Student Name...

Lisachem Materials

Chemistry Physics Biology Psychology

VCE PHYSICS 2007 YEAR 12 TRIAL EXAM UNIT 4

Reading Time: 15 minutes
Writing Time: 90 minutes

Structure of Booklet

Section	No of Questions	No of Questions to be answered	No of Marks
A Core - Areas of Study			
1. Electric Power	19	19	40
2. Interactions of Light and Matter	11	11	25
B Detailed Study			
3. Sound	11	11	25

Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, up to two pages (one A4 sheet) of pre-written notes (typed or handwritten) and an approved graphics calculator (memory cleared) and/or one scientific calculator.
Students are not permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.

Materials Supplied

Question and answer booklet with detachable data sheet.

Instructions

Detach the formula sheet during reading time.
Write your name in the space provided..
Answer all questions in this questions and answer book where indicated.
Always show your working where space is provided.
Where an answer box has a unit printed in it, give your answer in that unit.
All responses must be in English.

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VCE Physics 2007 Year 12 Unit 4 Data Sheet

1	photoelectric effect	$E_{K\max} = hf - W$
2	photon energy	$E = hf$
3	photon momentum	$p = \frac{h}{\lambda}$
4	de Broglie wavelength	$\lambda = \frac{h}{p}$
5	resistors in series	$R_T = R_1 + R_2$
6	resistors in parallel	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$
7	magnetic force	$F = IlB$
8	electromagnetic induction	$flux : \Phi = BA$; $emf : \varepsilon = -N\frac{\Delta\Phi}{\Delta t}$
9	transformer action	$\frac{V_1}{V_2} = \frac{N_1}{N_2}$
10	AC voltage and current	$V_{RMS} = \frac{1}{\sqrt{2}}V_{Peak} \quad I_{RMS} = \frac{1}{\sqrt{2}}I_{Peak}$
11	Voltage; power	$V = RI \quad P = VI$
12	transmission losses	$V_{Drop} = I_{Line}R_{Line} \quad P_{Loss} = I^2_{Line}R_{Line}$
13	mass of the electron	$m_e = 9.1\times10^{-31}\ kg$
14	charge on the electron	$q = -1.6\times10^{-19}\ C$
15	Planck's constant	$h = 6.63\times10^{-34}\ J\ s$ $= 4.14\times10^{-15}\ eV\ s$
16	speed of light	$c = 3.0\times10^{8}\ m\,s^{-1}$
17	Acceleration due to gravity near the Earth's surface	g = 10 m s^{-2}

Detailed Study 3 – Sound

18	speed, frequency and wavelength	$v = f\lambda$
19	intensity and levels	sound intensity level $(in\ dB) = 10\log_{10}\left\{\frac{I}{I_0}\right\}$ $where\ I_0 = 1.0\times10^{-12}\ W\,m^{-2}$

Prefixes/Units

p = pico = 10^{-12}

n = nano = 10^{-9}

μ = micro = 10^{-6}

m = milli = 10^{-3}

k = kilo = 10^{3}

M = mega = 10^{6}

G = giga = 10^{9}

t = tonne = 10^{3} kg

VCE Physics 2007 Year 12 Trial Exam Unit 4

SECTION A – Core

Instructions for Section A
Answer all questions for both Areas of study in this section of the paper.

Area of study 1 – Electric power

Questions 1 and 2 refer to the following information.

Figure 1 shows a wire of length 0.12 m carrying an electric current of 2.0 A in a uniform magnetic field of strength 0.90 T and perpendicular to the field. A magnetic force causes the wire to move.

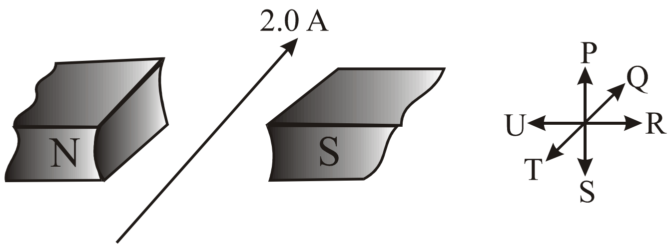


Figure 1

Question 1

Calculate the magnitude of the force on the wire.

N

2 marks

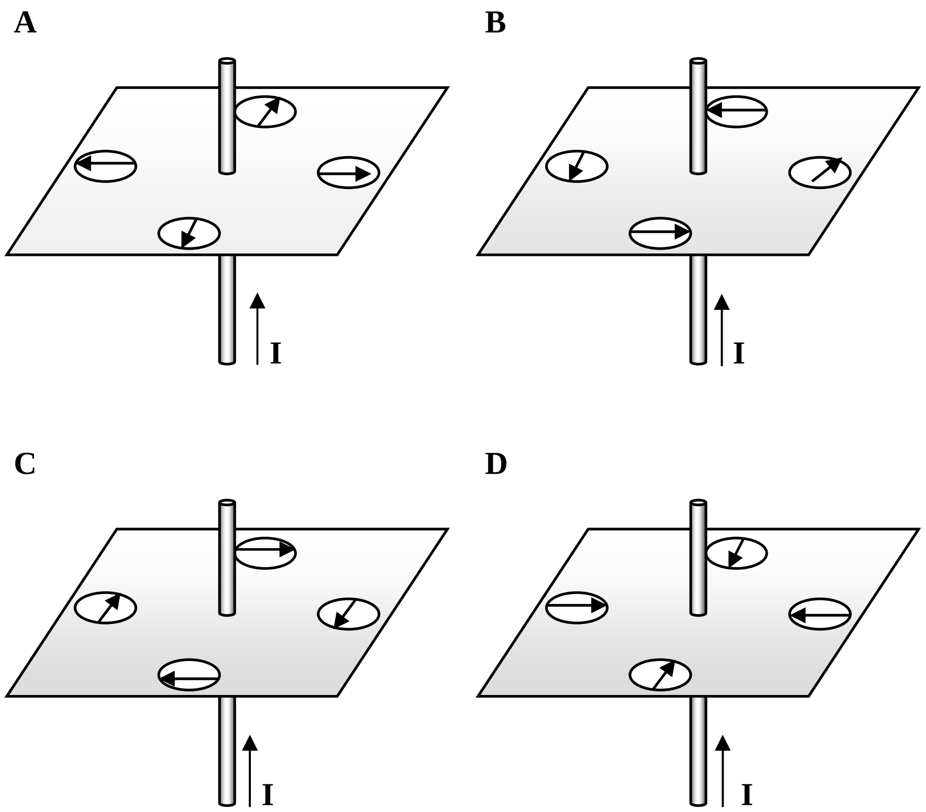
Question 2

Which one of the directions, P – U, shown in **Figure 2** indicates the direction of the force on the wire when the current flows.

1 mark

Question 3

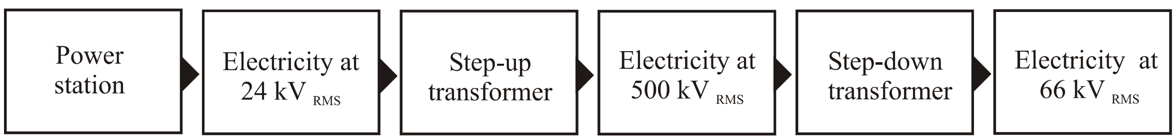
Which one of the following diagrams, A - D shown below, best shows the orientation for a set of four compasses placed around a current-carrying wire? The arrows indicate the north pole of the compass needle.



2 marks

Questions 4 - 7 refer to the following information.

The diagram shows part of the system used in Victoria for generating electric power and transmitting this power from the generating station to a terminal station.



Question 4

Which statement below correctly describes the operation of a transformer ?

A. A current flows from one coil through the core to the other coil.
B. An AC voltage across one coil induces an AC voltage across the other coil.
C. A DC voltage across one coil causes a DC voltage in the other coil.
D. An AC voltage in the primary coil is transformed to a DC voltage in the secondary coil.

2 marks

The primary coil of the step-up transformer has 1000 turns.

Question 5

Calculate the number of turns in the secondary coil.

turns

2 marks

One generator at the power station produces of 530 MW of power.

Question 6

Calculate the magnitude of the RMS current in the secondary coil of the step-up transformer. The transformer is considered to be ideal.

A

2 marks

The electric power is transmitted over a considerable distance to a step-down transformer. There is a power loss of 5.0 % due to heating of the transmission cables.

Question 7

Calculate the RMS voltage of the primary coil of the step-down transformer. Answer in kilovolts.

kV

2 marks

Questions 8 and 9 refer to the following information.

Figure 3 shows a transformer used in the home which converts mains 240 V_{RMS} electricity to 12 V_{RMS} to power a set of 100 identical Christmas lights wired in parallel. Assume zero power loss in this system.

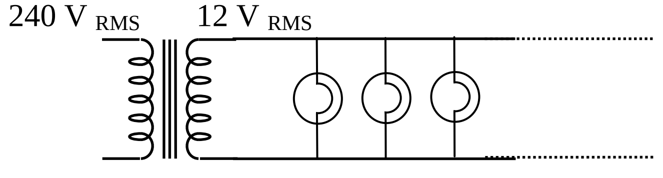


Figure 3

Question 8
Calculate the peak voltage across the secondary coil of the transformer.

V

2 marks

The primary circuit draws 240 W_{RMS} of power.
Question 9
Calculate the resistance, in ohms, of one of the Christmas lights.

Ω

2 marks

Two solenoids are positioned as shown in **Figure 4** and the switch, S, is closed,
Question 10
Determine the direction of the current that flows through resistor R as the switch closes. Justify your answer.

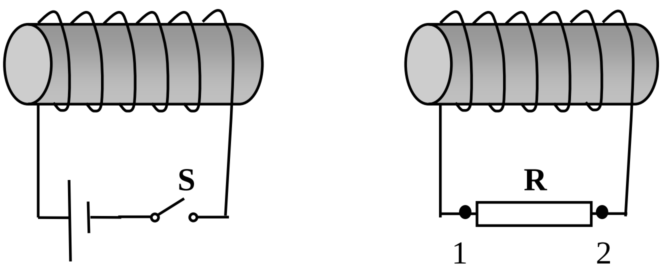


Figure 4

….. to …..

3 marks

Figure 5 shows a coil of area 1.13 x 10^{-2} m^2 consisting of 200 loops placed in a 0.35 T magnetic field.
The magnetic field is uniformly changed to 0.25 T in the **opposite** direction in 0.80 s.
(Dots and crosses indicate opposite sense of the magnetic field).

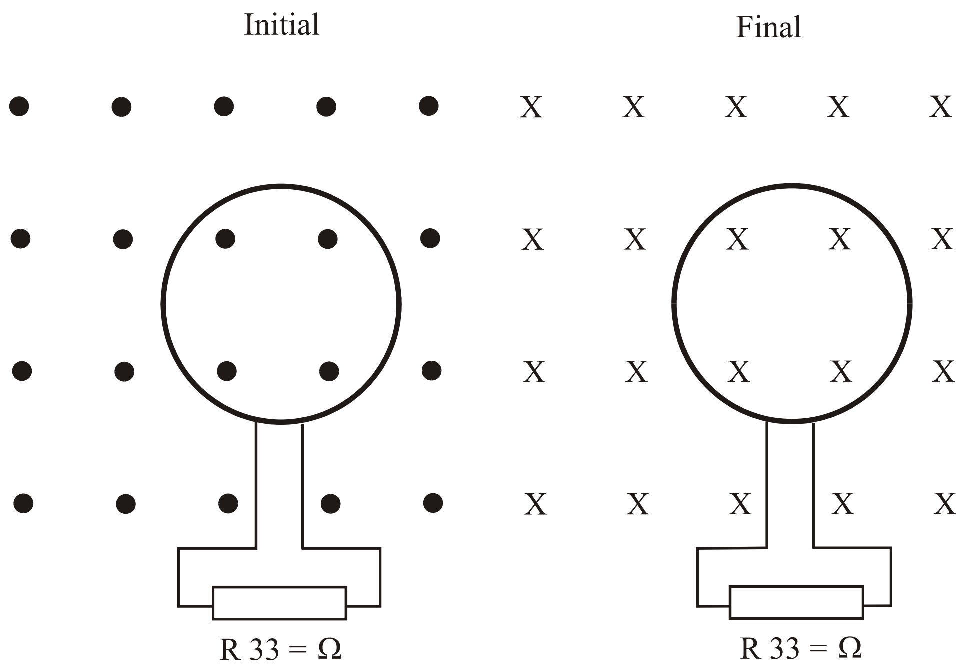


Figure 5

Question 11

Calculate the magnitude of the current in mA, that flows through the 33Ω resistor connected to the coil during this period.
(Ignore the resistance of the coil.)

mA

3 marks

Questions 12 – 14 refer to the following information.

Figure 6 shows a model motor which Eric used during an experiment. A coil of wire was connected to a split-ring commutator and placed as shown in the uniform magnetic field. Eric then connected the terminals, T_1 and T_2, to a battery. He observed that the coil began to rotate in a clockwise direction around axis XY.

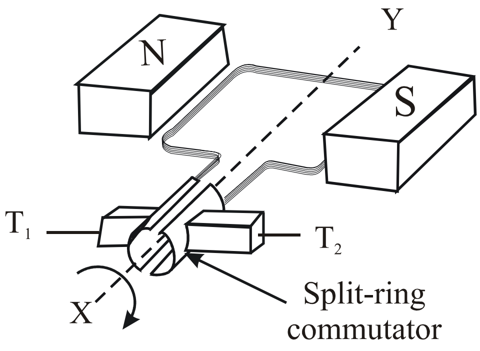


Figure 6

Question 12

Determine which of the terminals, T_1 or T_2 , is connected to the *positive* terminal of the battery.

2 marks

In order to observe the electromagnetic induction in the coil, Eric removed the battery connections and connected a cathode ray oscilloscope as shown in **Figure 7**. He then slowly rotated the coil around the axis XY in a clockwise direction (as shown).

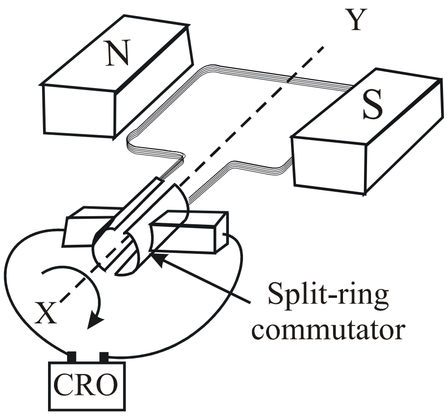
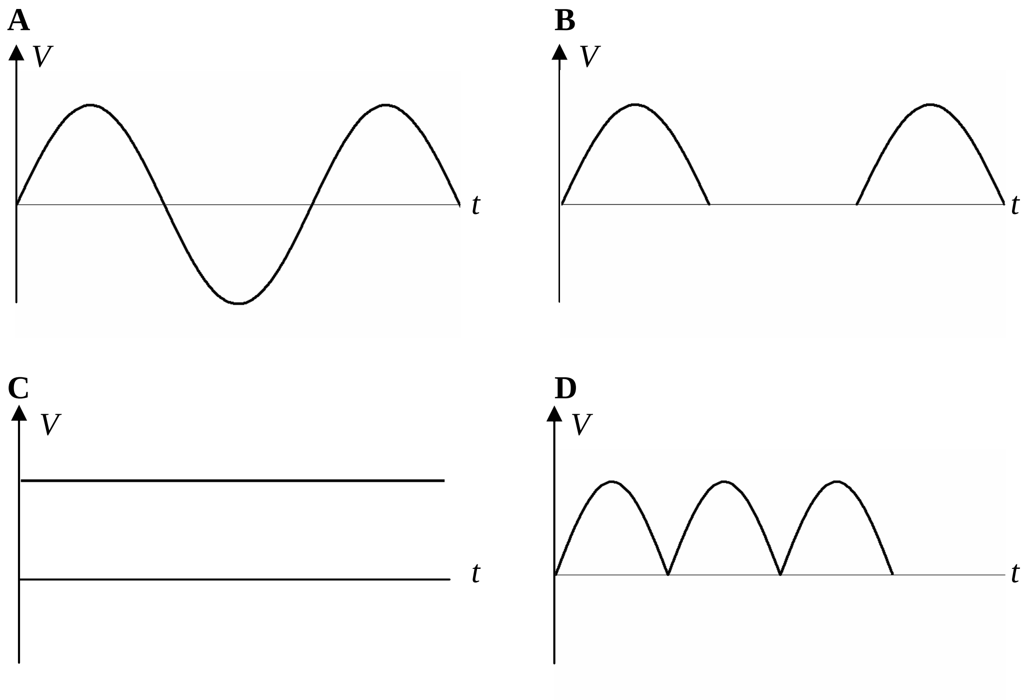


Figure 7

Question 13
Which one of the waveforms below best shows what Eric observed on the C.R.O when the coil was rotated in a clockwise direction as shown in **Figure 7**.



2 marks

Question 14
Describe the action of the split-ring commutator in **Figure 6**.

2 marks

Question 15 to 18 refer to the following information.

Figure 8 shows a simplified electrical generator consisting of a single square coil of wire PQRS placed in a uniform magnetic field of strength 0.60 T. The side length of the square coil is 10 cm.
The coil can be rotated about the axis XY. Louise, a physics students, experiments with this coil.

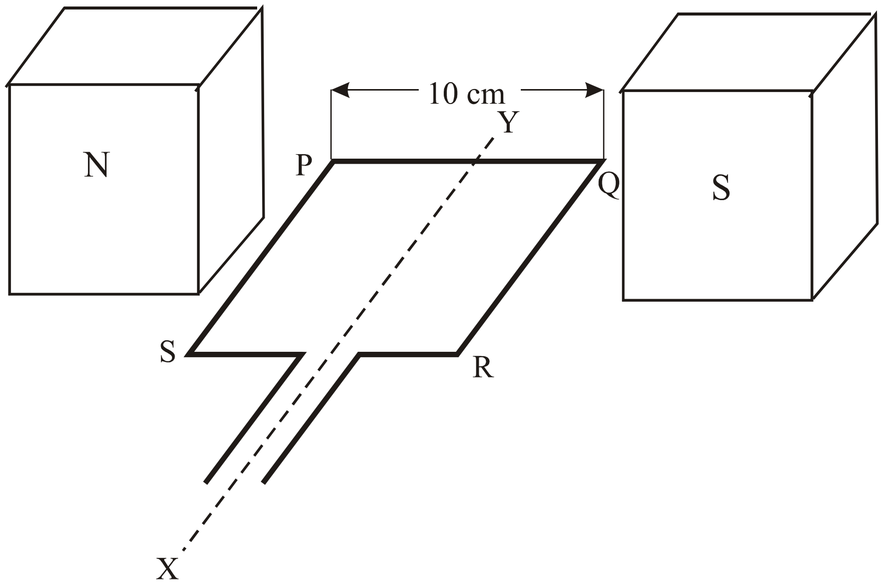


Figure 8

Question 15
Calculate the maximum magnetic flux that can pass through the coil.

Wb

2 marks

Figure 9 shows the variation of magnetic flux with time for one complete cycle, of the coil.

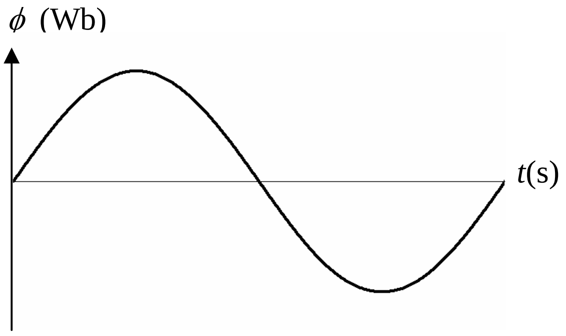
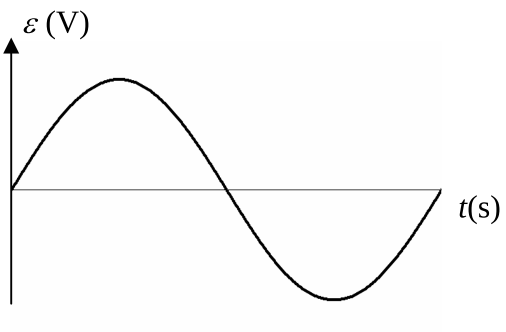


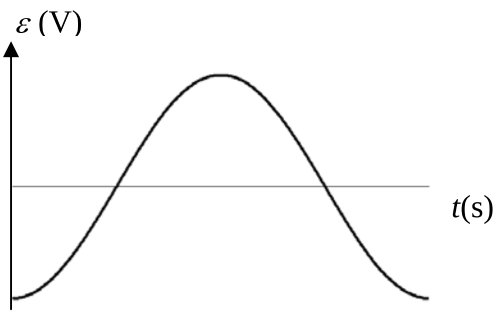
Figure 9

Question 16
From the graphs A – D shown below, choose the alternative that best shows the emf induced in the coil during this cycle.

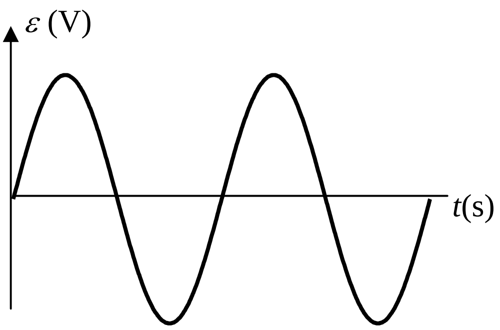
A



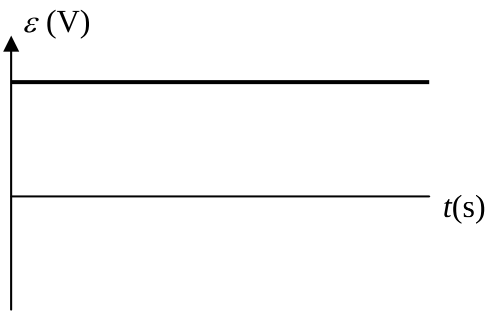
B



C



D



2 marks

Figure 10 shows the emf, ε, produced by a coil when it is rotated with a frequency of 20 Hz in a magnetic field.

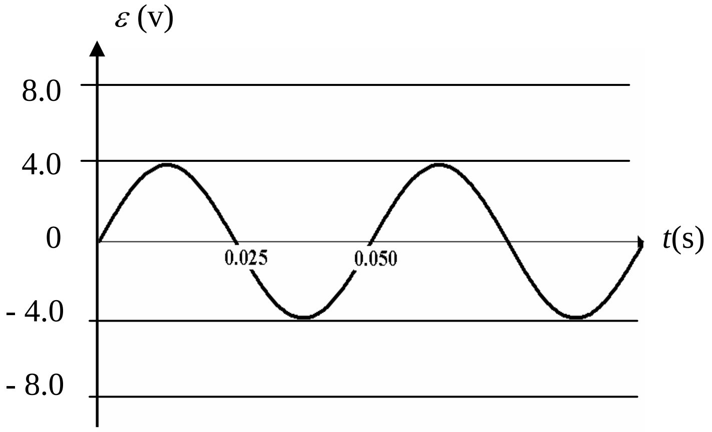


Figure 10

Question 17

On **Figure 10** above, draw the corresponding curve for emf induced in the same coil when it is rotated with a frequency of 40 Hz. Justify the shape of the curve that you draw.

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3 marks

Louise wrote the following in her physics notebook.

"When a coil of wire is turned in a magnetic field, a potential difference is induced between the ends of the coil. The size of this potential difference is greater when

- the area of the wire coil is greater.
- the number of turns on the coil is greater.
- the strength of the magnetic field is greater.
- the speed of rotation of the coil is increased.

Question 18

How many of Louise's dot points are correct?

A. None of them.
B. All of them.
C. Only three of them.
D. Only two of them.

2 marks

Looking along the axis of rotation from end X, in **Figure 8**, the coil rotated in a clockwise direction.

Question 19
Circle the correct alternative from those listed below.
The induced current will flow in the direction:
from R to Q
from Q to R

2 marks

Area of study 2 – Interactions of light and matter

Questions 1 – 4 refer to the following information.
John and Eric carry out an experiment in which light is shone onto a photocell whose cathode has a work function of 1.5 eV. They make two sets of measurements. For the first, the light has a wavelength of 400 nm and an intensity *I*, and for the second the light has a wavelength of 500 nm and an intensity of 3*I*. In both cases the photoelectric currents measured as a function of the voltage applied between the cathode and anode of the photocell.

Question 1
Calculate the stopping potential, in V, for each wavelength of light.

…………V for 400 nm …………V for 500 nm

4 marks

Question 2
On a graph of current versus applied voltage as given in **Figure 1**, draw two curves, each curve representing one of the two sets of measurements. The curves should be drawn accurately and be clearly marked with the appropriate wavelength.

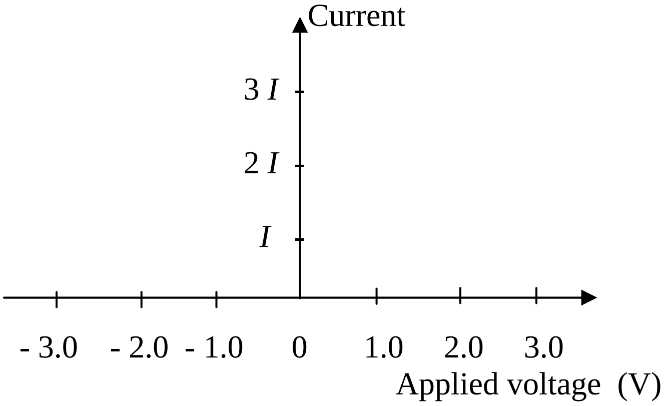

Figure 1

2 marks

Question 3
In the photoelectric effect, the existence of a cut-off frequency speaks in favour of the photon theory and against the wave theory. Give evidence that supports this statement.

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2 marks

In another experiment, John and Eric increased the wavelength of the incident light and found that light of wavelength greater than 827 nm did not produce any photoelectric effect.

Question 4
Calculate the value obtained for Planck's constant, in eV s, using this and other data given. Show your working.

2 marks

Questions 5 – 7 refer to the following information

Figure 2 shows the energy levels of neon that are involved in the production of laser light from a helium-neon laser. Energies are given relative to the ground state. (Not drawn to scale)

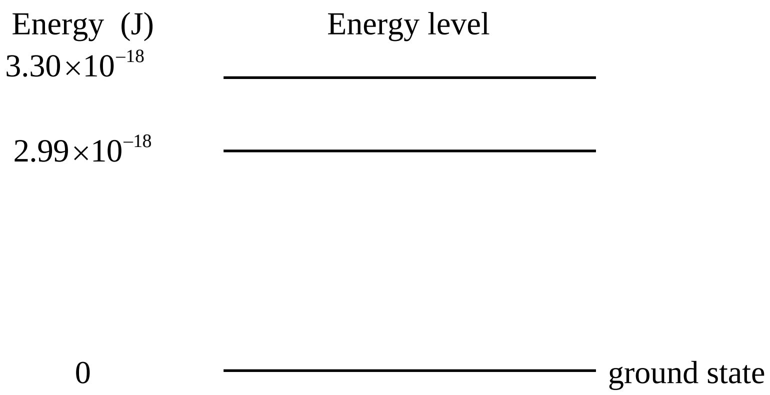


Figure 2

A photon of the laser light has an energy of 3.1×10^{-19} J.

Question 5

Use an arrow to show on **Figure 2** the energy level transition that produces this photon.

2 marks

Question 6

Calculate the wavelength, in nm, of the laser light.

nm

2 marks

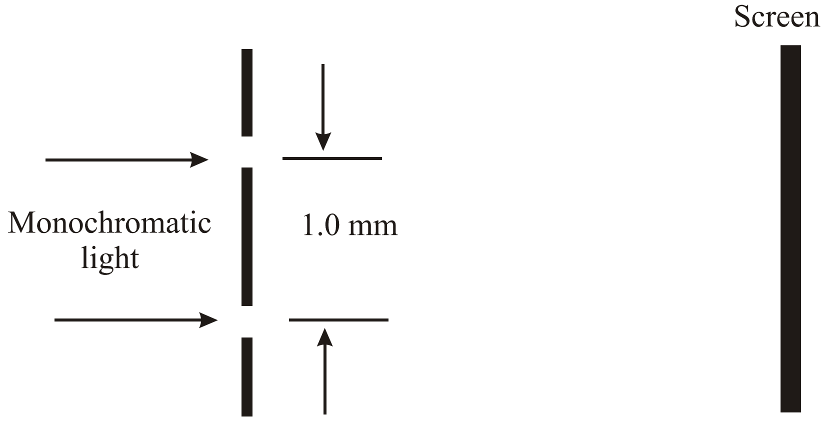
Question 7

Calculate the momentum of a photon of laser light having this wavelength.

J s nm^{-1}

2 marks

Questions 8 to 10 refer to the following information:
Figure 3 shows yellow light of wavelength 670 nm passing through two narrow parallel slits that are 1.0 mm apart. A pattern of alternating light and dark bands is produced on a distant screen.



Question 8
Which of the following statements correctly describes the effect on the pattern if violet light with a wavelength of 420 nm is used instead of the yellow light?
A. The pattern remains the same.
B. The bright bands move closer together.
C. The bright bands move further apart.
D. Only the colour of the bright band changes.

2 marks

Question 9
Which of the following statements correctly describes the effect on the pattern if the original yellow light of wavelength 670 nm was used, but narrow parallel slits 1.6 mm apart were used instead of the original set.
A. The pattern remains the same.
B. The bright bands move closer together.
C. The bright bands move further apart.
D. Only the colour of the bright bands changes.

2 marks

Question 10
Explain how the light and dark bands were formed and how this experiment supports the wave model for light.

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____

____

2 marks

Electrons accelerated through a large potential difference can have very short wavelengths.

Question 11
Calculate the wavelength, in nm, of an electron that has been accelerated through a potential difference of 100 kV. (Assume no relativistic effects).

nm

3 marks

End of Section A

SECTION B – Detailed study

Instructions for Section B
Answer all the questions on this Detailed study.

Detailed study 3 – Sound

Figure 1 shows how air pressure varies with distance in the region of a musical instrument.

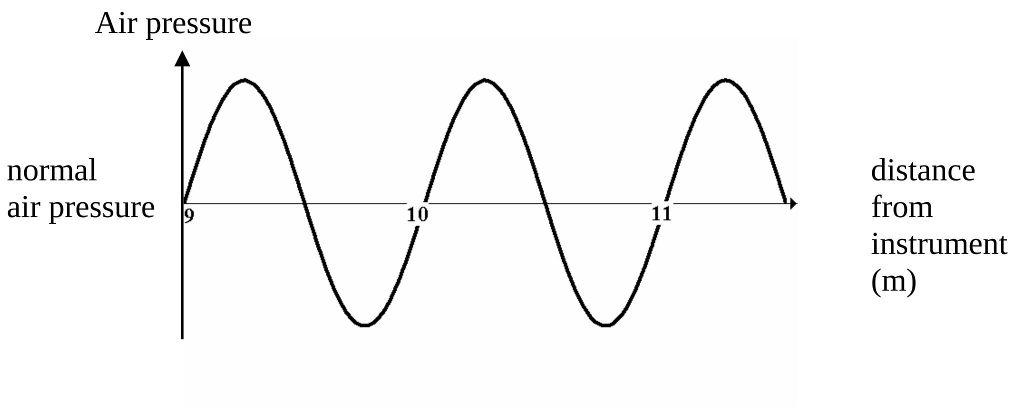

Figure 1

The speed of sound in air is 340 m s^{-1} at this time.

Question 1
Calculate the frequency of the sound being produced by the instrument.

Hz

2 marks

Microphones are <u>transducers</u> which detect sound signals and produce an electrical image of the sound. **Figure 2** shows the simplified structure of a dynamic microphone.

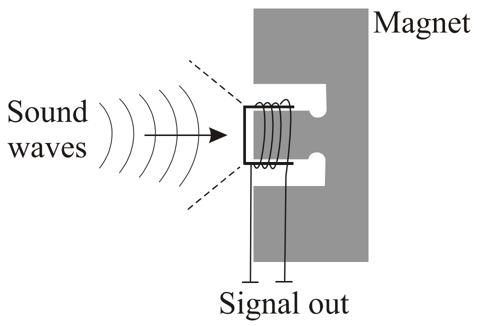

Figure 2

Question 2
Describe the principle of operation of a dynamic microphone.

2 marks

Sounds of different frequencies require different intensities to be heard with the same loudness.
The curve labeled 60 phon in **Figure 3** represents sounds that are heard to have the same loudness as a 1000 Hz sound with an intensity level of 60 dB. Similarly, the curve labeled 100 phon represents sounds that are heard to have the same loudness as a 1000 Hz sound with an intensity level of 100 dB.

Question 3
Use **Figure 3** to determine the intensity level (dB)of a 50 Hz tone which sounds as loud as a 1000 Hz tone with an intensity level of 60 dB.

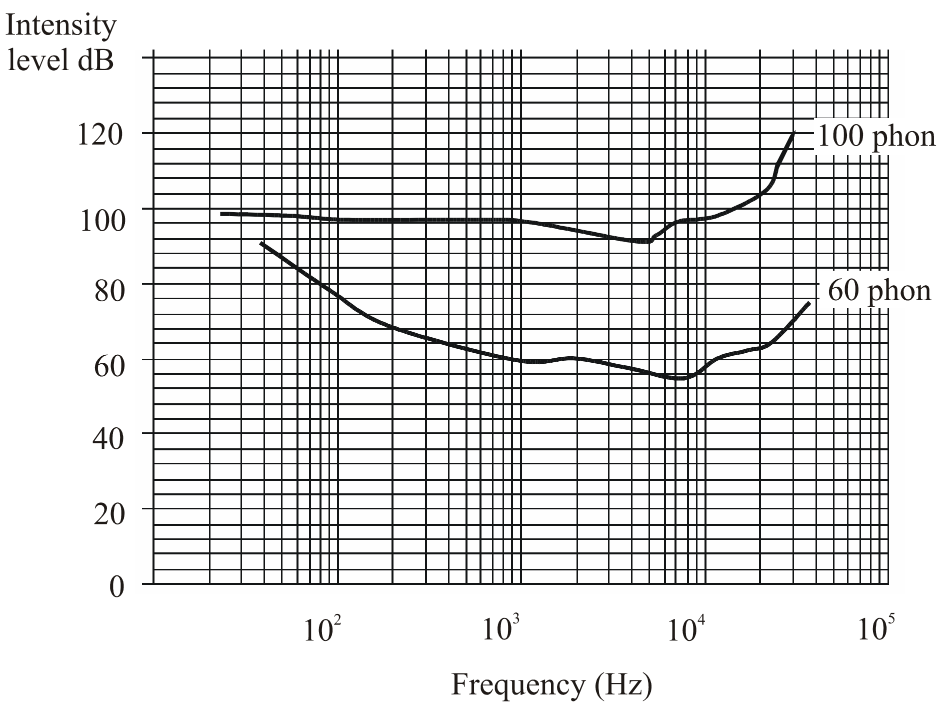

Figure 3

dB

2 marks

Question 4

Good quality loudspeakers contain baffle boards. From the alternatives A – D, select the one that best describes the function of the baffle board.

- **A.** The baffle board prevents sound from spreading out.
- **B.** Sound reflected from the back and the front of the speaker is out of phase and the baffle board prevents the waves from meeting and interfering with one another.
- **C.** The baffle board resonates and increases the fidelity of the sound.
- **D.** The baffle board enables the low frequency sound to diffract more.

2 marks

Questions 5 to 7 refer to the following information.

Khoa has bought a new speaker system consisting of two loudspeakers; a 12 cm diameter woofer (for the frequencies below 500 Hz) and a 3 cm diameter tweeter (for the higher frequencies). Khoa invites his friend Victor to listen to music on his new system. They are located as shown in **Figure 4** as they listen to some music.

Khoa says that the sound is great, but Victor is disappointed, as the frequencies above 5500 Hz seem very soft. On checking the system, Khoa finds that both speakers are working satisfactorily.

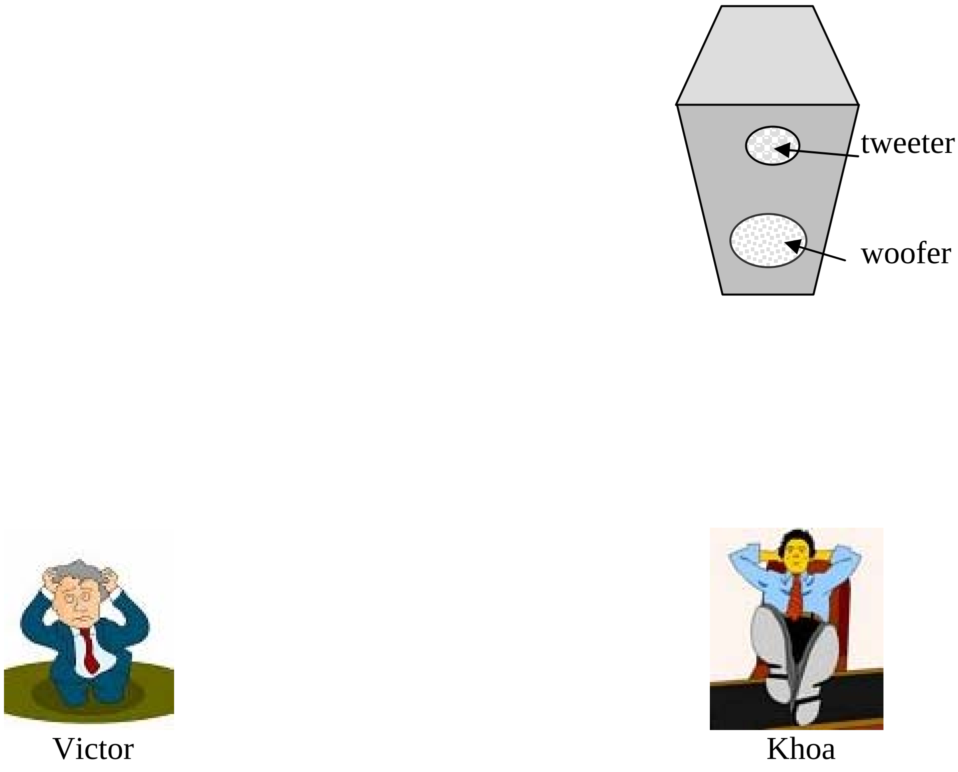

Figure 4

Question 5
Explain why Victor hears the sound differently to Khoa

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____

____

____

3 marks

Khoa has a sound level meter and records a sound level of 60 dB at a distance of 2.0 m from the sound system when it is operating. He moves backwards in a straight line to a second position and notes that the reading on the sound level meter is 52 dB.

Question 6
Calculate the distance that Khoa has moved backward.

m

3 marks

Question 7
Calculate the sound intensity difference in Wm^{-2} between the sound intensity levels of the 52 dB and the 60 dB sounds.

$W\ m^{-2}$

3 marks

Sound reproduction equipment shows variability and limitations in response to the input of different frequencies. Stereo systems contain speakers of various sizes. Tweeters produce sounds in the treble range, squawkers are used for sounds of middle pitch, while woofers respond to low frequencies.
Figure 5 shows the frequency response of a particular loudspeaker.

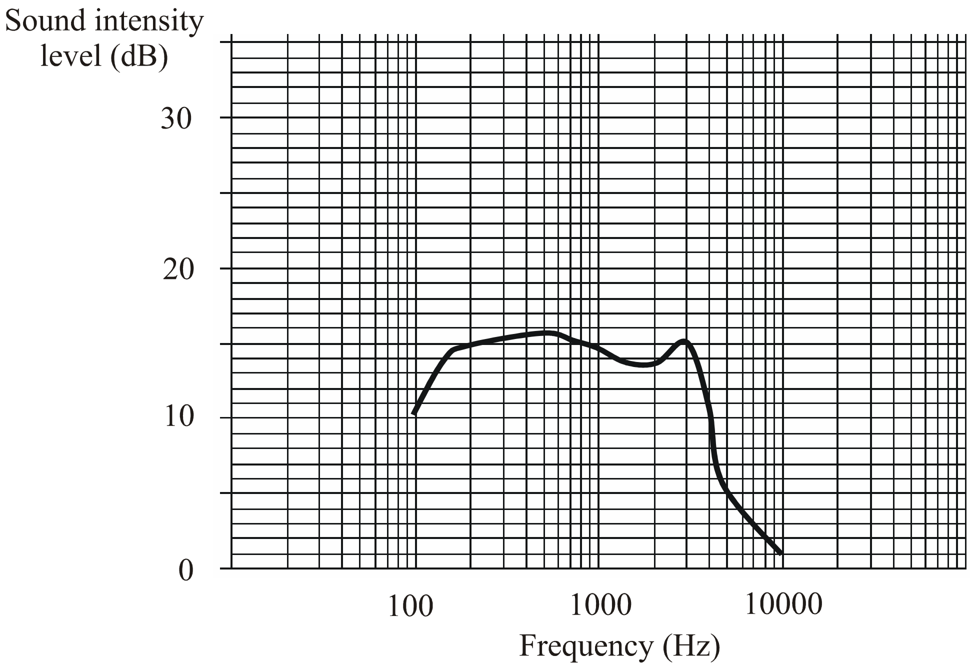


Figure 5

Question 8
Which one of the alternatives, A – D, best describes the range of frequencies over which the loudspeaker could be considered to have a good response.
A. 100 – 10 000 Hz.
B. 10 – 16 dB.
C. 200 – 3 000 Hz.
D. 100 – 2000 Hz.

2 marks

The A string of a violin has a length of 0.32 m between fixed points and produces a fundamental frequency of 440 Hz.

Question 9
Calculate the frequency of the first overtone of this instrument.

Hz

2 marks

Questions 10 and 11 refer to the following information.
An organ pipe closed at one end has a fundamental frequency of 440 Hz.
The speed of sound in air is 340 m s^{-1} .

Question 10

Calculate the frequency of the first overtone of this organ pipe.

Hz

2 marks

Question 11

Calculate the length of the organ pipe.

m

2 marks

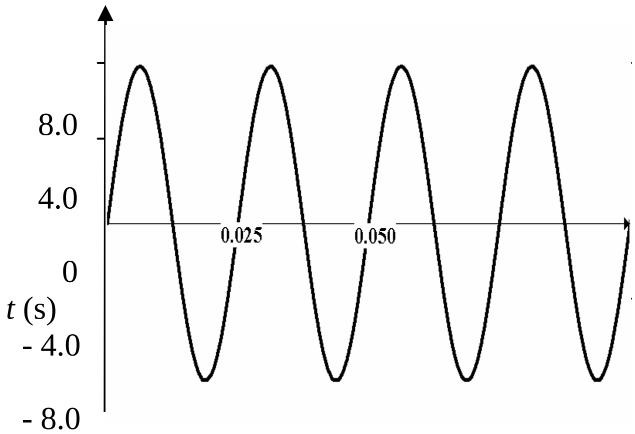
End of Section B
End of examination

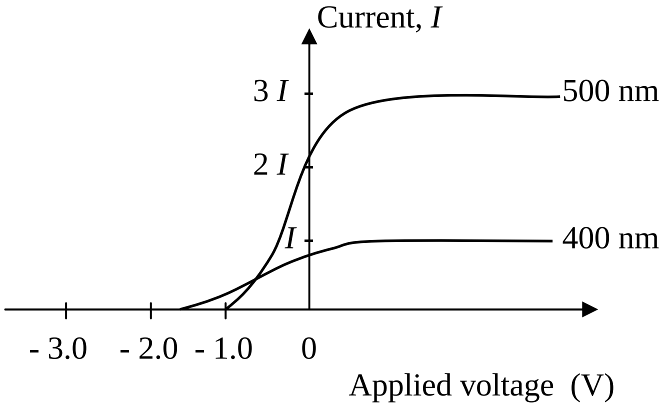
Suggested Solutions VCE Physics 2007 Year 12 Exam Unit 4

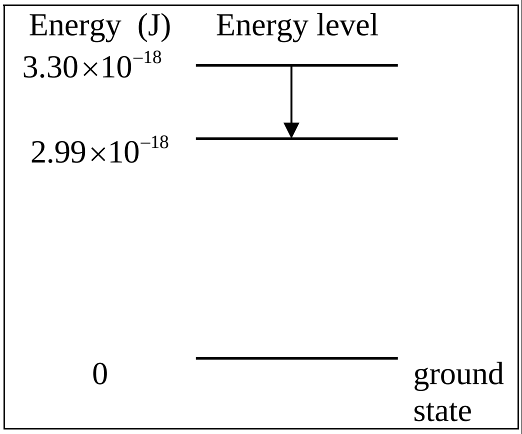
Question	**Section A – Core** **Area of study 1: Electric power**	Mark allocation
1	Use: $F = BIl$ $= 0.90 \times 2.0 \times 0.12$ $= 0.22$ N	1 1
2	Use the right hand slap rule. Answer: **S**	1
3	Use the right hand rule Answer **B**	2
4	The correct response is alternative **B**.	2
5	Use: $\frac{N_P}{V_P} = \frac{N_S}{V_S}$ $N_S = \frac{1000 \times 500\,000}{24\,000}$ $= 2.1 \times 10^4$ turns	1 1
6	Use: As the transformer is considered to be ideal; Power in = Power out $P = VI$ $530 \times 10^6 = 500\,000 \times I$ $I = 1060$ A $= 1.1 \times 10^3$ A	1 1

7	There is loss of 5.0% of the power during transmission. The current in the transmission lines remains constant. Power available $= \frac{95}{100} \times 530 \times 10^6$ W $\frac{95}{100} \times 530 \times 10^6 = V \times 1060$ $V = 475\,000$ $475\,kV$	1 1

8	Use: $V_{PEAK} = V_{RMS}\sqrt{2}$ $= 12 \times \sqrt{2}$ $= 17\text{ V}$	1 1
9	Each separate light will draw 2.4 W of power. The voltage across each light is the same; 12 V. Use; $P = \frac{V^2}{R}$ $R = \frac{V^2}{P}$ $= \frac{12 \times 12}{2.4}$ $= 60\ \Omega$	1 1
10	The right hand end of the solenoid with the switch will have a north polarity. This will induce a north polarity in the left hand end of the solenoid with the resistor, R. The current flowing will be in the direction 1 to 2.	1 1 1
11	Use: $\varepsilon = \frac{N\Delta\phi}{\Delta t}$ $= \frac{200 \times ((0.25 - (-0.35)) \times 1.13 \times 10^{-2}}{0.80}$ $= 1.695\text{ V}$ $= 1.7\text{ V}$ $I = \frac{V}{R}$ $= \frac{1.7}{33}$ $= 51 mA$	1 1 1
12	Use the right-hand slap rule. Terminal T_2 is positive.	2
13	This constitutes a DC generator due to the action of the split ring commutator. Alternative D best shows the waveform observed.	2

14	A split ring commutator is a type of mechanical switch that changes the direction of the current through the coil each half revolution, so that the coil continues spinning in the same direction.	1 1
15	Use; $\phi = BA$ $= 0.60 \times (0.10)^2$ $= 6.0 \times 10^{-3}$ Wb	1 1
16	The magnitude of the induced emf in a coil is directly proportional to the rate of change of magnetic flux threading the coil. When $\frac{\Delta\phi}{\Delta t}$ is a maximum, ε is maximum. When $\frac{\Delta\phi}{\Delta t} = 0$, ε is zero. Graph **B** is the best alternative.	1 1
17	If the coil rotates at twice the frequency, the period is halved. If Δt is halved, the maximum EMF is doubled. 	1 1 1 graph
18	All the statements made are correct. Answer **B**	2
19	The induced current will initially flow from Q to R.	2

Question	**Area of Study 2 – Interactions of light and matter**	
1	Use; $eV_0 = hf - W$ for 400 nm light; $= \frac{(4.14\times10^{-15})(3.0\times10^{8})}{400\times10^{-9}} - 1.5$ $= 1.61$ $V_0 = 1.6$ V	2
	for 500 nm light; $V_0 = \frac{(4.14\times10^{-15})(3.0\times10^{8})}{500\times10^{-9}} - 1.5$ $= 0.984$ $V_0 = 0.98$ V	2
2		1 1
3	In wave theory, the photoelectric effect should occur for any frequency of light. Low frequency waves should cause photon emission if irradiating for a long time. However, this is not the case.	1
	In the photon model, for an electron to be ejected from a metal surface, it must obtain a minimum amount of energy from the photon, (which is the work function of the surface) to be ejected. The energy of the photon is $E = hf$. This implies that the energy is quantized.	1

4	**From the equation;** $h = \frac{W}{f_0}$ $= \frac{W \times \lambda}{c}$ $= \frac{1.5 \times 827 \times 10^{-9}}{3.0 \times 10^{8}}$ $= 4.1 \times 10^{-15}\ eV\,s$	1 1
5	0.31×10^{-19}  	1 1
6	Use; $E = \frac{hc}{\lambda}$ $\lambda = \frac{6.63 \times 10^{-34} \times 3.0 \times 10^{8}}{3.1 \times 10^{-19}}$ $= 642\ nm$	1 1
7	Use; $p = \frac{h}{\lambda}$ $= \frac{6.63 \times 10^{-34}}{642 \times 10^{-9}}$ $= 1.03 \times 10^{-27}\ \mathrm{J\,s\,nm^{-1}}$	1 1

8	The bandwidth is directly proportional to the incident wavelength. Blue light has a smaller wavelength than yellow light. The bands will move closer together. Answer **B**	1 1
9	If the slit separation is increased, the band width of the pattern will decrease. Answer **B**	2
10	The bright bands on the pattern are produced by the constructive interference of light waves travelling distances from the slits which differ by a whole number of wavelengths. The dark bands are caused by the destructive interference of light waves travelling distances from the slits that differ by less than a whole number of wavelengths. The slits produce the same effects as two sources of mechanical which are in phase.	1 1
11	Use; $\frac{1}{2}mv^2 = eV$ $v = \sqrt{2\frac{eV}{m}}$ $= \sqrt{\frac{2\times1.6\times10^{-19}\times10^{5}}{9.1\times10^{-31}}}$ $= 1.88\times10^{8}\ \text{m s}^{-1}$ $\lambda = \frac{h}{mv}$ $= \frac{6.63\times10^{-34}}{9.1\times10^{-31}\times1.88\times10^{8}}$ $\lambda = 0.0039\ \text{nm}$	1 1 1
Question	**Detailed study 3 – Sound**	
1	Use; $v = f\lambda$ $f = \frac{v}{\lambda}$ $= \frac{340}{1.0}$ $= 340\ \text{Hz}$	1 1

2	Sound energy moves the cone and the attached coil of wire moves in the field of a magnet. The generator effect produces a voltage which changes in the same way as the sound pressure. Dynamic microphones produce a voltage or a current which is proportional to the sound signal.	1 1
3	From the graph, using the 60 phon line, 50 Hz would require an intensity level of 86 dB.	2
4	Alternative **B** is the best choice.	2
5	To reach Victor, the sound produced by the speakers would need to diffract. The amount of diffraction depends on the ratio of wavelength to speaker width, $\frac{\lambda}{d}$, and so the lower frequencies would be heard by Victor but less so the higher frequencies. Higher frequencies diffract less than lower frequencies. Khoa, being directly in front of the speakers, heard all frequencies well because diffraction of the sound was not a factor.	1 1 1

6	Use; $L_1 = 10\log\frac{I_1}{I_0}$ $60 = 10\log\frac{I_1}{I_0}$ $10^{6.0} = \frac{I_1}{I_0}$ similarly; $10^{5.2} = \frac{I_2}{I_0}$ since; $I_1 d_1^{\ 2} = I_2 d_2^{\ 2}$ then; $d_2^{\ 2} = \frac{I_1 d_1^{\ 2}}{I_2}$ $= \frac{10^{6.0}\times I_0 \times 4.0}{10^{5.2}\times I_0}$ $= 25.24$ $d = \sqrt{25.24}$ $d = 5.02$ $d = 5.0\ m$	1 1 1
7	$60 = 10\log\frac{I_1}{I_0}$ $\Rightarrow 10^{6.0} = \frac{I_1}{I_0}$ similarly; $52 = 10\log\frac{I_2}{I_0}$ $and,\ 10^{5.2} = \frac{I_1}{I_0}$ $I_1 - I_2 = I_0(10^{6.0} - 10^{5.2})$ $= 10^{-12}(10^{6.0} - 10^{5.2})$ $= 8.4\times 10^{-7}\ \text{W m}^{-2}$	1 1 1

8	This speaker responds to sounds of frequencies between about 100 and 4000 Hz, but is generally flat in the range 200 to 3000 Hz. Combinations of speakers are needed for reproduction of the wide range of frequencies in music. Answer: **C**	2
9	Since the string is fixed at both ends, the first overtone will have a frequency of twice that of the fundamental. For a string fixed at both ends, the frequency ratio for the first, second, third overtones is 1:2:3 etc. Answer: **880 Hz**	1 1
10	For a pipe closed at one end, the ratio of frequencies for succeeding overtones is; 1:3:5 etc. $f = 3 \times 440$ Hz $= 1320$ Hz The frequency of the second overtone is 1.3 x 10^2 Hz.	1 1
11	Use; $L =$ length of pipe $\lambda = 4L$ $f = 440$ Hz $v = 340\ m s^{-1}$ $v = f\lambda$ $340 = 440 \times 4L$ $L = 0.19$ m	1 1