Rewarding Learning

**ADVANCED SUBSIDIARY (AS)**
**General Certificate of Education**
**January 2011**

# Physics

## Assessment Unit AS 2

## Module 2: Waves, Photons and Medical Physics

**[AY121]**

**MONDAY 17 JANUARY, AFTERNOON**

# MARK SCHEME

| | | | | AVAILABLE MARKS |
|---|---|---|---|---|
| 1 | **(a)** | Source not mentioned, max [1]<br>Transverse – movement of the source is perpendicular to the direction of travel [1]<br>Longitudinal – movement of the source is parallel to the direction of travel or equivalent. [1] | [2] | |
| | **(b)** **(i)** | vibrations are not confined to 1 plane. | [1] | |
| | **(ii)** | Example of a longitudinal wave, e.g. sound [1]<br>Reason – longitudinal waves can't be polarised/only transverse waves can be polarised/the particles oscillate in the same direction as wave travels [1] | [2] | 5 |
| 2 | | Diagram including glass block, ray box [1]<br>Shine ray onto block at different angles [1]<br>Penalty [1] mark for incorrectly marked angles<br>Draw entering and emerging rays and join inside block must be stated in text [1]<br>Measure incident and refracted angles using a protractor [1]<br>Calculate sin i and sin r [1]<br>Find average value of sin i/sin r or calculate gradient of graph of sin i against sin r [1] | [6] | |
| | | Quality of written communication – accept bullet point answers. | [2] | |
| | | **2 marks**<br>The candidate expresses ideas clearly and fluently, through well linked sentences and paragraphs. Arguments are generally relevant and well structured. There are few errors of grammar, punctuation and spelling.<br><br>**1 mark**<br>The candidate expresses ideas clearly, if not always fluently. Arguments may sometimes stray from the point. There are some errors in grammar, punctuation and spelling, but not such as to suggest a weakness in these areas.<br><br>**0 marks**<br>The candidate expresses ideas satisfactorily, but without precision. Arguments may be of doubtful relevance or obscurely presented. Errors in grammar, punctuation and spelling are sufficiently intrusive to disrupt the understanding of the passage. | [2] | 8 |
| 3 | **(a)** | Long sight or hypermetropia | [1] | |
| | **(b)** **(i)** | Subs: 2.7 = v/.32 or v = 0.864 [1]<br>Subs: 1/f = 1/0.32 − 1/0.864 [1]<br>P = 1.97 [1]<br>Units: D or Dioptres or $m^{-1}$ – independent mark [1] | [4] | |
| | **(ii)** | Subs: 1.97 = 1/0.25 + 1/–v (or ecf) [1]<br>v = 49 (cm) [1] | [2] | 7 |

| | | | | | | AVAILABLE MARKS |
|---|---|---|---|---|---|---|
| **4** | **(a)** | **(i)** | (Progressive) sound wave travels down tube | [1] | | |
| | | | Sound is reflected from end | [1] | | |
| | | | Waves interfere/superposition of waves | [1] | | |
| | | | Supply frequency = natural frequency/resonance | [1] | | |
| | | | Any **three** | | [3] | |
| | | **(ii)** | Subs into $v = f\lambda$, 1.12 (m) | [1] | [1] | |
| | | **(iii)** | Antinode at open end, node at closed end | [1] | | |
| | | | Diagram correct showing 3 antinodes | [1] | [2] | |
| | **(b)** | | $\lambda = 4 \times 1.4 = 5.6\,m$ | [1] | | |
| | | | $f = 172\,(Hz)$ | [1] | [2] | 8 |
| **5** | **(a)** | | Monochromatic – single colour or wavelength | | [1] | |
| | **(b)** | **(i)** | Row of bright and dark fringes or spots or similar | [1] | | |
| | | | Equally spaced | [1] | [2] | |
| | | **(ii)** | Subs | [1] | | |
| | | | $\lambda = 6.34 \times 10^{-7}$ | [1] | | |
| | | | Converting correctly to nm | [1] | [3] | |
| | | **(iii)** | Smaller slit separation | [1] | | |
| | | | Increase distance to screen | [1] | [2] | 8 |
| **6** | **(a)** | | Logarithmic | | [1] | |
| | **(b)** | **(i)** | Similarity – Same lower limit | [1] | | |
| | | | Difference – Dogs have higher upper limit or wider range | [1] | [2] | |
| | | **(ii)** | Curve to show: Min at –20 dB, 5000 Hz | [1] | | |
| | | | to right of given minimum and before 10 kHz | | | |
| | | | Edges of curve at approx 20 Hz and 50 kHz | [1] | [2] | |
| | | **(iii)** | Dog would hear louder or better or clearer sound | [1] | | |
| | | | Intensity level curve for a dog is lower at this frequency or similar | [1] | [2] | 7 |
| **7** | **(a)** | | Produce controlled variations in the magnetic field/ locate region | [1] | | |
| | | | **Processes** the rf signals to **produce the image** | [1] | [2] | |
| | **(b)** | | Created using electromagnet | [1] | | |
| | | | Use of **superconductors** now | [1] | | |
| | | | (High current achieved with) fewer **energy** losses | [1] | [3] | |
| | **(c)** | | No **ionising** radiation | [1] | | |
| | | | Image in any plane | [1] | | |
| | | | Higher detail (in soft tissues) | [1] | [3] | 8 |

| | | | | | | AVAILABLE MARKS |
|---|---|---|---|---|---|---|
| 8 | (a) | (i) | $E = hc/\lambda$ or $E = hf + f = 1.03 \times 10^{15}$ | [1] | | |
| | | | Subs leading to ans | [1] | [2] | |
| | | (ii) | Energy delivered to surface $= 1.6 \times 10^{-4} \times 0.034$J | [1] | | |
| | | | $5.44 \times 10^{-6}/6.86 \times 10^{-19}$ | [1] | | |
| | | | $7.93 \times 10^{12}$ | [1] | [3] | |
| | (b) | (i) | Increased rate of electron emission | [1] | | |
| | | | Because higher intensity means more photons per second | [1] | [2] | |
| | | (ii) | No effect on (max) ke of emitted electrons | | [1] | 8 |
| 9 | (a) | | Discrete/well defined/specific/similar | | [1] | |
| | (b) | (i) | Read f from graph $6.13 \times 10^{14}$ | [1] | | |
| | | | Use of $E = hf$ to give $4.06 \times 10^{-19}$J | [1] | [2] | |
| | | (ii) | Conversion to eV: 2.54eV (Ecf **(b)(i)**) | [1] | | |
| | | | Line on correct transition $3.39 - 0.85$ | [1] | | |
| | | | Arrow up to show absorption. Independent mark: arrow must begin and end on a level. | [1] | [3] | |
| | (c) | | Electrons are excited | [1] | | |
| | | | More (electrons) in excited state than ground state | [1] | [2] | 8 |
| 10 | (a) | | Matter can behave as a particle or a wave | [1] | | |
| | | | Electron diffraction | [1] | | |
| | | | Further detail of experiment | [1] | [3] | |
| | (b) | (i) | Wavelength – wave property | [1] | | |
| | | | Momentum – particle property | [1] | [2] | |
| | | (ii) | 8% of speed of light $= 2.4 \times 10^7$ ms$^{-1}$ | [1] | | |
| | | | $\lambda = 6.63 \times 10^{-34}/(9.11 \times 10^{-31})(2.4 \times 10^7)$ | [1] | | |
| | | | $3.03 \times 10^{-11}$ m | [1] | [3] | 8 |
| | | | | | **Total** | **75** |