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<h1 style="margin: 0;">Applied Science</h1> <h2 style="margin: 0;">Unit 1: Principles and Applications of Science I</h2>	
Monday 5 June 2017 – Morning Time: 1 hour 30 minutes	Paper Reference <h3 style="margin: 0;">31617H</h3>
You must have: Calculator	Total Marks <div style="border: 1px solid black; height: 30px; width: 100%;"></div>

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and learner registration number.
- Answer **all** questions.
- Answer the questions in the spaces provided
– *there may be more space than you need.*

Information

- The total mark for this paper is 90.
- The paper is comprised of three sections worth 30 marks each.
Section A: Structure and functions of cells and tissues.
Section B: Periodicity and properties of elements.
Section C: Waves in communication.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*
- The periodic table of elements and formulae sheet can be found at the back of this paper.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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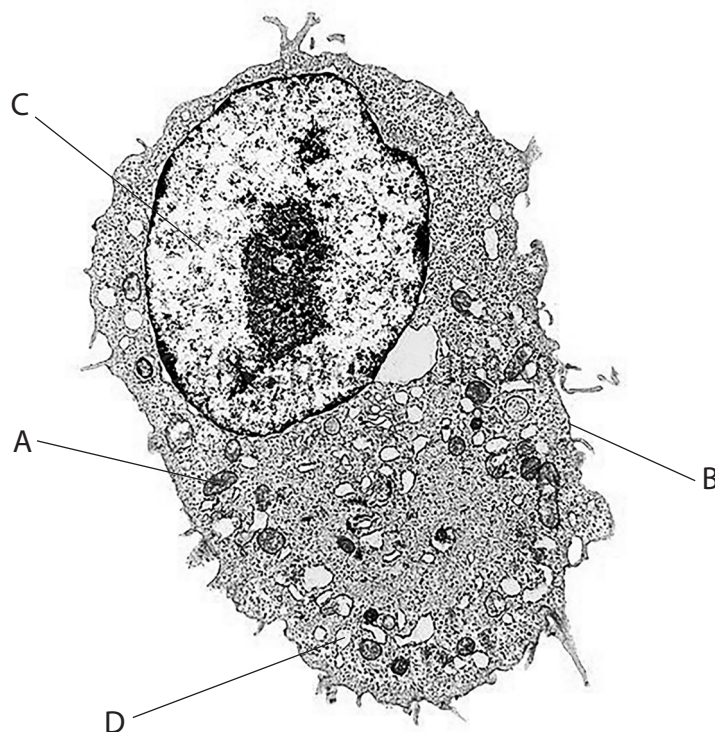

Pearson

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☐. If you change your mind about an answer, put a line through the box ☒ and then put a cross in another box ☐.

SECTION A – Structure and functions of cells and tissues

- 1 The electron micrograph shows the ultrastructure of an animal cell.



- (a) (i) Identify which cell component is a lysosome.

(1)

- ☐ A
☐ B
☐ C
☐ D

- (ii) Give **two** functions of lysosomes.

(2)

Function one

.....

Function two

.....



(b) The actual diameter of the animal cell is 45 μm .

The observed diameter of the animal cell in the electron micrograph is 1.8 cm.

Calculate the magnification used to view the image.

Show your working.

(3)

Magnification = \times

(c) State what is meant by the term **tissue**.

(1)

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(Total for Question 1 = 7 marks)



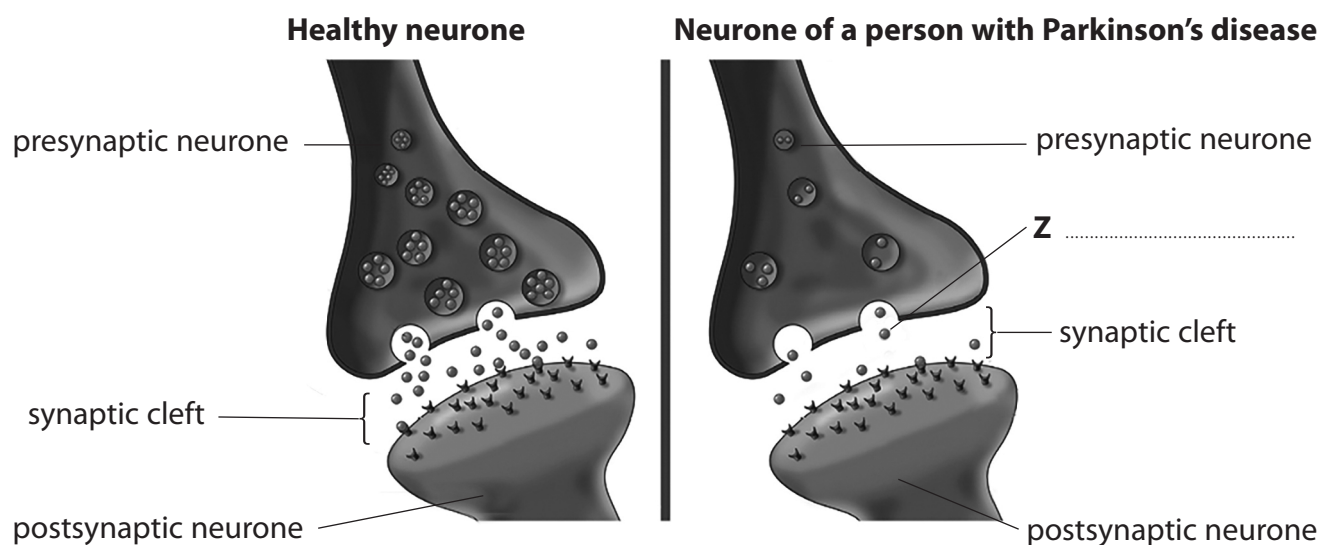
P 5 1 7 2 2 A 0 3 2 8

- 2 Parkinson's disease affects the nervous system and can be a genetic disorder.

The diagram shows a neurone releasing neurotransmitter in a healthy person and a neurone releasing neurotransmitter in a person with Parkinson's disease.

- (a) Complete the missing label, **Z**, in the diagram.

(1)



- (b) Some people with Parkinson's disease are given L-Dopa to control their symptoms.

Explain how L-Dopa affects synaptic transmission in a person with Parkinson's disease.

(3)

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(Total for Question 2 = 4 marks)



3 Some bacteria can cause infection in humans.

Microbiologists can use different techniques to find out if bacteria are Gram-positive or Gram-negative.

- (a) Complete the table for a technique used to find out if bacteria are Gram-positive or Gram-negative.

(3)

name of technique	
result for Gram-positive	
result for Gram-negative	

- (b) Penicillin is a type of antibiotic.

Penicillin is used to treat Gram-positive bacterial infections.

E. coli is a type of Gram-negative bacteria.

Explain how the structure of *E. coli* prevents penicillin being an effective treatment.

(2)

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(Total for Question 3 = 5 marks)



P 5 1 7 2 2 A 0 5 2 8

4 Alveolar tissue is found in the lungs.

Endothelial tissue is found in the blood vessels.

(a) State the type of epithelial tissue found in both alveolar and endothelial tissue.

(1)

(b) State the function of the endothelial tissue in an artery.

(1)

(c) Describe how a build-up of cholesterol in artery walls is a risk factor in the development of atherosclerosis.

(4)

(Total for Question 4 = 6 marks)

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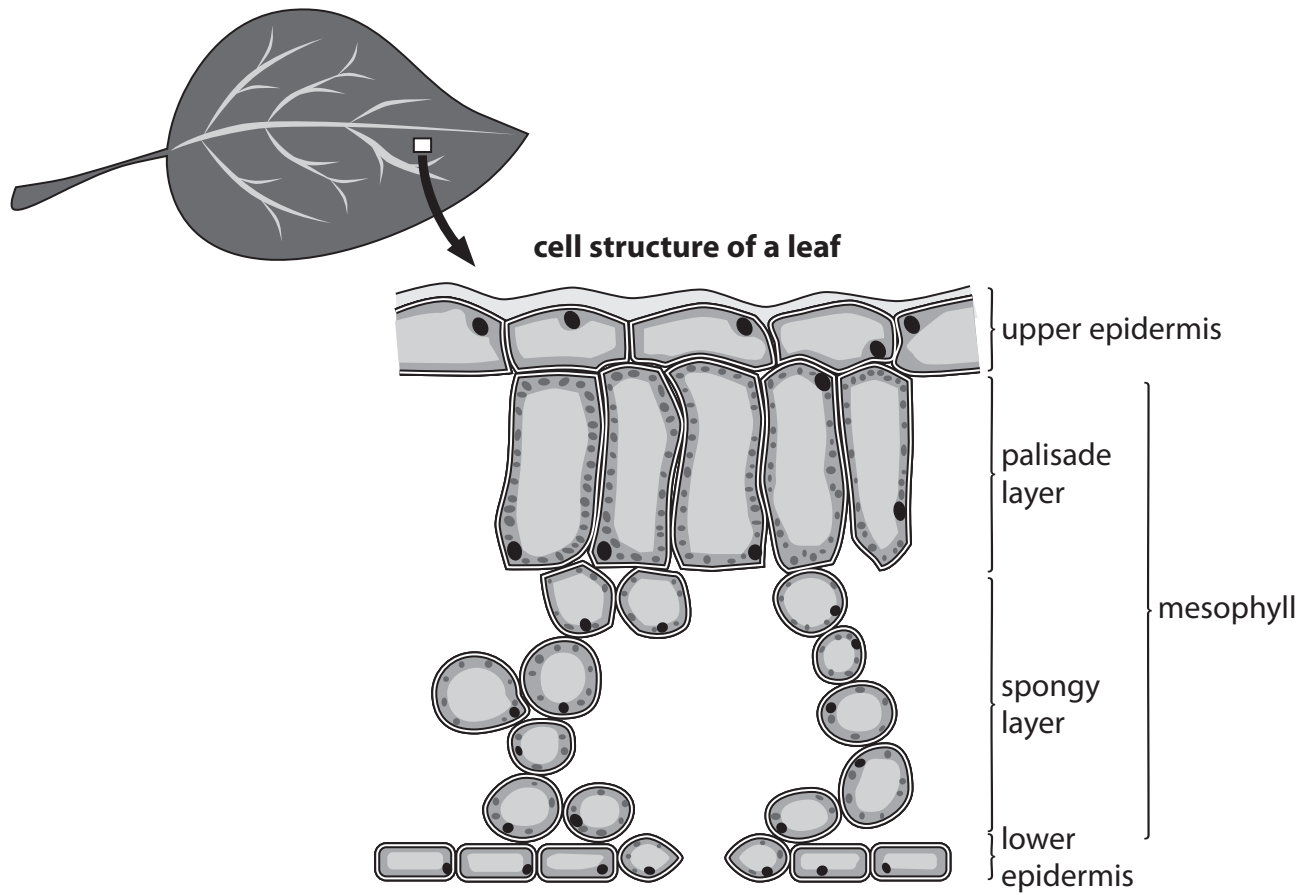
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Question 5 begins on next page



- 5 A palisade mesophyll cell is a specialised plant cell in the leaf.



- (a) Identify **two** organelles in a palisade mesophyll cell that help it maintain its rigid structure. (2)

.....

.....



(b) Explain how the structure of the palisade mesophyll cells is specialised to support the process of photosynthesis.

(6)

(Total for Question 5 = 8 marks)

TOTAL FOR SECTION A = 30 MARKS

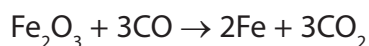


P 5 1 7 2 2 A 0 9 2 8

SECTION B – Periodicity and properties of elements

- 6** Iron is extracted from iron oxide in a blast furnace.

The balanced equation for the reaction is



- (a) Which substance is oxidised in the reaction?

(1)

- ☐ **A** CO
☐ **B** CO₂
☐ **C** Fe
☐ **D** Fe₂O₃

- (b) Calculate the relative formula mass of iron oxide.

Show your working.

(2)

Relative formula mass =

- (c) Give the oxidation state of iron in Fe₂O₃.

(1)

(Total for Question 6 = 4 marks)



- 7 The table shows the first ionisation energies of the first three elements in period 2 of the periodic table.

element	first ionisation energy kJ mol^{-1}
lithium	520
beryllium	900
boron	801

- (a) State what is meant by the term **first ionisation energy**.

(2)

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- (b) (i) Explain why the first ionisation energy of beryllium is higher than the first ionisation energy of lithium.

(2)

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- (ii) Explain why the first ionisation energy of boron is lower than the first ionisation energy of beryllium.

(2)

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(Total for Question 7 = 6 marks)



P 5 1 7 2 2 A 0 1 1 2 8

8 Table salt contains sodium chloride.

Sodium chloride can be prepared by reacting chlorine with sodium.

- (a) A chlorine molecule, Cl_2 , contains two covalently bonded chlorine atoms.

Draw a dot and cross diagram to show the bonding in a molecule of chlorine.

Show the outer electrons only.

(2)

- (b) (i) Describe how a chlorine atom forms a chloride ion, Cl^- .

(2)

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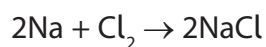
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- (ii) Sodium reacts with chlorine to form sodium chloride.

The balanced equation for the reaction is



In an experiment, 4.6 g of sodium was reacted with chlorine.

The actual yield of the experiment was 7.5 g.

Calculate the percentage yield.

(relative formula mass of sodium chloride = 58.5)

Show your working.

(4)

Percentage yield =%

(Total for Question 8 = 8 marks)



9 Aluminium is used to make drinks cans.

- (a) Give **two** properties of aluminium that means it is a suitable material for making drinks cans.

(2)

- (b) Describe the structure and bonding in aluminium metal.

(4)

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(c) Part of the reactivity series of metals is shown.

potassium	most reactive
sodium	↑
magnesium	least reactive

Explain the difference in the reactivity of these metals with reference to their:

- position in the periodic table
- electronic configuration.

(6)

(Total for Question 9 = 12 marks)

TOTAL FOR SECTION B = 30 MARKS

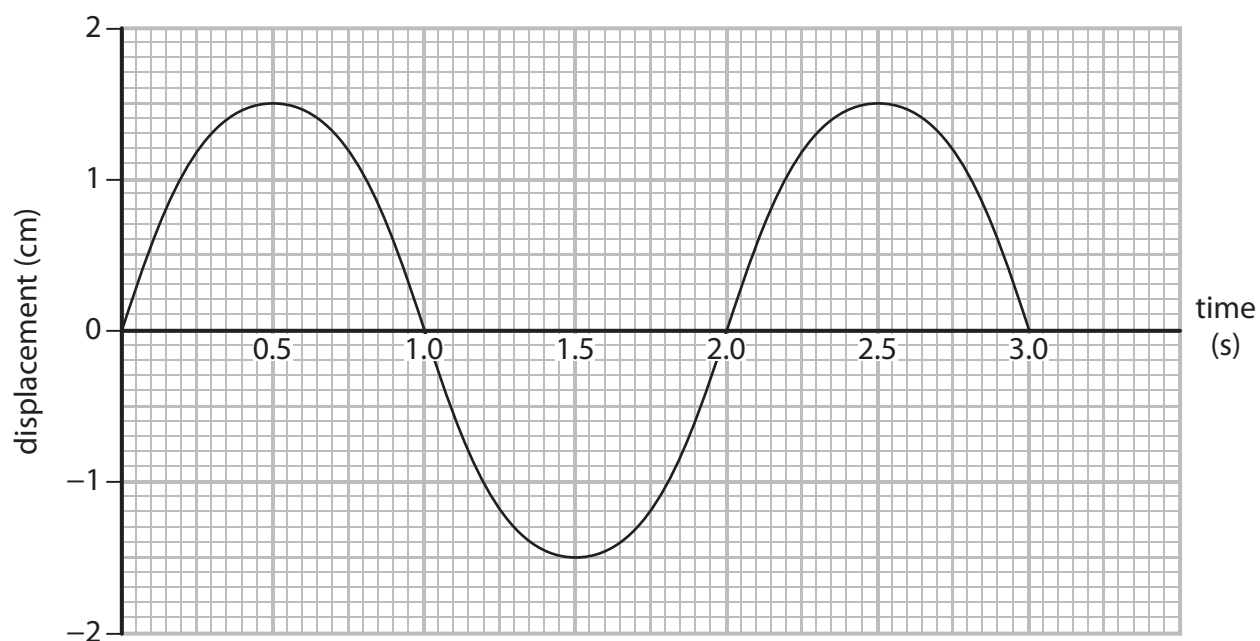


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SECTION C – Waves in communication

- 10** A student uses a cathode ray oscilloscope (CRO) to investigate the properties of waves produced by a signal generator.

The student obtains the following output.



- (a) Give the amplitude of the wave.

(1)

Amplitude = cm

- (b) Give the periodic time of the wave.

(1)



(c) The student investigates a different water wave.

The wavelength is 0.05 m and the wave speed is 0.075 m/s.

Calculate the frequency of the water wave.

Show your working.

(3)

Frequency = Hz

(Total for Question 10 = 5 marks)



11 A radio programme can be transmitted as an analogue signal or a digital signal.

(a) (i) State what is meant by the term **analogue signal**.

(1)

.....

.....

(ii) State what is meant by the term **digital signal**.

(1)

.....

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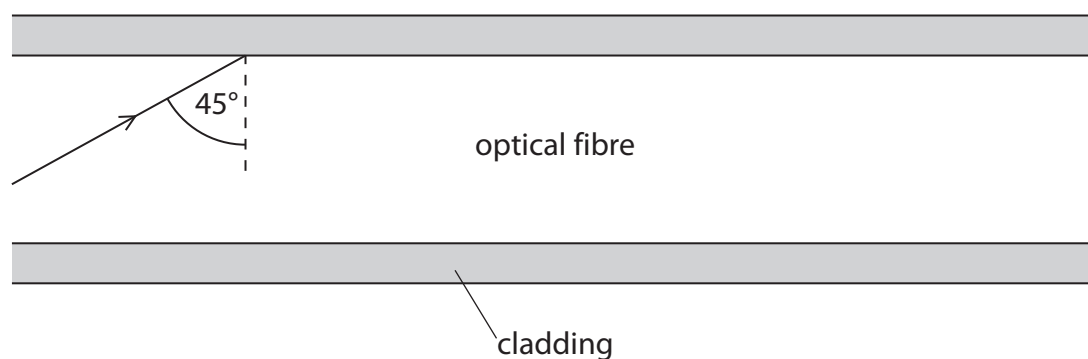
(b) Light travels through optical fibres by total internal reflection.

The diagram shows a ray of red light in an optical fibre.

The diagram is incomplete.

Complete the path of the red light through the optical fibre.

(2)



(c) Television programmes can be transmitted through optical fibres using digital signals.

Explain **two** advantages of using digital signals instead of analogue signals to transmit television programmes.

(4)

(Total for Question 11 = 8 marks)



P 5 1 7 2 2 A 0 1 9 2 8

12 Visible light transfers energy as a transverse wave.

Sound transfers energy as a longitudinal wave.

Visible light moves faster than sound.

(a) Give **two** other differences between visible light waves and sound waves.

(2)

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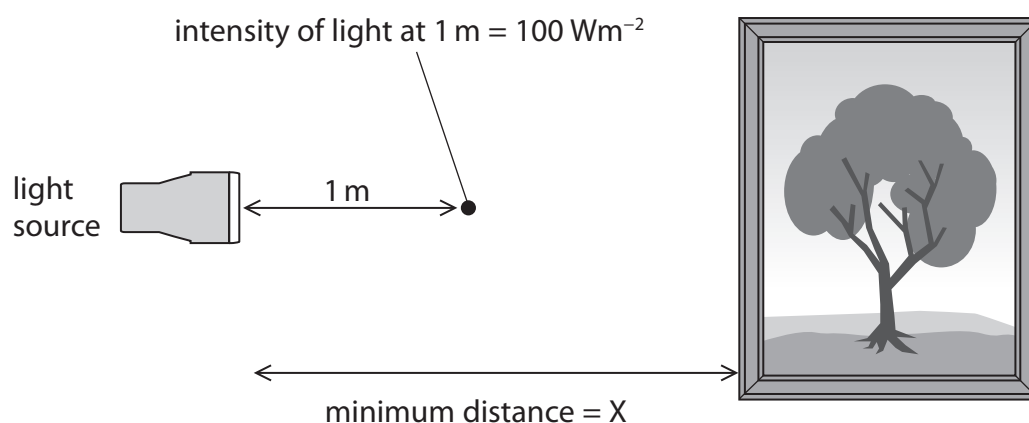


(b) A painting is displayed in a dark room.

An electrician fits a single light source to illuminate the painting.

The intensity of the light 1 m from the light source is 100 W m^{-2} .

The intensity of the light falling on the painting must not be greater than 30 W m^{-2} .



Calculate, using the inverse square law, the minimum distance the light source must be placed from the painting.

Show your working.

(3)

Minimum distance = m

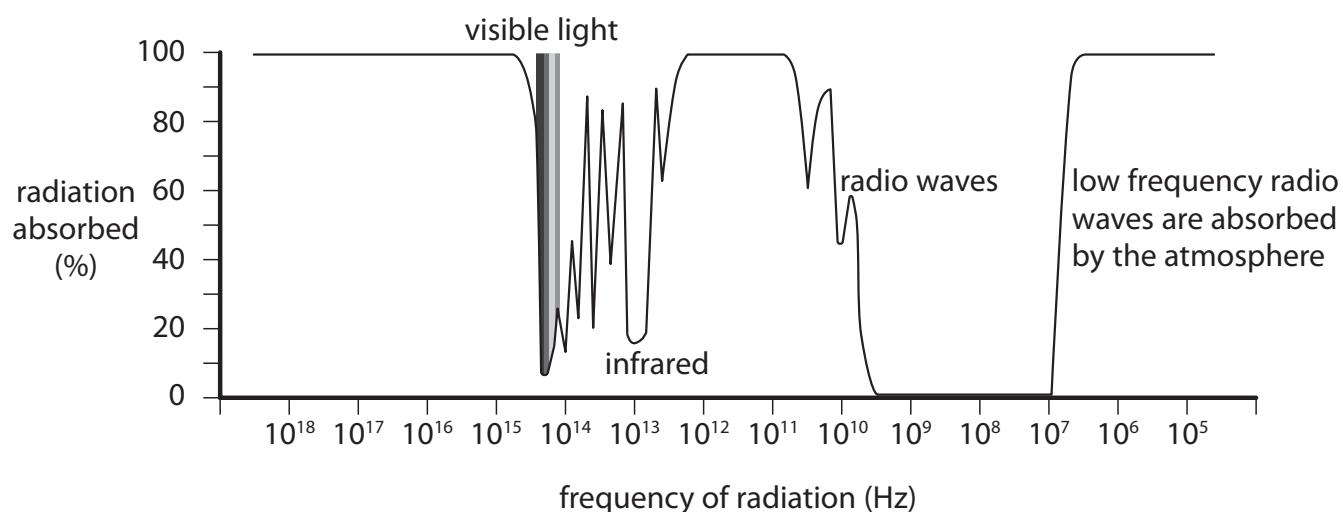
(Total for Question 12 = 5 marks)



13 A satellite, orbiting the Earth, collects information about asteroids that might hit the Earth.

A research team needs to collect a large amount of data from the satellite very quickly. This means that the data has to be transmitted rapidly.

The chart shows how the regions of the electromagnetic spectrum with different frequencies are absorbed by the Earth's atmosphere.



(a) Explain the advantages and disadvantages of using radio waves instead of light waves to send large amounts of information from the satellite to the surface of the Earth.

(4)

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- (b) The satellite transmits two signals, A and B, to another satellite in orbit around the Moon, using different electromagnetic waves.

The signals are transmitted over the same distance.

Signal A has a frequency of 3.0×10^{13} Hz and takes 1.28 seconds to travel between the two satellites.

Signal B has a frequency 4.0×10^9 Hz.

Explain how much time is taken for Signal B to travel between the two satellites.

(2)

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.....



P 5 1 7 2 2 A 0 2 3 2 8

(c) A home cinema system can be controlled either by an infrared remote control or a remote control that uses a Bluetooth® connection.

Evaluate the strengths and weaknesses of using:

- an infrared remote control
- a Bluetooth[®] remote control

to control the home cinema system.

(6)

(Total for Question 13 = 12 marks)

TOTAL FOR SECTION C = 30 MARKS
TOTAL FOR PAPER = 90 MARKS



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Formulae Sheet

Wave speed

$$v = f\lambda$$

Speed of a transverse wave on a string

$$v = \sqrt{\frac{T}{\mu}}$$

Refractive index

$$n = \frac{c}{v} = \frac{\sin i}{\sin r}$$

Critical angle

$$\sin C = \frac{1}{n}$$

Inverse square law in relation to the intensity of a wave

$$I = \frac{k}{r^2}$$



The Periodic Table of Elements

		1		2		3		4		5		6		7		0 (8)														
		1.0 H hydrogen 1																												
		Key																												
		relative atomic mass atomic symbol name atomic (proton) number																												
(1)	(2)	(3)														(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
6.9 Li lithium 3	9.0 Be beryllium 4	23.0 Na sodium 11	24.3 Mg magnesium 12	39.1 K potassium 19	40.1 Ca calcium 20	45.0 Sc scandium 21	47.9 Ti titanium 22	50.9 V vanadium 23	52.0 Cr chromium 24	54.9 Mn manganese 25	55.8 Fe iron 26	58.9 Co cobalt 27	58.7 Ni nickel 28	63.5 Cu copper 29	65.4 Zn zinc 30	69.7 Ga gallium 31	72.6 Ge germanium 32	74.9 As arsenic 33	79.0 Se selenium 34	79.9 Br bromine 35	83.8 Kr krypton 36	86 Rn radon 86								
87 Fr francium	226 Ra radium	132.9 Cs caesium	137.3 Ba barium	178.5 Hf hafnium	179.0 Ta tantalum	180.9 Nb niobium	183.8 W tungsten	186.2 Re rhenium	190.2 Os osmium	192.2 Ir iridium	195.1 Pt platinum	197.0 Au gold	200.6 Hg mercury	204.4 Tl thallium	207.2 Pb lead	209.0 Bi bismuth	210.0 Po polonium	210.0 At astatine	210.0 Rn radon	210.0 Fr francium	210.0 Ra radium	210.0 Ac actinium								
Elements with atomic numbers 112-116 have been reported but not fully authenticated																														
* Lanthanide series																														
* Actinide series																														

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* Actinide series

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