CSE CENTRE FOR STRATEGIC EDUCATION
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IARTV

YEAR 12

CSE TEST: OCTOBER 2010

PHYSICS

Written test 2

ANSWERS & SOLUTIONS BOOK

Figure numbers:	In this book the diagrams are identified as **Figure A**, **Figure B**, … to avoid any confusion with those in the Question and Answer Book where they are numbered **Figure 1**, **Figure 2**, …
Mark allocations:	As a guide, suggested mark allocations for each answer are shown within square brackets [ ].
Additional information:	With some answers, to enhance student understanding, additional information is shown within curly brackets { }.

SECTION A – AREA OF STUDY 1 – ELECTRIC POWER

Q	Marks	Answer	Solution
1	1	Left	Since the north pole of the magnet is repelled by the magnetic field from the left end of the solenoid, this magnetic field, i.e. the field at point P, must be directed to the left.
2	1	Right	Using the right hand grip rule around any of the wires at the point R, the curl of the fingers, representing the direction of the magnetic field, must point into the page (as we are told the compass needle points into the page). The direction of the thumb then gives the direction of the current at R, that is, to the right.
3	3		The polarity of the near end of the magnet is SOUTH. [1 mark] Using the right hand slap rule (*or* Fleming's left hand rule), the magnetic force represented by the direction of the palm is down [1 mark], the current represented by the direction of the thumb is to the left (from Y to X in Figure 3) [1 mark], and so the magnetic field represented by the direction of the fingers is towards the magnet. So the near pole of the magnet must be a South.
4	2	0.44 T	Using the equation $F = IlB_\perp$ transposed to make $B_\perp$ the subject, with $I = 3.8$ A, $l = 2.7 \times 10^{-2}$ m and $F = 0.045$ N, $B_\perp = \frac{F}{Il}$ $= \frac{0.045}{3.8 \times 2.7 \times 10^{-2}}$ [1 mark] $= 0.4386$ $= 0.44$ T (to 2 sig figs) [1 mark]
5	1		In the simplest way Terri could rearrange the equipment with the magnet reversed so that the polarity of the end of the magnet nearer the wire would be a NORTH pole. Alternatively, Terri could move the weights from the right hand end (at P In Figure 3) to the corresponding point on the left hand end.
6	2	0.27 N	Using the equation $F = nIlB_\perp$ with $n = 20$, $I = 3.2$ A, $l = 2.5 \times 10^{-2}$ m and $B_\perp = 0.17$ T. Thus: $F = 20 \times 3.2 \times 2.5 \times 10^{-2} \times 0.17$ [1 mark] $= 0.272$ $= 0.27$ N (to 2 sig figs) [1 mark]
7	1	0.27 N	As none of the four factors, n, I, l or $B_\perp$ have changed, the size of the magnetic force acting is still the same. **Consequential answer:** Ans6
8	2		Figure A (on page 3) shows the magnetic force F_m on the two sides of the coil tending to rotate it clockwise, until it reaches the position shown in Figure B where the coil would come to rest. To keep it rotating the two magnetic forces would need to be reversed [1 mark] at this point (Figure B) where the coil is at right angles to the magnetic field. This can be done by reversing the direction of the current in the coil [1 mark] every half-turn (180°) [1 mark] by means of the split-ring commutator.

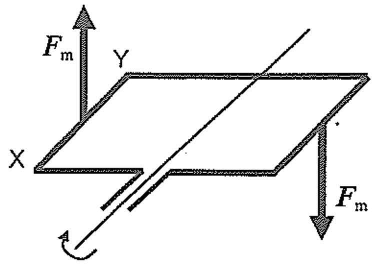


Figure A

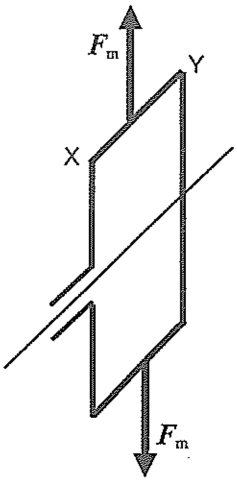


Figure B

Q	Marks	Answer	Solution
9	2	1.1×10^{-4} Wb	Using the equation $\phi = B_\perp A$ where $B_\perp = 0.17$ T and $A = (2.5 \times 10^{-2})^2$ m^2, $\phi = 0.17 \times (2.5 \times 10^{-2})^2$ [1 mark] $= 1.0625 \times 10^{-4}$ $= 1.1 \times 10^{-4}$ Wb (to 2 sig figs) [1 mark]
10	3	8.5×10^{-3}V	The average voltage ε_{av} can be determined from the equation $\varepsilon_{av} = -n\frac{\Delta\phi}{\Delta t}$ where $n = 20$, $\Delta t = 0.50$ s and $\Delta\phi =$ the change in magnetic flux that occurs when the coil is rotated 180°. Taking the magnetic flux through the coil as positive when entering the coil from the original left side in Figure 5, $\Delta\phi = \phi_{\text{final}} - \phi_{\text{initial}}$ $= (-1.0625 \times 10^{-4}) - (1.0625 \times 10^{-4})$ (using Answer 9) $= -2.125 \times 10^{-4}$ Wb. [1 mark] $\varepsilon_{av} = -n\frac{\Delta\phi}{\Delta t}$ $= -20 \times \frac{-2.125 \times 10^{-4}}{0.50}$ [1 mark] $= 8.5 \times 10^{-3}$ V (to 2 sig figs) [1 mark] **Consequential answer:** 80 × Ans9

Q Marks Answer Solution

11 2 See Figures C and D. Either answer is acceptable since the positive direction of the voltage or current was not specified in the question.
[1 mark for showing a DC output. 1 mark for showing a maximum voltage at 0.25 s and every 0.5 s thereafter.]

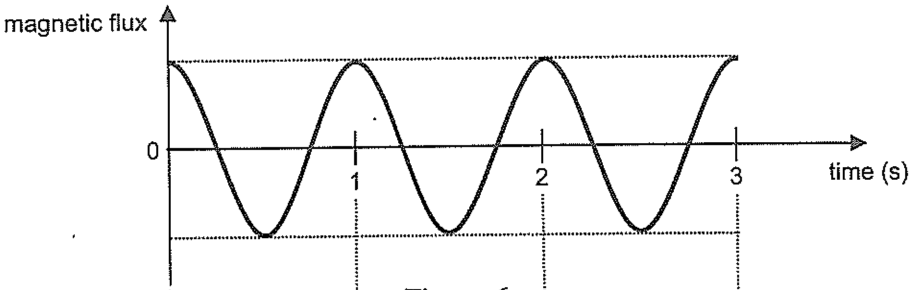


Figure 6

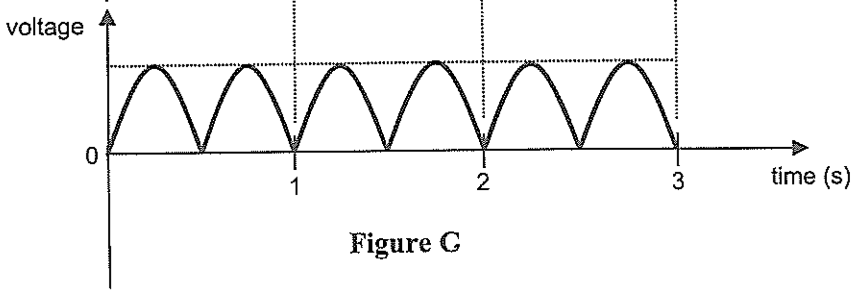


Figure C

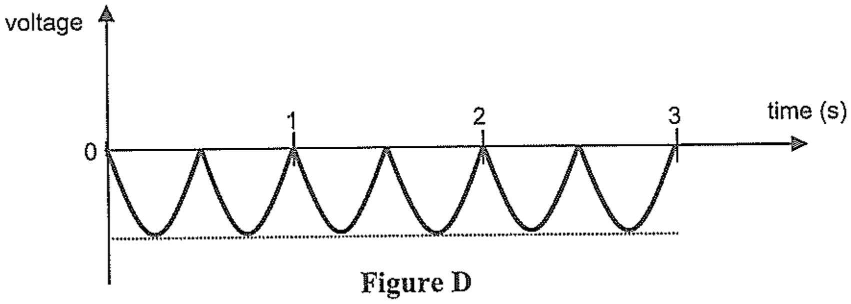


Figure D

12 3 With the magnet moving towards the loop and the observer James, the magnetic flux through the loop in the direction **towards** James is increasing [1 mark]. The induced current in the loop will generate a second magnetic field, with its flux through the loop opposing this increase (or change) and therefore is directed **away from** James [1 mark]. Using the right hand grip rule around the wire at, say, the top of the loop, with the curled fingers representing the direction of this induced magnetic field pointing away from James inside the loop, the thumb will predict the direction of the current, that is, to the right. So the induced current in the loop will be in a **clockwise** sense as seen by James. [1 mark]

13 2 11 V The peak voltage V_{peak} is represented vertically by 3 cm on the screen. With a scaling of 5.0 V cm^{-1},

$$V_{\text{peak}} = 3.0\text{ cm} \times 5.0\text{ V cm}^{-1}$$
$$= 15\text{ V} \qquad [1\text{ mark}].$$

$$V_{\text{RMS}} = \frac{1}{\sqrt{2}} V_{\text{peak}}$$
$$= \frac{1}{\sqrt{2}} 15$$
$$= 10.606$$
$$= 11\text{ V (to 2 sig figs)} \qquad [1\text{ mark}]$$

Q	Marks	Answer	Solution
14	1	46 V (or 48 V if the value of V_s below was taken as 11 V rounded to 2 sig figs)	Using the ideal transformer equation and RMS values of the voltages: $\frac{V_s}{V_p}=\frac{N_s}{N_p}$ $\frac{10.6}{V_p}=0.23$ (using Answer 13) $V_p=\frac{10.6}{0.23}$ $=46.08$ $=46\text{ V}$ (to 2 sig figs) **Consequential answer**: $\frac{\text{Ans13}}{0.23}$
15	1	B	To reduce the heat loss in the transmission lines requires a low current in the wires ($P_{\text{loss}}=I_{\text{line}}^2 R_{\text{line}}$). To transmit power at a low current ($P = VI$) the transmitting voltage has to be high. So the transformer near the source is a step-up transformer and near the destination a step-down transformer.
16	2	0.20 A	Applying the equations for an ideal transformer, $\frac{V_s}{V_p}=\frac{N_s}{N_p}$ and $V_p I_p = V_s I_s$ to transformer Y, $\frac{N_s}{N_p}=\frac{I_p}{I_s}$ $\frac{1}{12}=\frac{I_p}{2.4}$ [1 mark] $I_p=\frac{2.4}{12}$ $= 0.20\text{ A}$ [1 mark]

Q Marks Answer Solution

17 3 10 Ω

RMS output voltage of transformer X can be obtained from relationship:

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

$$\frac{V_s}{6.0} = \frac{12}{1}$$

$$V_s = 12 \times 6.0$$

$$= 72\text{ V} \qquad \text{[1 mark]}$$

The voltage across the primary coil of transformer Y at the other end of the transmission lines is only 70 V. So the voltage across the total length of the two transmission lines is 2 V. [1 mark]

Considering the total length of the two transmission lines,

$$V_{\text{lines}} = I_{\text{lines}} R_{\text{lines}}$$

$$2 = 0.20\,R \qquad \text{(using } I_{\text{lines}} = 0.20\text{ A from Answer 16)}$$

$$R = \frac{2}{0.20}$$

$$= 10\ \Omega \text{ (to 2 sig figs)} \qquad \text{[1 mark]}$$

Consequential answer: $\frac{2}{\text{Ans16}}$

18 3 In the secondary circuit of transformer Y, placing a second globe in series with globe G increases the resistance and hence tends to reduce the current in that circuit. [1 mark]

Since the primary and secondary currents in transformer Y are in a fixed ratio, $\frac{I_p}{I_s} = \frac{N_s}{N_p} = \frac{1}{12}$, the primary current, i.e. the current I_{lines} in the transmission lines, will also be reduced. [1 mark]

For the transmission lines $V_{\text{lines}} = I_{\text{lines}} R_{\text{lines}}$. So if I_{lines} is reduced, so too will be the voltage across the transmission lines. [1 mark]

SECTION A – AREA OF STUDY 2 – INTERACTIONS OF LIGHT AND MATTER

1 2 The light from the laser source undergoes diffraction as it passes through each slit. The bright bar on the screen at E is due to constructive interference (*or* reinforcement) [1 mark] due to the superposition of the light waves, where the light from one slit (the upper one) has travelled two wavelengths further than light from the other slit (*or* where the path difference from the two slits to E is two wavelengths) [1 mark].

2 2 B Red and orange light have longer wavelengths than green light and will only spread the pattern, as does moving the screen further from the slits.

3 3

Vertical Axis	Horizontal Axis	Graph
Maximum kinetic energy of photoelectrons	Frequency of incident light	B
Stopping voltage	Intensity of incident light	D
Photoelectron current	Voltage across photocell	C

[1 mark for each correct response]

Q	Marks	Answer	Solution
4	2	1.9×10^{-19} J	The maximum kinetic energy of the ejected photoelectrons will equal the energy lost by an electron as it moves from the metal surface to the other electrode in the photocell, that is, $E_{\text{k max}} = qV_{\text{stopping}}$ $= 1.6 \times 10^{-19} \times 1.19$ [1 mark] $= 1.904 \times 10^{-19}$ $= 1.9 \times 10^{-19}$ J (to 2 sig figs) [1 mark]
5	2	1.7 eV	The work function W can be obtained using the equation: $E_{\text{k max}} = hf - W$ $qV_{\text{stopping}} = \frac{hc}{\lambda} - W$ $W = \frac{hc}{\lambda} - qV_{\text{stopping}}$ $= \frac{4.14\times10^{-15} \times 3.0\times10^{8}}{428\times10^{-9}} - (1\times1.19)$ [1 mark] $= 2.901 - 1.19$ $= 1.711$ $= 1.7$ eV (to 2 sig figs) [1 mark] **Consequential answer:** $\frac{4.67\times10^{-19} - \text{Ans4}}{1.6\times10^{-19}}$ (if hc/λ was calculated in joule rather than in electron volt, and Answer 4 was used.)
6	2	0.39 V	The stopping voltage V_{stopping} for the second incident light can be found from the equation: $qV_{\text{stopping}} = \frac{hc}{\lambda} - W$ $1\times V_{\text{stopping}} = \frac{4.14\times10^{-15} \times 3.0\times10^{8}}{590\times10^{-9}} - 1.711$ [1 mark] $= 2.105 - 1.711$ $= 0.39$ V (to 2 sig figs) [1 mark] **Consequential answer:** 2.105 – Ans5
7	2	Electrons are considered to be particles but diffraction is regarded as a wave phenomenon [1 mark], so if electrons exhibit diffraction patterns they can thought of as having a wave nature [1 mark]	
8	2	5.55×10^{-24} kg m s^{-1}	$E_{\text{X-ray}} = 10.4 \times 10^{3}$ eV $= 10.4 \times 10^{3} \times 1.6 \times 10^{-19}$ J $= 1.664 \times 10^{-15}$ J [1 mark] $p = \frac{E_{\text{X-ray}}}{c}$ $= \frac{1.664\times10^{-15}}{3.0\times10^{8}}$ $= 5.55 \times 10^{-24}$ kg m s^{-1} [1 mark]

Q	Marks	Answer	Solution
9	2	1.19×10^{-10} m	$\lambda = \frac{h}{p}$ $= \frac{6.63\times10^{-34}}{5.55\times10^{-24}}$ [1 mark] $= 1.19\times10^{-10}$ m [1 mark] **Consequential answer:** $\frac{6.63\times10^{-34}}{\text{Ans8}}$
10	2	Since the diffraction patterns are similar for the X-rays and electrons, they are assumed to be of similar wavelength [1 mark]. Since momentum and wavelength are related by $p = h/\lambda$ for both, these electrons and X-rays can be considered to have similar momentum [1 mark]. {**Note**: The energy of an electron can be expressed as $E_k = p^2/2m$ and the energy of a photon can be expressed as $E = hc/\lambda = pc$, but these two energies are not the same, even when the wavelengths of the electron and photon are equal.}	
11	2	B	The photon must be of exactly the energy difference between the two energy levels, i.e. the energy difference between the 1st excited state and the ground level, i.e. 4.86 eV.
12	2	P	$-\Delta E_{\text{atom}} = E_{\text{photon}}$ $E_{\text{initial}} - E_{\text{final}} = \frac{hc}{\lambda}$ $8.81 - 6.67 = \frac{4.14\times10^{-15} \times 3.0\times10^{8}}{\lambda}$ [1 mark] $2.14 = \frac{1.242\times10^{-6}}{\lambda}$ $\lambda = \frac{1.242\times10^{-6}}{2.14}$ $= 5.803\times10^{-7}$ m $= 580$ nm On Figure 4 this suggests P. [1 mark]
13	2	1.2×10^{15} Hz	$E_{\text{photon}} = hf$ $f = \frac{E_{\text{photon}}}{h}$ $= \frac{-\Delta E_{\text{atom}}}{h}$ $= \frac{4.86}{4.14\times10^{-15}}$ [1 mark] $= 1.173\times10^{15}$ $= 1.2\times10^{15}$ Hz (to 2 sig figs) [1 mark]
14	2	C	Figure 6 represents the 4th energy level which is the 3rd excited state.

SECTION B – DETAILED STUDY 1 – SYNCHROTRON AND ITS APPLICATIONS

Q	Answer	Solution
1	D	
2	C	The magnitude of the electric field is related to the potential difference V between the plates and the distance d between the plates by the relationship: $E = \frac{V}{d}$ $= \frac{90{,}000}{0.25}$ $= 360{,}000 \text{ V m}^{-1}$ $= 360 \text{ kV m}^{-1}$
3	C	Transposing the relationship for a force on an electron: $F = qE = ma$ gives: $a = \frac{qE}{m}$ $= \frac{1.6 \times 10^{-19} \times E}{9.1 \times 10^{-31}}$ $= 1.75 \times 10^{11} E$
4	A	$\Delta E_k = qV$ $= 1.6 \times 10^{-19} \times 90{,}000$ $= 1.44 \times 10^{-14} \text{ J}$
5	B	Using the right hand slap rule (*or* Fleming's left hand rule) and remembering that it is negatively charged electrons moving, the thumb representing the direction of conventional current is backwards along the beam, the palm representing the direction of the magnetic force is towards the centre of the circular path, resulting in the fingers representing the direction of the magnetic field pointing downwards.
6	B	Using the relationship: $F = qvB$ $= 1.6 \times 10^{-19} \times 5 \times 10^{6} \times 1.2 \times 10^{-4}$ $= 9.6 \times 10^{-17} \text{ N}$
7	A	Transposing the relationship for the magnetic force on the electron: $F = qvB = \frac{mv^2}{r}$ $r = \frac{mv}{qB}$ $= \frac{9.1 \times 10^{-31} \times 5.0 \times 10^{6}}{1.6 \times 10^{-19} \times 1.2 \times 10^{-4}}$ $= 0.2369 \text{ m}$
8	D	Synchrotron light has a low level of divergence which means the light travels in directions near to parallel. A, B or C all give incorrect statements about synchrotron radiation as it leaves the storage ring.

Q	Answer	Solution
9	A	Transposing the relationship $n\lambda = 2d\sin\theta$, where d is the spacing between adjacent layers of atoms gives: $d = \frac{n\lambda}{2\sin\theta}$ $= \frac{1 \times 0.12\times10^{-9}}{2 \times \sin 10.32^\circ}$ $= 3.35 \times 10^{-10}$ m $= 0.335$ nm
10	B	Calculations using $\theta_n = \sin^{-1}\left(\frac{n\lambda}{2d}\right)$. where n = 1, 2, 3, … show that the intensity peaks will be at 10.32° and 20.99° with a third at 32.50°. So there will be only 2 intensity peaks between 0° and 30°.
11	C	
12	D	A wiggler is a form of insertion device. Insertion devices are used to bend the electron beam inwards within the storage ring so as to produce synchrotron radiation. Options A, B and C are found on a beamline, not in the storage ring.
13	A	A double-crystal monochromator helps to select, for experiments at the end of the beamline, particular wavelengths from a range of wavelengths from the synchrotron radiation that has already left the storage ring.

SECTION B – DETAILED STUDY 2 - PHOTONICS

1	C	
2	A	Band gap energy E_g corresponding to the emitted wavelength λ can be determined by the relationship: $E_g = \frac{hc}{\lambda}$ $= \frac{4.14\times10^{-15} \times 3.0\times10^{8}}{625\times10^{-9}}$ $= 1.987$ eV
3	C	The energy of the photons emitted is dependent on the materials used to construct the LED and so would not change. With a lower voltage battery the voltage across each diode would be less, which could result in two possibilities, (1) the voltage would be insufficient to raise any electrons from the valence band to the conduction band and no light would be emitted, which is not given as a possible response, and (2) the voltage across each diode would be slightly less and therefore fewer electrons would be raised from the valence to the conduction band, resulting in fewer photons being emitted per second, i.e. the brightness of the light would be decreased, which fits response C.
4	B	
5	D	

Q Answer **Solution**

6 A By the law of reflection the angle γ in Figure 2 is equal to the critical angle θ_c which can be found using the relationship:

$$\begin{aligned}\sin\theta_c &= \frac{n_{\text{cladding}}}{n_{\text{core}}}\\ &= \frac{1.47}{1.61}\\ &= 0.913\\ \theta_c &= 65.9^\circ\end{aligned}$$

7 C Using the relationship, $n_1 \sin\theta_1 = n_2 \sin\theta_2$, for the light entering the core at P in Figure 2,

$$\begin{aligned}n_{\text{air}} \sin\theta_{\text{air}} &= n_{\text{core}} \sin\theta_{\text{core}}\\ 1.00 \sin\theta_{\text{air}} &= 1.61 \sin 30^\circ\\ \sin\theta_{\text{air}} &= 1.61 \times 0.5\\ &= 0.805\\ \theta_{\text{air}} &= 53.6^\circ\\ \theta_{\text{acceptance}} &= 53.6^\circ\end{aligned}$$

8 D At the air-to-core interface at P, some light will be reflected and some transmitted into the core, irrespective of the size of the angle of incidence. For the light passing into the core to be then totally internally reflected along the fibre at the core-to-cladding interface, the angle of incidence at P (45°) would have to be less than the acceptance angle (here 40°). But it is not. Thus at the core-to-cladding interface some of the light will be partially reflected and some partially transmitted into the cladding. The resulting paths of the laser beam are shown by the dashed lines in Figure E.

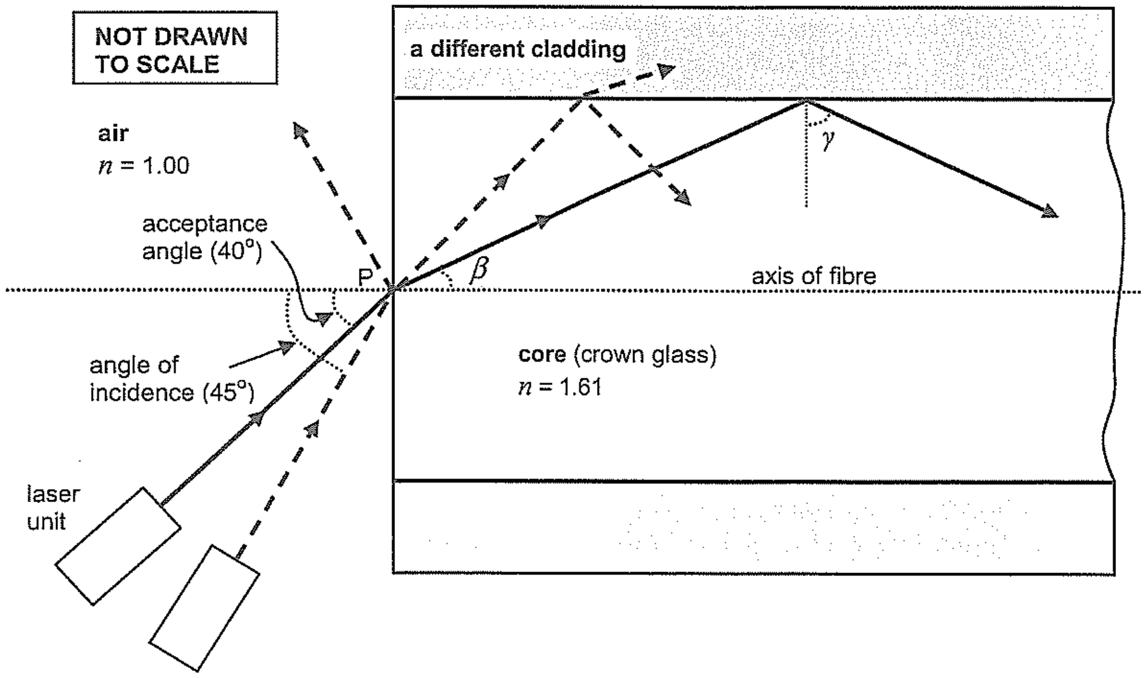
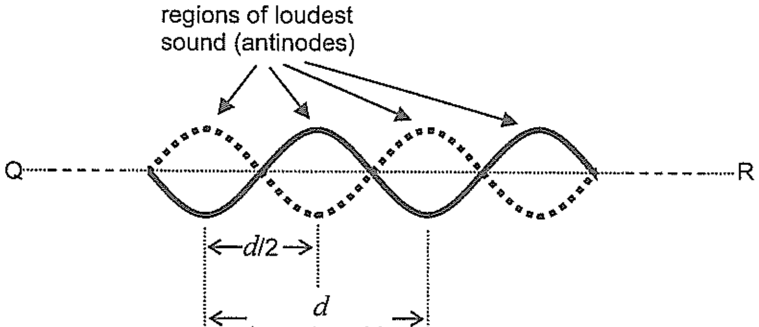


Figure E

Q	Answer	Solution
9	B	Since the fibre optic wave guide consists of two materials with different refractive indices, it has a step-graded index. The fibre would provide many possible different light paths with varying numbers of reflections along a given length of cable, so it would have a multi order mode.
10	B	A: Modal dispersion is reduced by using multimode fibres with the **highest** (not lowest) refractive index at the centre and gradually **decreasing** (not increasing) as we move outwards. B: Modal dispersion is minimised by using a very thin core in a step-index fibre. With a thinner core the number of possible pathways decreases, reducing modal dispersion. C and D: Material dispersion is greater when there is a range of wavelengths used (such as generated by an LED) rather than a narrow range (as is the case for laser light).
11	D	Peta: Wavelengths above about 1600 nm are in the range of the natural frequencies of vibration of the silicon dioxide molecules, enabling the electromagnetic energy to be absorbed by these molecules. Quentin: The loss in the region with shorter wavelengths is due to Rayleigh scattering which increases with an increase in the frequency of the light, i.e. with a decrease in wavelength. So both Peta and Quentin are correct.
12	A	A: Multimode fibres can be used for short distance communication where modal dispersion is insufficient to cause overlapping of pulses. For long fibres that would cause overlapping. B: Light from LEDs (with a relatively larger range of wavelengths) as opposed to lasers (with a much narrower range of wavelengths) would give rise to significant material dispersion for long distance communication. C: In long distance optic fibres modal dispersion is reduced by using single-mode fibres where modal dispersion is much less of a problem than material dispersion. D: The core diameter is usually **greater** (not smaller) in short distance than in long distance fibres, as the modal dispersion is less of a problem there than in long distance fibres where single-mode fibres with thin cores are used.
13	C	A: 'Coherent' has a different meaning when applied to lasers and fibre bundles. B and D: Non-coherent rather than coherent bundles are used to illuminate difficult areas to see, such as inside a patient's lungs, as they are being used simply to transmit light to the area and not bring back images. C: To provide medical images inside a patient's stomach, at each end of the fibre bundle all the individual fibres must be in the same relative position to one other. Otherwise the image would be jumbled.

SECTION B – DETAILED STUDY 3 – SOUND

Q	Answer	Solution
1	B	Distance d in Figure 2 represents the wavelength λ of the sound wave. This can be determined from the relationship: $v = f\lambda$ $340 = 500\lambda$ $\lambda = \dfrac{340}{500}$ $= 0.68\text{ m}$

Q	Answer	Solution
2	C	As can be seen in Figure 2 the distance between adjacent compressions, i.e. between adjacent peaks, is *d*.
3	D	The compressions and rarefactions will move to the right, away from the source, but the wavelength, i.e. the distance between adjacent compressions or adjacent rarefactions, will remain constant.
4	C	Given the sound intensity level L_R at R, the sound intensity I_R can be found using the relationship: $L_R \text{ (in dB)} = 10 \log_{10} \frac{I_R}{I_0}$ $60 = 10 \log_{10} \frac{I_R}{1.0\times10^{-12}}$ $6 = \log_{10} \frac{I_R}{1.0\times10^{-12}}$ $10^6 = \frac{I_R}{1.0\times10^{-12}}$ $I_R = 1.0\times10^{-12} \times 10^6$ $= 1.0\times10^{-6}\,\text{W m}^{-2}$
5	D	There will be interference between the sound waves travelling towards the board and those reflected back from the board, setting up a standing wave.
6	B	Figure F shows a section of the air pressure standing wave pattern that would be set up along the line between Q and R. The separation of adjacent points of maximum intensity, the antinodes, would be ½λ, i.e. ½*d*.  **Figure F**
7	A	If Callum obtained 60 dB at R using 500 Hz, then for the same frequency at U closer to the speaker the sound level intensity would be higher, i.e. higher than 60 dB. This eliminates C and D. At V with 500 Hz the sound level would be less than at R (even though V is the same distance from the source as R), due to diffraction where the intensity would drop off as one moved sideways from the line directly in front of the speaker. So it would have to be less that 60 dB. This eliminates B and reinforces A. At V with a lower frequency of 200 Hz (longer wavelength) the diffraction would be greater than for 500 Hz and therefore give a higher sound intensity level at V than for 500 Hz. 54 dB is higher than 50 dB. So A is the correct response.

Q	Answer	Solution
8	C	A: As shown by the minimum sound intensity levels, lower values were obtained for frequencies below about 25 Hz and above about 27,000 Hz. So not A. B: The sound was louder at about 3,300 Hz. So not B. C: The speaker shows an almost constant response, i.e. good fidelity (a flat portion of the curve) for frequencies from about 30 to 180 Hz, suitable for a low frequency speaker or woofer. So C is correct. D: For these frequencies the speaker has a stronger response than for the low frequencies but it is uneven with poor fidelity. So D is not right.
9	D	As the sound waves leaving the front of the speaker cone will be exactly 180° out of phase with the waves leaving the back of the cone, these would give rise to destructive interference severely reducing the intensity of the sound. The front wall of the speaker box keeps these two sound waves apart and prevents this.
10	A	The highest frequency of the three notes will be that of the third mode of vibration. The standing wave will have an air pressure node at the open end and an antinode at the closed end. The standing waves for the first (fundamental) and second modes of vibration are shown in Figures G and H. The next simplest and third mode is that provided in response A of the question.

Figure G

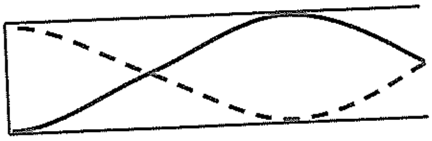


Figure H

Q	Answer	Solution
11	A	Figure B shows the standing air pressure wave for the fundamental note. If L is the length of the air column, the wavelength λ will be $4L$. $v = f\lambda$ $= f \times 4L$ $350 = f \times 4 \times 1.4$ $f = \frac{350}{4 \times 1.4}$ $= 62.5\,\text{Hz}$
12	D	For a vibrating air column the second mode of vibration is the third harmonic and the third mode is the fifth harmonic.
13	B	Only a dynamic microphone fits the description.