

# MARK SCHEME

# GCSE

## PHYSICS

## AQA - TRIPLE SCIENCE

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P6 - TEST 3

WAVES

Intermediate

## Mark schemes

- 1.** (a) (i) 440 (sound) waves produced in one second  
*accept vibrations / oscillations for waves* 1
- (ii) 0.773 (metres)  
*allow 2 marks for an answer that rounds to 0.773*  
*allow 2 marks for an answer of 0.772*  
*allow 2 marks for an answer of 0.772*  
*allow 1 mark for correct substitution ie  $340 = 440 \times \lambda$*  3
- (b) (sound is) louder  
*do not accept the converse* 1
- as amplitude is larger  
*waves are taller is insufficient* 1
- higher pitch / frequency 1
- as more waves are seen  
*reference to wavelengths alone is insufficient*  
*waves are closer together is insufficient* 1
- [8]
- 2.** (a) infrared / IR  
*correct answer only* 1
- (b) any **two** from:
- increase the power / watts  
*allow increase the temperature of the oven or make the oven hotter*
  - decrease the speed  
*allow leave the biscuits in for longer*
  - put biscuits through again  
*increase radiation is insufficient*  
*ignore changes to the design of the oven* 2
- (c) (inside) surface is a (good) reflector or poor absorber (of IR)  
*Ignore bounce for reflect*  
*surface is a (good) reflector of light does not score*  
*surface is a (good) reflector of light and infrared / heat does score* 1

(and) outside surface is poor emitter (of IR)

1

(so) increases the energy reaching the biscuits

*allow reduces energy loss or makes oven more efficient*

*do **not** accept no energy losses*

*keeps oven hotter is insufficient*

1

**[6]**

3.

- (a) (sound waves) which have a frequency higher than the upper limit of hearing for humans  
**or**  
a (sound) wave (of frequency) above 20 000 Hz  
*sound waves that cannot be heard is insufficient*  
*a wave of frequency 20 000 Hz is insufficient*

1

- (b) 640

*an answer of 1280 gains 2 marks*  
*allow 2 marks for the correct substitution*  
*ie  $1600 \times 0.40$  provided no subsequent step*

*allow 2 marks for the substitution  $\frac{1600 \times 0.80}{2}$*   
*provided no subsequent step*  
*allow 1 mark for the substitution  $1600 \times 0.80$  provided no subsequent step*  
*allow 1 mark for the identification that time (boat to bed) is 0.4*

3

- (c) any **one** from:

- pre-natal scanning / imaging
- imaging of a named organ (that is not surrounded by bone), eg stomach, bladder, testicles  
*accept heart*  
*do **not** allow brain **or** lungs (either of these negates a correct answer)*
- Doppler scanning blood flow

1

- (d) advantage

any **one** from:

- (images are) high quality or detailed or high resolution  
*clearer / better image is sufficient*
- (scan) produces a slice through the body
- image can be viewed from any direction  
*allow images are (always) 3D / 360°*
- an image can be made of any part (inside the body)  
*allow whole body can be scanned*
- easier to diagnose **or** see a problem (on the image)

1

disadvantage

any **one** from:

- (the X-rays used **or** scans) are ionising  
*allow a description of what ionising is*
- mutate cells **or** cause mutations **or** increase chances of mutations  
*allow for cells:*  
*DNA / genes / chromosomes / nucleus / tissue*

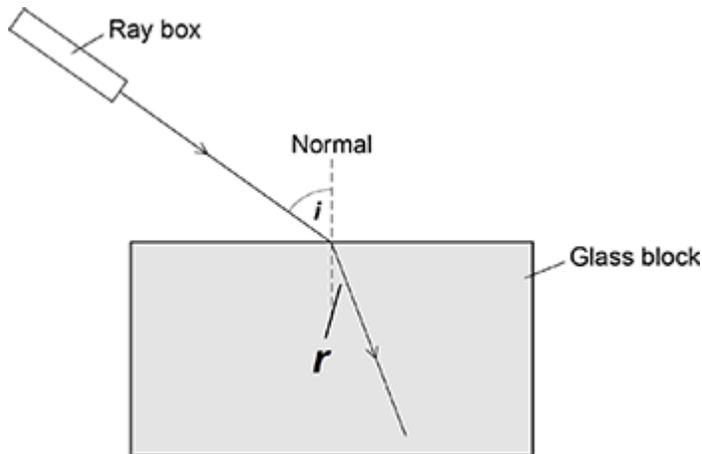
- turn cells cancerous **or** produce abnormal growths **or** produce rapidly growing cells
- kill cells
- *damage cells is insufficient*
- shielding is needed
- *can be dangerous (to human health) unqualified, is insufficient*

1

[7]

4.

(a) (i)



1

(ii) 1 degree

1

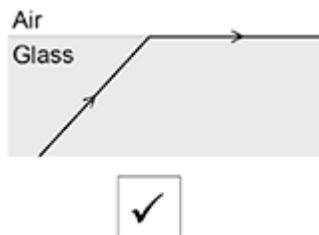
(iii) 1.6

*allow 1 mark for correct substitution, ie 0.80 / 0.5 provided no subsequent step shown*

*working showing 1.59(9.....) scores zero*

2

(b) 2<sup>nd</sup> diagram ticked



1

(c) (i) any **one** correct description:

- upright
- virtual
- diminished.

*treat multiple words as a list*

1

(ii) 0.25

*allow 1 mark for correct substitution, ie 1 / 4 or 5 / 20 provided no subsequent step shown*  
*ignore any unit*

2

(iii) Correcting short sight

1

[9]

5.

(a) dark matt

1

light shiny

1

(b) B A C

1

biggest temperature difference (80 °C)  
*dependent on first mark*

1

(c) (i) (the can that is) dark matt

1

best absorber (of infrared radiation)

1

(ii) any **three** from:

- same area / shape of can
- surrounding temperature is the same for all cans
- same surface underneath cans
- same position in the room

3

(d) fox A

smaller ears

1

thicker fur

1

these minimise energy transfer  
*dependent on first 2 marks*

1

[12]

6.

(a) ultrasound is not ionising

*allow ultrasound does not harm the (unborn) baby*

1

but X-rays are ionising

1

so X-rays increase the health risk to the (unborn) baby

*accept specific examples of health risks, eg cancer, stunted growth, impaired brain function etc*

*X-rays are dangerous is insufficient*

1

(b) ultrasound/waves are partially reflected

(when they meet a boundary) (between two different media / substances / tissues)

*must be clear that not all of the wave is reflected*

1

the time taken is measured (and is used to determine distances)

1

(c) 1600 (m/s)

*800 (m/s) gains 2 marks*

*160 000 (m/s) gains 2 marks*

*0.0016 (m/s) gains 2 marks*

*allow 2 marks for*

$$\frac{0.04}{25 \times 10^{-6}}$$

**or**

$$\frac{0.08}{50 \times 10^{-6}}$$

*80 000 (m/s) gains 1 mark*

*0.0008 (m/s) gains 1 mark*

*allow 1 mark for*

$$\frac{0.04}{25}$$

**or**

$$\frac{0.08}{50}$$

*allow 1 mark for evidence of doubling the distance or halving the time*

3

(d) (i) they are absorbed by bone  
*allow stopped for absorbed*  
*X-rays are reflected negates this mark* 1

they are transmitted by soft tissue  
*allow pass through for transmitted*  
*allow flesh / muscle / fat*  
*accept less (optically) dense material for soft tissue* 1

(the transmitted) X-rays are detected 1

(ii) short  
*accept small* 1

[12]

7.

(a) **use of infrared:**  
remote controls  
fibre optic (communications) 1

**use of microwaves:**  
mobile/cell phones  
*accept mobiles*  
*accept phone signals*  
satellite (communications/TV)  
wi-fi  
Bluetooth 1

(b) any **two** from

- same speed
- **or**  
travel at the speed of light (in a vacuum)
- transverse  
*accept a full description of a transverse wave*
- transfer energy (from one place to another)
- can be reflected
- can be refracted
- can be diffracted
- can be absorbed / transmitted
- can travel through a vacuum/space
- can be polarised

*travels in straight lines is insufficient* 2

[4]

<b>8.</b>	(a) frequency		1
	(b) echo(es)		1
	(c) 340 (m/s)	<p><i>allow 1 mark for correct substitution ie <math>25\ 000 \times 0.0136</math> provided no subsequent step</i></p> <p><i>or</i></p> <p><i>allow 1 mark for a correct calculation showing an incorrect value from conversion to hertz <math>\times 0.0136</math></i></p> <p><i>an answer of 0.34 gains 1 mark</i></p>	2
	(d) (a wave where the) oscillations are parallel to the direction of energy transfer	<p><i>both marking points may appear as labels on a diagram</i></p> <p><i>accept vibrations for oscillations</i></p> <p><i>accept in same direction as for parallel to</i></p> <p><i>allow direction of wave (motion) for direction of energy transfer</i></p> <p><i>allow 1 mark for a correct calculation showing an incorrect value from conversion to hertz <math>\times 0.0136</math></i></p>	1
	causing (areas of) compression and rarefaction	<p><i>accept correct description in terms of particles</i></p> <p><i>mechanical wave is insufficient</i></p> <p><i>needs a medium to travel through is insufficient</i></p>	1
			<b>[6]</b>
<b>9.</b>	(a) 20,000	<p><i>accept 20 kilo</i></p> <p><b>or</b></p> <p><i>20 k</i></p> <p><b>or</b> <i>20 001</i></p>	1
	an atom		1

- (b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer in the Marking Guidance and apply a 'best-fit' approach to the marking.

**0 marks**

no relevant content

**Level 1 (1–2 marks)**

At least one relevant statement is given for either type of wave

**Level 2 (3–4 marks)**

**either**

a use, risk and precaution is given for one type of wave

**or**

A medical use is given for both types of wave

**plus**

a risk or precaution for one type of wave

**Level 3 (5–6 marks)**

At least one medical use is given for both types of wave linked to the risks and any precautions necessary

## Examples of the points made in the response

### Medical use of X-rays

Any one from:

- Detecting bone fractures
- Detecting dental problems
- Killing cancer cells
- CT scanning.

*Ignore details about how X-rays / ultrasound work  
accept any specific use of X-rays, eg*

- *detecting heart / lung disorders (with chest X-rays)*
- *mammograms / breast cancer detection*
- *detecting stones / bowel disease (with abdominal X-rays)*

### Risks with X-rays

X-rays pose a risk / danger / hazard

*accept are harmful*

X-rays cause ionisation / damage to cells

**or**

mutate cells / cause mutations / increase chances of mutations

**or**

turn cells cancerous / produce abnormal growths / produce rapidly growing cells

**or**

kill cells

*accept a description of what ionising is*

*instead of cell, any of these words can be used: DNA / genes / chromosomes / nucleus*

*accept (may) cause cancer*

### Operator precautions with X-rays

The X-ray operator should go behind a (metal / glass) screen / leave the room when making an X-ray / wear a lead lined apron

*accept appropriate precautions for the patient e.g. limit the total exposure / dose (in one year)*

*wear a radiation badge is insufficient*

### Medical use of ultrasound

Any one from:

- Pre-natal scanning
- Imaging (a named body part).
- removal / destruction of kidney / gall stones
- removing plaque from teeth

*cleaning teeth is insufficient*

- *accept examples of repair, eg alleviating bruising, repair scar damage, ligament / tendon damage, joint inflammation.*

*accept physiotherapy*

*accept curing prostate cancer or killing prostate cancer cells*

**Risks with ultrasound**

Ultrasound poses no risk / danger / hazard (to the user / patient)

*accept ultrasound is safer than using X-rays*

Ultrasound is not ionising

**or**

Ultrasound does not damage (human) cells

**Precautions with ultrasound**

The operator needs to take no precautions when making an ultrasound scan

*this can be assumed if it is stated that ultrasound is harmless or it is safer than using x-rays or it is non-ionising*

6

[8]