

Electromagnetic Waves

Mark Scheme 1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Physics
Exam Board	AQA
Topic	6.6 Waves
Sub-Topic	Electromagnetic Waves
Difficulty Level	Gold Level
Booklet	Mark Scheme 1

Time Allowed: 60 minutes

Score: /60

Percentage: /100

Grade Boundaries:

M1.(a)	(i)	frequency	1
		wavelength	1
	(ii)	10^{-15} to 10^4	1
(b)		2.0×10^5 <i>correct substitution of 3.0×10^8 / 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:	

- 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]

M2.(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 5×10^{-7} metres), decreases the (percentage) transmission

1

(for both fibres) the minimum transmission happens at 5×10^{-7} metres)

or

maximum transmission occurs at 6.5×10^{-7} metres)

accept for a further 1 mark:

(for both fibres) increasing the wavelength of the light from 5×10^{-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]

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

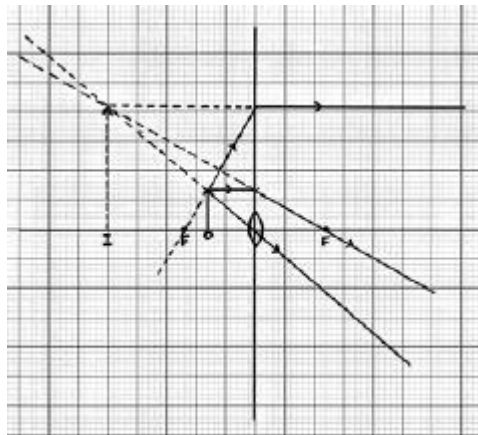
unreliable data is insufficient

1

[6]

- M4.(a)** 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]**
- M5.** (a) (i) **two** correct rays drawn 1
- 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]

M6. (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 $3.0 \times 10^8 = f \times 2.5 \times 10^6$

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]

M7. (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

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

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]

M8. (a) any **two** for 1 mark each

deduct (1) from the first two marks if a ruler has not been used but the intention is clear

ray from the object's arrowhead

- through centre of lens

- parallel to the axis then, when it reaches the lens, through F on the right
- through F on the left then, when it reaches the lens parallel to the axis

example of a 4 mark response

if more than two construction lines have been drawn all must be correct to gain 2 marks

construction lines drawn as dashed lines do not score credit

2

image shown as vertical line from axis to where their rays intersect

image need not be marked with an arrowhead but, if it is, it must be correct

1

ray direction shown

only one correct direction

arrow needed but there must not be any contradiction

1

(b) any **two** from:

- inverted

accept 'upside down'

- magnified

accept 'bigger'

- real

accept 'not virtual / not imaginary'

one correct feature gains 1 mark

ignore any reference to position

an incorrect feature negates a correct response

2

[6]

M9. (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

[5]