Mark schemes

1. (a) potential axis: unit mV and suitable labelling of 0 and 1 for scale ✓

time axis suitable use of numbers from 0 to 0.6 / 1 ✓

2

(b) Possible answers to include:

electrodes are not non-reactive ✓

electrodes are not securely taped in place ✓

the patient is not relaxed or does not remain still ✓

the amplifier is not low noise ✓

the amplifier has damaged shielded leads / interference from other AC sources ✓

Any 3 points with reason and some extension to explain.
Be aware of the section 3.1 in the instructions to examiners.
If more than 3 answers given remember
'right + wrong = wrong'

3

[5]

2. (a) $t = (32.5 - 3.0) \times 10^{-6}$ ($= 29.5 \times 10^{-6}$ s) ✓

1st mark is for correctly using the timing from the first and last reflection.

1

$s = vt = 1560 \times 29.5 \times 10^{-6}$ ✓ ($= 46 \times 10^{-3}$ m)

ecf for 2nd and 3rd mark if wrong reflections used.

1

Eyeball length = $\frac{46 \times 10^{-3}}{2} = 23 \times 10^{-3}$ ✓ m

3rd mark is for dividing by 2 and is independent

1

(b) **The mark scheme gives some guidance as to what statements are expected to be seen in a 1 or 2 mark (L1), 3 or 4 mark (L2) and 5 or 6 mark (L3) answer.**

Guidance provided in section 3.10 of the 'Mark Scheme Instructions' document should be used to assist in marking this question.

Mark	Criteria
6	Select the B-scan, Cover all 3 areas in detail, referring to both scans in at least 2 areas, without error. It must relate to amniocentesis.
5	Select the B-scan, Cover all 3 areas, referring to both scans in at least 2 areas. May contain minor errors. It must relate to amniocentesis.
4	choose the B-scan Cover at least 2 areas, referring to both scans Or cover all 3 areas referring to one scan
3	Cover at least 2 areas referring to one scan Or Cover 1 area referring to both scans in detail It may or may not choose the B-scan.
2	Cover 1 area referring to both scans It may or may not choose the B-scan
1	Cover 1 area referring to one scan. It may or may not choose the B-scan
0	No relevant comments

Difference between the A-scan and B-scan

- *Multiple sensors in B-scan as opposed to one sensor in A-scan*
- *A scan intensity determines amplitude*
- *B scan intensity determines brightness*

Advantages/Disadvantages

A-scan

- *An A-scan only produces a graph*
- *Good for accurately determining distances (where a limited number of surfaces lie along a straight line)*
- *With complex structures it is difficult to identify which surface produces which echo*
- *The structures may not lie along one line*

B-scan

- *B-scan produces a picture*
- *A 2D cross section is obtained rather than a single line*
- *Allows the structures to be identified more easily*
- *Allows features that are not along one line to be identified*
- *Harder to accurately determine distances along a straight line*

Suitability

Why a B-scan is suitable

- *Multiple features of needle, foetus, uterus and placenta require an image to identify*

Why an A-scan is not suitable

- *Multiple features of needle, foetus, uterus and placenta*
- *are complex structures*
- *which do not lie along a straight line*
- *cannot be easily identified on a graph*

6

[9]

3. (a) The mark scheme gives some guidance as to what statements are expected to be seen in a 1 or 2 mark (L1), 3 or 4 mark (L2) and 5 or 6 mark (L3) answer.
Guidance provided in section 3.10 of the 'Mark Scheme Instructions' document should be used to assist in marking this question.

Mark	Criteria
6	All 3 areas covered in some detail. 6 marks can be awarded even if there is an error and/or parts of one aspect missing.
5	All 3 areas covered at least 2 in detail. Whilst there will be gaps, there should only be an occasional error.
4	Two areas successfully discussed, or one discussed and two others covered partially. Whilst there will be several gaps, there should only be an occasional error.
3	One area discussed and one discussed partially, or all three covered partially. There are likely to be several errors and omissions in the discussion.
2	Only one area discussed, or makes a partial attempt at two areas.
1	None of the three areas covered without significant error.
0	No relevant analysis.

Points to consider

How an ultrasound pulse is produced:
- alternating potential difference applied across the crystal
- causes crystal to expand and contract
- creating pressure waves in the crystal / plastic membrane
- frequency of alternating pd equal to that of crystal / resonant frequency of crystal
- which is above 20 kHz.

How the ultrasound reflection is detected:
- pressure wave in the crystal
- causes crystal to expand and contract
- which produces a potential difference across the crystal.

The same transducer acts as receiver as well as transmitter:

- short application of ac to produce short pulse
- use of backing material to damp and stop vibration of crystal
- crystal must stop vibrating before reflection reaches it.

6

(b) $\lambda = \frac{c}{f} = \frac{1600}{1.0 \times 10^6} = 0.0016$

Resolution = 1.6 mm ✓

Allow 1 sf answer of 2 mm

1

(c) $Z_1 = \rho c = 1.3 \times 330$ (= 429) or

$Z_2 = \rho c = 1075 \times 1580$ (= 1.70×10^6) ✓

$\left(\frac{Z_2 - Z_1}{Z_2 + Z_1}\right)^2 = \left(\frac{1.70 \times 10^6 - 4.29 \times 10^2}{1.70 \times 10^6 + 4.29 \times 10^2}\right)^2$ ✓ = 0.999 ✓

100 – 99.9 = 0.1% ✓

Allow ecf

Allow 1 sf

4

(d) Not suitable as all/most/99.9% of the ultrasound would be reflected ✓

Allow correct argument based around transmission

when going from the air inside the lungs to the lung tissue ✓

MP2 is for the direction where most is reflected.

2

[13]

4. (a) Coherent bundle – fixed arrangement of fibres at each end ✓

Used to transmit image (from inside the body to the viewer) ✓

Non-coherent bundle – random arrangement of fibres ✓

Used to transmit light into the body / to illuminate (area under investigation) ✓

Name of bundle plus either point for first mark.

If no marks awarded, give 1 mark if both bundles have been named.

4

(b) Core at 1.6; cladding 1.55 ie half way between their core and 1.5 ✓

Series of clear horizontal steps with air at 1.0 ✓

Although they are told to do a calculation, give the mark on the diagram for 1.55 even if no calc shown.

If no marks awarded for drawing, then give 1 mark for correct calculation.

2

[6]