

Applied Science

Advanced GCE A2 H575/H775

Advanced Subsidiary GCE AS H175/H375

Mark Schemes for the Units

January 2009

H175/H375/MS/R/09J

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Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

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G622 Monitoring the activity of the human body

Question		Expected Answers	Marks	Additional Guidance
1	(a)	releases/provides/gives/supplies energy / makes ATP ; <i>plus any two from:</i> nerve transmission ; muscle contraction ; uptake of ions against concentration gradient ; AVP ;	3	reject makes / produces energy. e.g. sperm motility / cell division
	(b) (i)	aerobic glucose / amino acids / protein / lipid / fat / fatty acid <u>and</u> oxygen ; anaerobic glucose ;	2	N.B. substrates only, full equation negates mark
	(ii)	aerobic carbon dioxide and water ; anaerobic lactic acid / lactate ;	2	N.B. products only, full equation negates mark
	(iii)	aerobic 32 – 38 inclusive ; anaerobic 2 ;	2	
	(c) (i)	long distance running / swimming / cycling / circuit training / AVP ;	1	running must be qualified accept any high endurance/ low intensity exercise
	(ii)	sprint / weight lifting / shot putting / discus throwing / tennis / squash ;	1	running must be qualified accept any short / high intensity explosive exercise
Total			11	

Question	Expected Answers	Marks	Additional Guidance
2	<p><i>any seven from:</i> (spirometer) with medical grade oxygen ; left full with taps closed ; ensure subject sitting down / at rest ; mouthpiece rinsed in antiseptic solution / sterilised ; mouthpiece placed in subject's mouth ; nose clip in place / breathing through mouth only ; tap open to atmosphere ; start recorder / trace produced / computer used to record results ; tap turned to connect subject to spirometer (at end of outward breath) ; record normal breathing for about 1 minute ; ask subject to breathe in as deeply as possible ; resume normal breathing for a few breaths ; breathe out as far as possible ; normal breathing for a few minutes ;</p>	7	
	Total	7	

Question			Expected Answers	Marks	Additional Guidance
3	(a)	(i)	A. alveolus / air sac ; B. red blood cell ;	2	
		(ii)	bronchiole ;	1	
	(b)		ribs/ ribcage (and sternum) moved ; contraction ; intercostal muscles ; diaphragm pulled down ; contraction of (diaphragm) muscles ; diaphragm becomes dome shaped/ moves up ; when muscles relax ; AVP ; QWC specialist terms ; spelling punctuation and grammar ;	6 2	reject if incorrect direction of movement of ribcage stated or implied ignore references to pressure / volume changes reject if incorrect direction of movement of diaphragm stated or implied e.g. correct mention of external and internal intercostal muscles/ nervous stimulation. <i>any two from:</i> diaphragm, thorax, intercostal, contraction / contract / relax, sternum, muscle, inhale, exhale and derivatives allow one error in SPAG
	(c)	(i)	<i>any four from:</i> naming of gas exchange surfaces / alveolar surfaces / blood ; diffusion ; concentration gradient ; oxygen moves from air space to blood ; carbon dioxide moves from blood to air space ;	4	
		(ii)	<i>any two from:</i> thin ; moist ; permeable ; large surface area ; proximity of blood / OWTTE ;	2	reject one cell thick short diffusion distance
			Total	17	

Question			Expected Answers	Marks	Additional Guidance
4	(a)	(i)	BPressure: 123 / 80 mm Hg ; BTemp: 36.5 – 37.2_°C ; HR: 60 – 80 bpm ; VC: 4.25 dm ³ ;	4	accept single value on or between limits accept beats per minute accept litres
		(ii)	for comparison; diagnostic aid;	2	
		(iii)	<i>top:</i> anaemia / Fe deficiency; <i>middle:</i> hyperglycaemia / circulatory shock likely / diabetes; <i>bottom:</i> hypothermia ;	3	
	(b)	(i)	<i>clinitix:</i> glucose ; <i>sphygmo'r :</i> blood pressure ; <i>peak f.meter:</i> speed of air flow ; <i>thermometer:</i> (body) temperature ;	4	accept sugar
		(ii)	1. electrocardiogram / ECG ; 2. B <u>bradycardia</u> ; C (ventricular) fibrillation / VF ;	3	

Question	Expected Answers	Marks	Additional Guidance
(c)	<p><i>any six from:</i> enzyme-linked immunosorbent assay ; use antigens (in wells) ; specific to disease ; serum / blood sample added ; if antibody is present, antigen will bind to antibody ; wash cells at appropriate point ; antibody (enzyme / fluorescent marker / radio active marker) complex added ; binds to antigen / antibody ; substrate added ; enzyme reaction occurs ; end point / colour change / fluorescence / radio activity ;</p>	6	
	Total	22	

Question			Expected Answers	Marks	Additional Guidance
5	(a)	(i)	named pulse location ; (index) finger / data logger ; count number per unit time / read off meter ;	3	accept references to digital sphygmomanometer or ECG
		(ii)	<i>any five from:</i> increased ; 80 – 190 bpm / any relative pair of bpm ; from 4 – 17 km per hour / accept matching numbers for above ; heart rate max / levels off at 17 – 20 km per hour ; remains at 190 bpm after 17 km per hour ; increase linearly / steady increase up to 17kmph / 190 bpm ; AVP ;	5	
	(b)	(i)	plotting ; ; curve ;	3	deduct 1 mark for each error in plotting no mark for curve if line extended beyond plotted points
		(ii)	<i>any two from:</i> max SV achieved approx. 11 km per hour / kmh^{-1} whereas max HR achieved at 17 km per hour / kmh^{-1} ; HR remains constant after 17km per hour whereas SV decreases after 14km per hour ; HR increases linearly up to max exercise intensity whereas SV increases up to about 40 to 50 % max exercise intensity ; HR increased after time SV max achieved ; SV increases at a faster rate than HR ; AVP ;	2	max HR achieved at a higher speed than max SV HR remains high whereas SV peaks and then decreases accept any valid comparison,

Question			Expected Answers	Marks	Additional Guidance
5	(b)	(iii)	130 x 140 / 131 x 140 / 132 x 140 / 133 x 140 ; 18 200 / 18340 / 18480 / 18620 ;	2	accept ecf for 1 mark
	(c)	(i)	(anabolic) steroids / (anabolic) androgenic steroids / testosterone / nandrolone / stanozol / beta blockers / erythropoietin / EPO ;	1	
		(ii)	<i>any three from:</i> blood sampled ; two taken / two aliquots ; one for analysis, one for reference ; reference to relevant technique for c(i) e.g. chromatography / spectrometry / red cell count for EPO ; compare to standard ; repeats ;	3	
Total				19	

Question		Expected Answers	Marks	Additional Guidance
6	(a)	<p><i>any six from:</i> x-ray through body to film ; (radiation) produces an image on the film ; bone / denser material absorbs more radiation ; soft tissue absorbs less ; different tissues absorb different amounts of x-rays ; idea of image dark where most gets through / shadow image / bones white or light grey ; x-ray film/ image as record ; AVP ;</p> <p>QWC: order ; flow ;</p>	6	e.g. contrasting medium – barium meal
		<p><i>any two from:</i> noise ; magnetism / metal / staples / earrings / implants ; enclosed space / claustrophobia ; movement of machine ;</p>	2	
	(ii)	<p><i>any two from:</i> deafness / ear damage / panic ; MRI banned therefore incomplete diagnosis / metal sucked into machine / out of patient (not implants) / damage to machine / damage to patient / erroneous diagnosis ; panic from claustrophobia ; damage to patient ;</p>	2	

Question			Expected Answers	Marks	Additional Guidance
6	(b)	(iii)	<i>any two from:</i> ear plugs / music ; interview / remove 'metals' ; counsel ; lay still / no loose clothing ;	2	
			Total	14	

G623/01 Cells and Molecules - Plan

Planning Exercise

The effect of concentration of barley straw extract on the population growth of a culture of two freshwater algae, *Spirogyra* sp. and *Chlorella vulgaris*.

Marking of the plan:

- 1 Read the material presented.
- 2 Then award 1 mark if *scientific terminology* has been used appropriately. Record using the letter Y. **NB Remember not to award criteria B and C if only 1 type of alga involved.**
- 3 Then re-read, this time point marking up to 24, by placing letters A to X in the margin where you see evidence of the marking criteria.
- 4 The same piece of evidence can be used to award one criterion only.

Marking Point	Marking Criteria	Mark	Additional notes
A	easily recognised safety procedures highlighted;	1	Evidence of something that is going to make doing the investigation safer – an active document, a working document <u>related</u> to the plan. Reject anything 'over the top'.
B*	prediction made;	1	Prediction related to task.
C*	with justification;	1	Use evidence
D	description of preliminary work;	1	At least one from:
E	clear and in detail;	1	Explain how to do it.
F	reason (for doing it) explained;	1	Explain why it's necessary for completion of the whole investigation.
G	clear and in detail;	1	Extra information/suitable extension.
H	at least two secondary sources of information identified;	1	State at least 2 references including at least 1 researched source . Full website address needed. Full description of named text (Title, Author, Publisher.)
I	relevance explained;	1	Brief explanation as to how references helped in the planning.
J	basic practical skills and accuracy;	1	Simple method / list of instructions. Basic. 'Is it a feasible approach?'
K	sound practical skills and accuracy; (may also look for evidence of 'P' here)	1	Could someone follow the instructions unaided? Are quantities shown? Is it repeatable to appropriate degree of accuracy?

2 from:
glass break,
electrical,
biohazard,
waste
disposal,

'straw
concentration',
culture
temperature,
dilution factors,
how to set up
dilution series;
range of dilution to
consider; suitable
population density
for counting;
incubation time;
volume/type of
vessel; light

Preliminary
work starts
here

Main
investigation
starts here.

Marking Point	Marking Criteria	Mark	Additional notes
L	range of appropriate equipment listed;	1	List of names of main items of equipment and materials needed for the investigation. Generic terms: beakers, flasks etc are OK here.
M	full range of appropriate equipment listed;	1	Qualification noted at least once. Indication of number of each, specific sizes, eg 250 cm ³ beaker, 1dm ³ flask. If any major item is missing do not award eg colorimeter/microscope/haemocytometer/graticule/balance
N	appropriate number of measurements stated;	1	Mentions replicates / repeats
O	need for range of measurements stated;	1	Statement: to come to a reliable conclusion/to have enough data to see a pattern or trend OWTTE
P	appropriate range stated;	1	5 concentration values to provide a sensible range
Q	relevant variables are identified (stated); controlled variables	1	At least 2 from:
R	how variables to be controlled explained;	1	Explanation for at least 2 of variables.
S	one suitable method to display data;	1	One display of results eg Table with appropriate column headings (NB units but do not penalise lack of units x2)
T	additional method to display data;	1	Any <u>different</u> display eg graph.
U	simple data handling;	1	mean / use of graph data
V	possible conclusions;	1	Statements of expectations or observations to confirm or reject prediction made in B . 'What would the results need to show to confirm or reject the prediction?'
W	recognises sources of error;	1	At least two examples: equipment / materials / specific human error.
X	suggests methods for improving accuracy and or validity;	1	Accuracy: relate to ' W ' or use of alternative technique(s). AND / OR Validity: state aspect of collected data to be compared with secondary sources.
Marks	Maximum for plan = 25	24 + 1	<i>(scientific terminology)</i>

VARIABLES
age of straw sample, initial age of algal culture, seasonality, time of incubation; surface area (exposure); light intensity; light wave length; carbon dioxide conc'n; nutrient solution; source of algae; initial mass/volume / population of cells, temperature

Accuracy:
precision of water bath

Validity:
comparison with secondary source

G623/02 Cells and Molecules

Question	Gd	Expected Answers	Mk	Additional Guidance
1	(a)	genetic / faulty gene / recessive allele / pair of recessive alleles / error on chromosome 7 ;	1	
	(b)	<i>any three from:</i> thick mucus ; salty sweat / high sodium levels in sweat ; chronic lung congestion ; lung infection ; pancreatic obstruction ; trypsin deficiency ; (ultimately) liver damage ; diabetic (tendency) ; out of breath quickly ; coughing ; weight loss ; greasy stools ;	3	
	(c)	<i>any two from:</i> moves mucus ; (assists in getting) mucus removed from air passages / lungs ; ease breathing / reduce cough ; decreases risk of infection ;	2	
	(d)	<i>any three from:</i> whether or not to pursue elective abortion ; religious issues ; accuracy issues ; post natal issues e.g. gene therapy or not ;	3	
		Total	9	

Question		Gd	Expected Answers	Mk	Additional Guidance
2	(a)	(i)	golgi <i>link to</i> processing and packaging ; nucleus <i>link to</i> controls cellular activity ; mitochondrion <i>link to</i> activities assoc. aerobic respiration ;	3	any structure with more than one link automatically wrong
		(ii)	ring around 1 ;	1	
	(b)	(i)	electromagnets / magnets / magnetic field ;	1	
		(ii)	40 – 1500 times ;	1	accept anywhere between limits
		(iii)	dead ;	1	
		(iv)	zero pressure / vacuum ;	1	accept high voltage
	Total			8	

3	(a)	(i)	Iodine / iodine in potassium iodide solution / I ₂ /KI ;	1	
		(ii)	A before D D before C C before B B before F	3	mark correct with a dot, mark error with 'x' 0 or 1 error = 3 marks 2 errors = 2 marks 3 errors = 1 marks
		(iii)	<i>any two from:</i> glucose is a reducing sugar / sucrose is a non-reducing sugar ; glucose is a monosaccharide / sucrose is a disaccharide / sucrose made from glucose and fructose ; glucose has 6C atoms / sucrose has 12C ;	2	N.B. use of 'It' implies ref to sucrose accept comparatives for number of C atoms involved accept 'result of non-hydrolysed sucrose with benedicts different' OWTTE
	(b)	(i)	hydrolysis ;	1	
		(ii)	condensation ;	1	
		(iii)	they speed up the rate of reaction / chemical change ;	1	
		(iv)	protein ;	1	
			very small (quantity) ;	1	
			<i>any three from:</i> pH ; temperature ; concentration of enzyme ; concentration of substrate ; presence of inhibitors ;	3	
		Total			14

Question			Gd	Expected Answers	Mk	Additional Guidance
4	(a)	(i)		8 ;	1	
		(ii)		0.2 x 0.2 ; 0.2 x 0.2 x 0.1 OR 0.04 x 0.1 ;	2	
	(b)		<p><i>any three from:</i></p> <p>part of 'blood tests' process asked for by medical practitioner ;</p> <p>to aid or assist in diagnosis ;</p> <p>cell counts may be helpful in anaemia or leukaemia investigations ;</p> <p>cell abnormality may be helpful in cancer investigations ;</p>	3		

G628 Sampling, testing and processing

Question		Expected Answers	Marks	Additional Guidance
1	(a)	(i)	1	a reason needs to be given allow inorganic matrix with organic kerogen
		(ii)	2	not high soil heaps biohazard too vague – can give if qualified
		(iii)	1	reject just reliable / representative / accuracy if more representative + qualification accept ignore fair test
		(iv)	1	carried safely - needs qualification -ignore
		(v)	2	

Question		Expected Answers	Marks	Additional Guidance
1	(b)	(i)	2	reject only 'books' or 'journals' allow oil industries
		(ii)	1	reject accurate / easier reject same way
	(c)	(i)	1	numerical answer only
		(ii)	3	ignore mass of water If B chosen 1 mark to be given if qualified correctly
		(iii)	1	numerical value
	(d)	sedimentary rock – a rock laid down by deposition in water / air /contains fossils/plant & animal remains/compressed layers/erosion & weathering ; hydrocarbon – a compound containing carbon and hydrogen <u>only</u> ; immiscible – liquids that do not dissolve/mix with each other ;	3	
	(e)	(i)	1	
		(ii)	1	allow 2403.8 / 2404 years
	(f)	(i)	1	
		(ii)	1	
(iii)		1	allow ecf (1/10 th of answer f(ii))	

Question		Expected Answers	Marks	Additional Guidance
1	(f)	(iv) <i>any two from:</i> cost of the solvent ; availability /quantity of the solvent ; environmental effect ; storage / transporting ; AVP ;	2	
		(v) electrical heated hot plate – the solvent is flammable / better temperature control ; fume cupboard – the vapour / phenols are toxic / harmful fumes ;	2	accept safer than using naked flame –safer needs to be qualified accept dangerous
	(g)	sketch shows appropriate method of heating ; effective removal of 'oil' / evidence of hole or drilling ;	2	
	(h)	<i>any two from:</i> sulphur dioxide / acidic gases / acid rain / alkali fumes / alkali rain ; carbon dioxide ; (fine) ash in the flue gases ; large amount of ash produced ;	2	
	(i)	(i) <i>any two from:</i> mix better ; break shale into smaller pieces / crush / grind ;	2	reject time or temperature references
		(ii) <i>any two from:</i> how much water to add ; mix / stir ; how to add water ; temperature of water added ; temperature to cool to / how much to cool to ;	2	reject time references

Question			Expected Answers	Marks	Additional Guidance
1	(i)	(iii)	use of gravel / glass wool / cotton wool / sieve / evaporation ;	1	accept any kind of mineral wool accept use of a centrifuge / buchner funnel reject decanting / distillation
		(iv)	7.8 – 8.2 (%) inclusive ;	1	
		(v)	other substances may be present / we cannot say that the rest is pure alum ;	1	
Total				38	

Question	Expected Answers	Marks	Additional Guidance		
2	(a) (i)	so that the results can be compared / standardise procedure ;	1	reject just fair test allow valid testing	
		(ii) <i>any two from:</i> type of nettle plant ; fully grown / (same) height / size ; free from disease / not damaged ;	2	reject leaves	
	(b)	(i)	time ;	1	
		(ii)	32 °c – peak rate / highest rate temperature at which the stems are broken down the quickest ; 0.02 g dm ⁻³ - is the minimum concentration at which the greatest rate of separation occurs ;	2	a reference to rate is needed / or implied for 1 mark
		(iii)	to remove traces of enzyme / impurities ;	1	
		(iv)	results compared – keep the diameter the same ; results precise – add smaller differences in mass ;	2	
	(c)	(i)	100 ;	1	reject 99
		(ii)	20 000 ecf ;	1	if 99 in c(i) accept 19 800 ecf 200 x c(i)
	(d)	<i>any two from:</i> temperature ; weeds / competing plants ; (sun)light ; weather / wind / season / rainfall ; soil quality / pH ; insects / pests ;	2	reject location of plot	

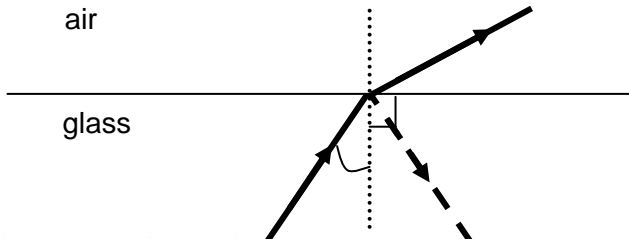
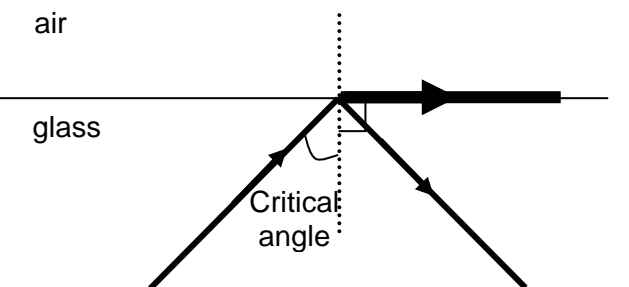
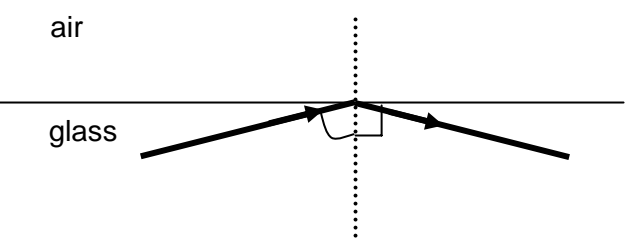
Question		Expected Answers	Marks	Additional Guidance	
2	(g)	(ii)	any two from: does it react with the fabric ; does it affect comfort / softness ; does it 'damage' the skin / allergy ; the effectiveness of the fireproofing ; toxicity / of material / safety ; smell ; cost ;	2	ignore amount
	(h)	(i)	a compound that is not pharmacologically active / fake / artificial / inactive ingredient / pretend / psychological effect only / awt ;	1	
		(ii)	any two from: use more people / larger sample ; larger / smaller dose ; different time period ; different age ranges ; different gender ;	2	ignore other illnesses
		Total	32		

Question		Expected Answers	Marks	Additional Guidance
3	(a)	(i) $\frac{3.6 \times 0.25}{45}$; = 0.02 (kg) ;	2	ecf on fraction
		(ii) a volume greater than 250 cm ³ (up to and including 1000 cm ³) ;	1	
		(iii) add the solids (slowly) to the water ; with stirring ; OR dissolve each (separately) in half the water; then mix ;	2	independent marks – stirring reject hot water / reference to heating identification of chemicals needed neutral – grinding of solid etc.
		(iv) above 100 g dm ⁻³ the amount added becomes less effective / slows down ;	1	
		(v) only a certain amount of copper can be absorbed / the mixture on the leaves can be washed off ;	1	
		(vi) eye protection ; skin protection ;	2	
3	(b)	<i>any two from:</i> it needs water to dissolve into the root system / slow to dissolve / powder is difficult to absorb ; washed away by rain ; particle size may be (too) large ; it does not spread evenly / difficult to apply / difficult to cover whole tree / does not stay on tree ; wind drift ; ingested by wildlife/kills or harms wildlife ;	2	reject eutrophication

Question		Expected Answers	Marks	Additional Guidance
	(c) (i)	surface area is greater / faster reaction / heats up faster / all the limestone is heated ;	1	reject reference to dissolving reject broken down easier
	(ii)	less heat is lost / more efficient/even heating of mixture / even dispersal of heat ;	1	air draught needs a comparison ignore reference to safety
	(iii)	method shows that it is continuous ; method works, must include heating up and adding water ;	2	independent marks here
	(iv)	water added slowly / add small amounts of water ; some method of heat removal / done in a controlled area ;	2	
	(v)	exothermic ;	1	
	(vi)	$\frac{84000 \times 18}{56}$; = 27000 g / 27 kg ;	2	ecf on fraction allow assumed working completely in kilograms for fraction i.e. $\frac{84 \times 18}{56}$ accept 26.9-27.1
		Total	20	

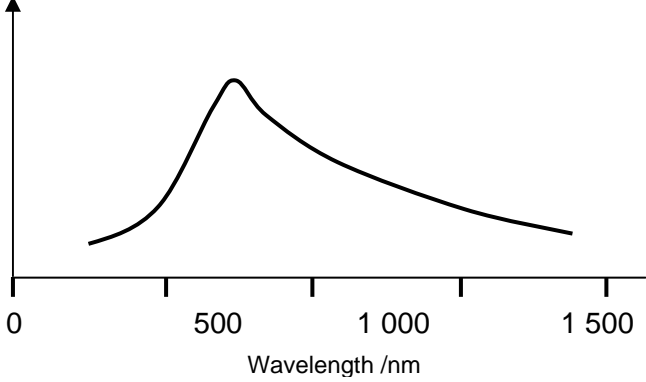
G635 Working waves

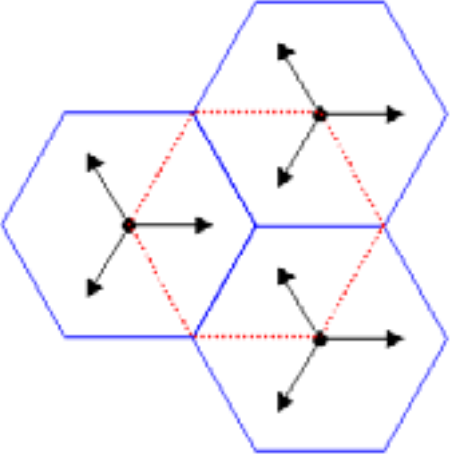
Question		Expected Answers	Marks	Additional Guidance	
1	(a)	(i)	$v = f\lambda$;	1	accept speed, badly written λ accept word equation accept c for velocity accept $f=v/\lambda$ $\lambda=v/f$ accept other suitable demonstration of relationship
		(ii)	velocity of orange light = 3×10^8 (m s ⁻¹) ; rearrangement of formula ; substitution ; $\lambda = 400$ nm ;	4	$\lambda=v/f$ $\lambda = 3.0 \times 10^8 / 7.5 \times 10^{14}$. accept $3.0 \times 10^8 / 7.5 \times 10^{14}$ ecf allowed (may be done before rearrangement) 400 nm scores 2 nd 3 rd & 4 th accept 1 or 2 sf
	(b)	(i)	fibres not parallel / arrangement of fibres is random / not the same at both ends / throughout ;	1	accept fibres are mixed up/muddled up/jumbled up/wtte accept cables instead of fibres reject data is scrambled accept rearranges image/spatial arrangement of signal
		(ii)	not transmitting image / data / information / not used for communications so arrangement not important / incoherent bundles just / only transmit light not data or wtte ;	1	reject (coherent bundles) just transmit data not light"
		(iii)	easier to manufacture / cheaper ;	1	accept computers
		(iv)	endoscope / data / information transmission / AVP ;	1	accept broadband

Question		Expected Answers	Marks	Additional Guidance
(c)	(i)	Fig. 1.1 emerging ray bending away from normal ; (reflected ray optional)	1	 <p>air</p> <p>glass</p> <p>angle to normal must be $< 90^\circ$ condone no arrow allow any reflected rays but no mark of > 1 refracted ray shown</p>
	(ii)	Fig. 1.2 emerging ray at grazing angle ; reflected ray ($i = r$ by eye) ;	2	 <p>air</p> <p>glass</p> <p>Critical angle</p> <p>condone no arrow if it is clear that ray has been drawn Max 1 if extra rays drawn</p>
	(iii)	Fig. 1.3 no emerging ray or ray at grazing angle (must be some attempt at emerging ray or ray at grazing angle in 1.1. or 1.2) ;	1	<p>must have drawn reflected ray in correct quadrant</p>  <p>air</p> <p>glass</p>

Question		Expected Answers	Marks	Additional Guidance	
1	(d)	(reflected) ray in Fig. 1.1 weaker / less intensity than (reflected) ray in Fig. 1.3 ORA or combined intensity of rays in Fig. 1.1 equal to intensity of reflected ray in Fig. 1.3	1	reject comparison of intensity to angle.	
	(e)	(i)	same / <u>very</u> close / slightly slower in air ;	1	[Note for reference speed of light in a vacuum is 299 792 458 m/s. speed of light in air is 299 702 547 m/s]
		(ii)	no (detectable) change, speed of light in air (very nearly) same as in a vacuum ;	1	must give reason. reject just NO [accept change would be very slight]
	(f)	(i)	(alternative) bigger / higher / greater (refractive index) ;	1	
		(ii)	(alternative) slower / reduced / lower (speed of light) ;	1	reject ecf from (i)
		(iii)	light less likely to escape from alternative glass / cables can be bent through tighter curve ;	1	accept TIR more likely/ (smaller critical angle), therefore easier to create TIR
			Total	20	

Question		Expected Answers	Marks	Additional Guidance	
2	(a)	<p>any four from:</p> <p>thermal imaging cameras detect Infra-red (radiation) ;</p> <p>not having to dig up floor ;</p> <p>finding problem that might not otherwise have been known about ;</p> <p>pipes / leakages are at a different temperature (to rest of floor) ;</p> <p>enables leakages to be discovered / located.</p> <p>inspection of system / location of pipes ;</p> <p>can avoid damaging pipes if drilling into floor ;</p> <p>pipes / leakages show as different / false colours ;</p> <p>possible to test areas otherwise impossible to reach ;</p> <p>AVP;</p>	4	<p>reject detect images in dark</p> <p>ignore responses not relevant to this context e.g. looking for dead bodies</p> <p>accept detects differences in amount of heat emitted in different places / by different objects</p> <p>accept detects <u>different</u> temperatures/heat emitted, without qualification for 1 mark but NOT just detects temperatures/heat emitted</p> <p>reject just 'Uses false colour'</p> <p>accept infra-red radiation rather than heat</p>	
		QWC: clear logical answer ;	1		
	(b)	(i)	b ;	1	
		(ii)	f ;	1	
		(iii)	c ;	1	
		(iv)	d [accept e] ;	1	
		(v)	e ;	1	

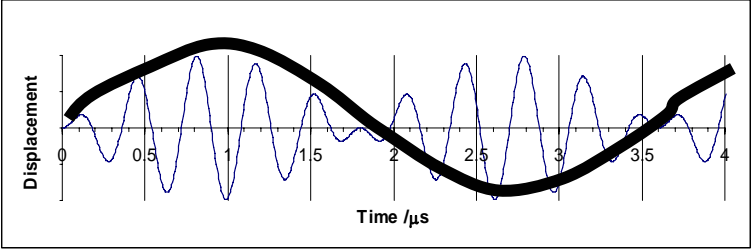
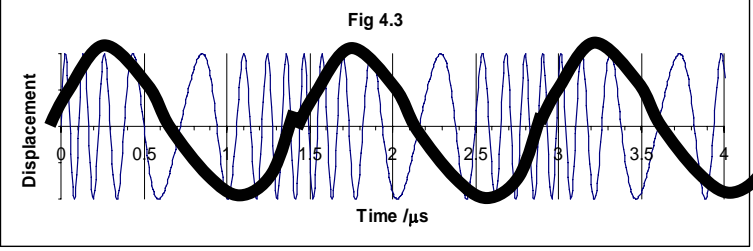
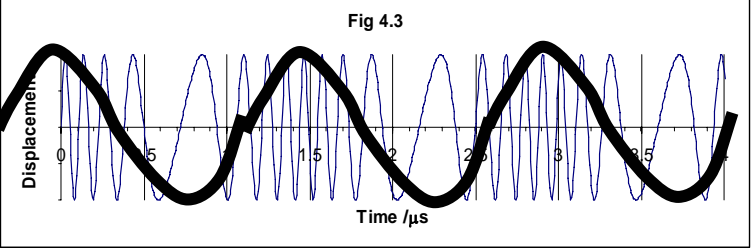
Question		Expected Answers	Marks	Additional Guidance
2	(c)	curve with single peak not at ends ; steeper slope on left ; peak between 600 and 800* nm ;	3	*allow 600 – 1000 nm 2 nd & 3 rd mark not allowed if >1 peak Intensity/ Arbitrary units 
Total			13	

Question	Expected Answers	Marks	Additional Guidance
3 (a)	city split up into a grid pattern of cells (min 3 cells) ; hexagonal cells shown ; 2 base stations shown at appropriate place ; scale indicating city cells 0.5 to 20 miles(1 to 20 km) ;	4	<p>either at alternate corners of cells or near centres of cells (see diagram and note below);</p>  <p>"Most people see the cell as the blue hexagon, being defined by the tower in the centre, with the antennae pointing in the directions indicated by the arrows. In reality, the cell is the red hexagon, with the towers at the corners, as you depict it above and I illustrate it below. The confusion comes from not realizing that a cell is a geographic area, not a point. We use the terms 'cell' (the coverage area) and 'cell site' (the base station location) interchangeably, but they are not the same thing.</p> <p>Cellular Telephone Basics. January 01, 2006. Posted by Tom Farley & Mark van der Hoek: http://www.howstuffworks.com/framed.htm?parent=cell-</p>

Question		Expected Answers	Marks	Additional Guidance
3	(b)	<p><i>any three from:</i> number of available frequencies is limited ; the same frequencies can be reused ; in non-adjacent cells (explained in words or indicated on diagram) ; because cell phones and base stations use low-power transmitters ;</p>	3	<p>this question is about reuse of a limited number of available frequencies may be indicated by appropriate numbering of cells in diagram</p> <p>not multiplexing. Question asks about how cells have enabled more users</p>
	(c)	<p>half ; full ;</p> <p><i>plus any two from:</i> full duplex / mobile phone both users can speak at the same time ; CB / half: only one frequency available ; mobile / full: two frequencies available ;</p>	4	<p>half duplex / CB only one user can speak at a time does NOT score because in the question</p>
	(d)	<p>up-link - the signals transmitted by (mobile phone (s)) to the base station/ the signals received by the base station from (mobile phone(s)) ;</p> <p>down-link - the signals transmitted by base station to the (mobile phone(s)) / the signals received by the (mobile phone(s)) from the base station ;</p>	2	accept satellite instead of base station
	(e) (i)	<p>signal consists of pulses / square wave / binary / 1s and noughts ; discrete levels ;</p>	2	

Question			Expected Answers	Marks	Additional Guidance
3	(e)	(ii)	time division ; multiple access ;	2	
		(iii)	<i>any two from</i> e.g. a narrow frequency band / bandwidth / conversation / communication is spilt into (three) time slots ; each call is given a certain portion of time (at the designated frequency) ;	2	not just divides the time
Total				19	

Question			Expected Answers	Marks	Additional Guidance
4	(a)	(i)	constant / regular / same amplitude (throughout wave shown) ; constant/regular / same frequency / equal distances peak to peak / trough to trough (throughout wave shown) ;	2	accept constant maximum displacement, not constant displacement accept constant time (intervals)/ constant wavelength
		(ii)	0.35 or 0.36 or 0.4 ; 0.36 / measurements indicate attempt at division by more than one cycle ; μs / ms / s as appropriate to answer ;	3	accept answer converted to s or ms accept answer converted to s or ms but must show units allow if candidate has clearly made an attempt to measure 5 or more cycles, even if they have counted incorrectly or counted half-cycles
		(iii)	correct numerical substitution of their value for T ; correct answer to 2 sf ecf ; correct unit Hz or MHz according to value substituted ;	3	regardless of conversion from s to μs for their value substituted
				0-35 μs 0-36 μs 0-4(0) μs must relate to their numbers	2 900 000 Hz 2 800 000Hz 2 500 000Hz
	(b)	(i)	amplitude / AM ;	1	

Question		Expected Answers	Marks	Additional Guidance
4	(b) (ii)	envelope shown ; single line, correct phase ;	2	<p>even if double line or double peak above axis</p>  <p>or</p> <p>inverse</p>
	(c) (i)	frequency / FM ;	1	
	(ii)	shape correct ; frequency and phase correct ; May be drawn as displacement graph (zero at compressions and rarefactions) or compression graph (max at compressions and min at rarefactions accept converse)	2	 <p>or inverse</p>  <p>or inverse</p>

Question		Expected Answers	Marks	Additional Guidance
	(d) (i)	samples taken ; indication of adequate frequency of sampling e.g. at least 5 vertical lines or crosses drawn on graph ; each voltage / signal level / measurement is represented by a binary code ;	3	in words or vertical lines or rectangles shown on graph at (roughly) height of curve BOD digital signal
	(ii)	series of binary number shown e.g. 11011 01111 10111 ; (1s and 0 need not relate to graph)	1	at least 3 binary digits
		Total	18	

Question			Expected Answers	Marks	Additional Guidance
5	(a)	(i)	identification / statement of a patient's disease / investigation of abnormality / naming a disease after examination ;	1	accept test for disease/ to see what is wrong accept 'to find out what the problem is'
		(ii)	e.g. to locate bone problems (deposits on bones) / image organs / bones / detect tumours etc. ;	1	accept to see structure/ to see if bones are broken / 'broken bones' accept to investigate organ function / where cancer is
		(iii)	any three from: injection / ingestion of tracer / dye / substance; radioactive ; identification of substance as $^{99}\text{Tc}^m/^{131}\text{I}$; preferential absorption ; examination with gamma camera ; AVP ;	3	reject barium meal / Gamma rays injected / give substance reject gamma machine e.g. appropriate (not just short) half life
	(b)	(i)	treatment / cure ;	1	reject just an example
		(ii)	e.g. to kill / destroy / damage cancer (cells) ;	1	reject 'to relieve pain e.g. joint pain'.

Question		Expected Answers	Marks	Additional Guidance
	(iii)	<p>any three from:</p> <p>check identity / other details of practical arrangements ;</p> <p>external irradiation ;</p> <p>using Co-60 ;</p> <p>or internal irradiation ;</p> <p>using Iodine 131 ;</p> <p>(body) will be penetrated by gamma rays ;</p> <p>destroying (cancerous cells) ;</p> <p>rotating source ;</p> <p>In order to reduce dose to healthy tissues ;</p> <p>divided doses ;</p> <p>in order to reduce harm to patient ;</p> <p>AVP ;</p>	3	<p>reject gamma rays go straight through</p> <p>e.g. have a drink, sit an wait, lie down / still</p> <p>e.g. use of collimator</p> <p>max 2 if candidate is referring to CAT scans</p>
(c)	(i)	<p>any five from:</p> <p>bones have higher atomic number / calcium / more dense ;</p> <p>bones readily absorb X-rays ;</p> <p>soft tissues allow rays to pass through ;</p> <p>lungs have lower atomic number / air / tissue / less dense ;</p> <p>air absorbs less X-rays than bone / soft tissue / fat ;</p> <p>so less X-radiation reaches film where bones are / shadow image of bone ;</p> <p>most X-radiation reaches film where lungs are ;</p> <p>film is blackened where it is exposed / opposite soft tissue / lungs / negative image ;</p>	5	<p>condone stopped instead of absorbed</p> <p>If lungs mentioned expect reference to air.</p> <p>reject killing bacteria in the body</p>
		QWC	1	Allow one error

Question	Expected Answers	Marks	Additional Guidance
(d)	<p>any five from:</p> <p>X-rays from X-ray tube contain a range of energies/ frequencies heterogeneous ; filters reduce low-energy radiation ; filters made of aluminium (for diagnostic X-rays) ; placed between source & patient ;</p> <p>(peak) energy of remaining radiation increases ; high frequency will show image better</p> <p>reduces scatter ; contrast improved ; sharpness / resolution improved ;</p> <p>less radiation absorbed (un-necessarily) by patient ; reduces radiation hazard ;</p>	5	<p>allow composite / copper / tin / lead / gold if stated that this applies to therapeutic applications</p> <p>'clearer image' scores max 1 of these three.</p>
	Total	21	

Grade Thresholds

Advanced GCE Applied Science AS (H175, H375) and
GCE Applied Science A2 (H575, H775)
January 2009 Assessment Session

Portfolio Unit Threshold Marks (AS)

Unit		Maximum Mark	a	b	c	d	e	u	Total nos of candS
G620	Raw	50	42	37	32	27	22	0	489
	UMS	100	80	70	60	50	40	0	
G621	Raw	50	42	37	32	27	22	0	214
	UMS	100	80	70	60	50	40	0	
G624	Raw	50	42	37	32	27	22	0	73
	UMS	100	80	70	60	50	40	0	
G625	Raw	50	40	35	30	25	21	0	70
	UMS	100	80	70	60	50	40	0	
G626	Raw	50	42	37	32	27	23	0	80
	UMS	100	80	70	60	50	40	0	

Examined Unit Threshold Marks (AS)

Unit		Maximum Mark	a	b	c	d	e	u	Total nos of candS
G622	Raw	90	71	62	53	45	37	0	1120
	UMS	100	80	70	60	50	40	0	
G623	Raw	90	69	61	53	45	37	0	128
	UMS	100	80	70	60	50	40	0	

Portfolio Unit Threshold Marks (A2)

Unit		Maximum Mark	a	b	c	d	e	u	Total nos of candS
G627	Raw	50	42	37	32	27	23	0	153
	UMS	100	80	70	60	50	40	0	
G629	Raw	50	42	37	32	27	23	0	24
	UMS	100	80	70	60	50	40	0	
G630	Raw	50	42	37	32	27	22	0	6
	UMS	100	80	70	60	50	40	0	
G632	Raw	50	43	38	33	28	23	0	15
	UMS	100	80	70	60	50	40	0	
G633	Raw	50	42	37	32	28	24	0	100
	UMS	100	80	70	60	50	40	0	
G634	Raw	50	42	37	32	27	22	0	18
	UMS	100	80	70	60	50	40	0	

Examined Unit Threshold Marks (A2)

Unit		Maximum Mark	a	b	c	d	e	u	Total nos of candS
G628	Raw	90	68	60	53	46	39	0	330
	UMS	100	80	70	60	50	40	0	
G635	Raw	90	65	57	50	43	36	0	267
	UMS	100	80	70	60	50	40	0	

Specification Aggregation Results

Uniform marks correspond to overall grades as follows.

Advanced Subsidiary GCE (H175):

Overall Grade	A	B	C	D	E
UMS (max 300)	240	210	180	150	120

Advanced Subsidiary GCE (Double Award) (H375):

Overall Grade	AA	AB	BB	BC	CC	CD	DD	DE	EE
UMS (max 600)	480	450	420	390	360	330	300	270	240

Advanced GCE (Single Award) (H575)

Overall Grade	A	B	C	D	E
UMS (max 600)	480	420	360	300	240

Advanced GCE (Double Award) (H775)

Overall Grade	AA	AB	BB	BC	CC	CD	DD	DE	EE
UMS (max 1200)	960	900	840	780	720	660	600	540	480

Cumulative Percentage in Grade

Advanced Subsidiary GCE (Single Award) (H175):

A	B	C	D	E	U
1.9	14.8	40.7	66.7	90.7	100.0
There were 55 candidates aggregating in January 2009.					

Advanced Subsidiary GCE (Double Award) (H375):

AA	AB	BB	BC	CC	CD	DD	DE	EE	U
0.0	0.0	0.0	11.1	22.2	33.3	44.4	77.8	77.8	100.0
There were 11 candidates aggregating in January 2009.									

Advanced GCE (Double Award) (H775):

AA	AB	BB	BC	CC	CD	DD	DE	EE	U
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
There was 1 candidates aggregating in January 2009.									

For a description of how UMS marks are calculated see:

http://www.ocr.org.uk/exam_system/understand_ums.html

Statistics are correct at the time of publication.

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