

M1. (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) $v = f \lambda$

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

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

[6]

- M2.**
- (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

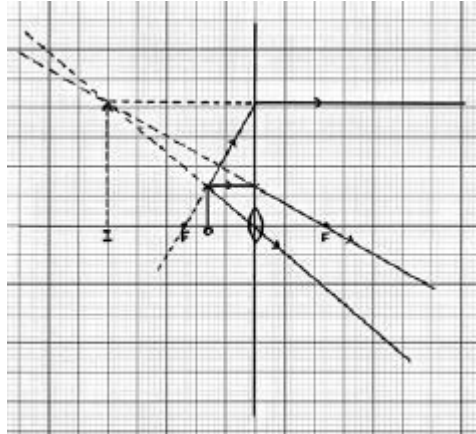
(iii) (Universe is) expanding

1

[9]

M3. (a) (i) **two** correct rays drawn
1 mark for each correct ray

- ray parallel to axis from top of object **and** refracted through focus **and** traced back beyond object
- ray through centre of lens **and** traced back beyond object
- ray joining top of object to focus on left of lens taken to the lens refracted parallel to axis **and** traced back parallel to axis beyond object



2

an arrow showing the position **and** correct orientation of the image for their rays

*to gain this mark, the arrow must go from the intersection of the traced-back rays to the axis **and** the image must be on the same side of the lens as the object and above the axis*

1

(ii) (x) 3.0
accept 3.0 to 3.5 inclusive

or

$$\frac{\text{their image height}}{\text{object height}}$$

correctly calculated

*allow 1 mark for correct substitution into equation using their figures
 ignore any units*

2

(b) any **two** from:

in a camera the image is:

- real not virtual
- inverted and not upright
accept upside down for inverted
- diminished and not magnified
accept smaller and bigger
accept converse answers but it must be clear the direction of the comparison
both parts of each marking point are required

2

[7]

M4. (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]

M5.(a)	(i)	frequency	1
		wavelength	1
	(ii)	10^{-15} to 10^4	1
(b)		2.0×10^5	
		<i>correct substitution of $3.0 \times 10^8 / 1500$ gains 1 mark</i>	2
		Hz	1
(c)	(i)	(skin) burns	1
	(ii)	skin cancer / blindness	1
(d)	(i)	any one from:	
		<ul style="list-style-type: none"> • (detecting) bone fractures • (detecting) dental problems • treating cancer 	1
	(ii)	any one from:	
		<ul style="list-style-type: none"> • 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]

M6. (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]

M7.(for both fibres) increasing the wavelength of light decreases and then increases the percentage / amount of light transmitted
*accept for 1 mark:
(for both fibres) increasing the wavelength (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]

M8. (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]