark:*
(for both fibres) increasing the <u>wavelength</u> (of light) to 5 (x 10^{-7} metres), decreases the (percentage) transmission

1

(for both fibres) the minimum transmission happens at 5 (x 10^{-7} metres)
or
maximum transmission occurs at 6.5 (x 10^{-7} metres)

*accept for a further **1** mark:*
(for both fibres) increasing the wavelength of the light from 5 (x 10^{-7} metres) increases the amount of light transmitted
increasing wavelength (of light), decreases the percentage transmitted is insufficient on its own

1

the shorter fibre transmits a greater percentage of light (at the same wavelength)

*accept for **1** mark:*
Any statement that correctly processes data to compare the fibres

1

[3]

5 (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]

6 (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]

7

(a) radio – 1500
ultra violet 3×10^{-8}
visible – 5×10^{-7}
X-rays – 1×10^{-11}

4

(b) 1×10^{10}Hz 10^{10}HzOK

for 4 marks

else 1×10^{10}

for 3 marks

else 3×10^{8}/0.03

for 2 marks

else v = frequency × wavelength or $3 \times 10^{8} = 0.03$f
any answer with unit Hz scores 1, 2 or 3

for 1 mark

4

[8]

8

(a) (i) to check rise in temperature (of other thermometers) was due to the (different wavelengths of) light

accept as a control / comparison

to measure room temperature is insufficient

1

(ii) any **two** from three:

- different colours produce different heating effects / (rises in) temperatures
- red light produces the greatest heating effect / (rise in) temperature

or

- violet produces the least heating effect / (rise in) temperature
- all colours produce a greater heating effect than outside the spectrum

an answer

the longer the wavelength the greater the (rise in) temperature

or

the lower the frequency the greater the (rise in) temperature gains both marks

2

(b) move a thermometer into the infrared region / just beyond the red light

allow use an infrared camera / infrared sensor

1

the temperature increases beyond 24(°C)

accept temperature higher than for the red light

1

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

9.4×10^{-6}

accept 9.375×10^{-6} or 9.38×10^{-6}

or

0.0000094

accept 0.000009375

or *0.00000938*

*allow **1** mark for correct substitution*

ie $3 \times 10^{8} = 3.2 \times 10^{13} \times \lambda$

2

(d) at night the surroundings are cooler

accept at night the air is colder

there is no heat from the Sun is insufficient

or

at night there is a greater temperature difference between people and surroundings

1

(so surroundings) emit less infrared (than in daytime)

accept camera detects a greater contrast

or

gives larger difference in infrared emitted (between people and surroundings)

1

[9]

9 (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]

10 (a) (i) frequency

1

wavelength

1

(ii) 10^{-15} to 10^{4}

1

(b) 2.0×10^{5}

correct substitution of
*3.0×10^{8} / 1500 gains **1** mark*

2

Hz

1

(c) (i) (skin) burns

1

(ii) skin cancer / blindness

1

(d) (i) any **one** from:

- (detecting) bone fractures
- (detecting) dental problems
- treating cancer

1

(ii) any **one** from:

- affect photographic film
- absorbed by bone
- transmitted by soft tissue
- kill (cancer) cells

*answer must link to answer given in **(d)(i)***

1

(iii) 9 / 36 = 0.25
0.5 / 2 = 0.25
4 / 16 = 0.25

accept:
36 / 9 = 4
2 / 0.5 = 4
16 / 4 = 4

2

conclusion based on calculation

*two calculations correct with a valid conclusion scores **2** marks*
*one correct calculation of k scores **1** mark*

1

[13]