

1)

(a)	(i)	mitosis ;	1	<b>Mark the first answer.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b>
	(ii)	<i>idea that:</i> cells, <u>genetically</u> identical / have same DNA ;  so both (daughter) cells receive a full, copy / complement ;	2	<b>ACCEPT</b> in context of identical to each other or identical to parent <b>ACCEPT</b> 'same genetic information/material'  <b>ACCEPT</b> same / correct amount of DNA <b>ACCEPT</b> same / correct number of chromosomes <b>IGNORE</b> ref to clones unqualified <b>IGNORE</b> 'new cells need genetic material' without ref to full amount  daughter cells have all the identical genetic material = 2 marks (mp 1 and 2)
(b)		1 one maternal and one paternal / AW ; 2 carry same <u>genes</u> ;  3 carry, same / different, alleles ; 4 (usually) same / similar, length ;  5 centromere in same position ; 6 same banding pattern ;  7 pair up in meiosis / form bivalent ;	3 max	<b>CREDIT</b> 'same loci' <b>IGNORE</b> 'genetic material', 'genetically identical' 'genetic information'  <b>ACCEPT</b> 'same shape' 'same size'  <b>IGNORE</b> 'same pattern'
(c)	(i)	a, group / collection, of cells ; (cells) specialised / AW ; to perform a function(s) / working together ;	2 max	<b>IGNORE</b> 'same' or 'different' cells  <b>ACCEPT</b> same job

(ii)	<table border="1"> <thead> <tr> <th>function</th> <th>location</th> </tr> </thead> <tbody> <tr> <td rowspan="3">acts as a surface  or  short (diffusion) pathway ;</td> <td>alveoli</td> </tr> <tr> <td>or</td> </tr> <tr> <td>cheek lining</td> </tr> <tr> <td rowspan="5">move, mucus / AW  or  secrete mucus ;</td> <td>or</td> </tr> <tr> <td>in blood vessels ;</td> </tr> <tr> <td>bronchioles</td> </tr> <tr> <td>or</td> </tr> <tr> <td>bronchi</td> </tr> <tr> <td rowspan="3"></td> <td>or</td> </tr> <tr> <td>trachea</td> </tr> <tr> <td>or</td> </tr> <tr> <td></td> <td>airways ;</td> </tr> </tbody> </table>	function	location	acts as a surface  or  short (diffusion) pathway ;	alveoli	or	cheek lining	move, mucus / AW  or  secrete mucus ;	or	in blood vessels ;	bronchioles	or	bronchi		or	trachea	or		airways ;	4	<b>Mark the first answer in each box.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b> <b>Mark each box independently.</b>  <b>IGNORE</b> description e.g. 'one cell thick' <b>ACCEPT</b> glomerulus as blood vessel      <b>ACCEPT</b> move fluid / liquid for mucus <b>IGNORE</b> removal of germs / dirt / substances / particles   <b>ACCEPT</b> 'move ovum' and 'in fallopian tubes'   <b>ACCEPT</b> removal of bacteria / fungal spores / dust if in mucus
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<b>Total</b>		<b>12</b>																			

2)

(a)	(i)	3	<p><b>Mark the first answer on each prompt line.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b>  <b>DO NOT CREDIT</b> lysosome  <b>ACCEPT</b> cell plasma membrane  <b>IGNORE</b> rough endoplasmic reticulum</p>
	(ii)	1	<p><b>Mark the first answer.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b>  <b>ACCEPT</b> named example e.g. insulin, mucus, cytokine, antibodies, collagen  <b>IGNORE</b> haemoglobin, histamine, steroid hormones e.g. testosterone</p>
	(iii)	1 max	<p><b>Mark the first answer.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b>  <b>CREDIT</b> greater detail of cytoskeleton activity e.g. role of protein motors / changing length of microtubules - 'transport' alone not enough  <b>IGNORE</b> ref to membrane unqualified  <b>ACCEPT</b> binding / merging  <b>IGNORE</b> bonding</p>
	(iv)	2 max	<p><b>IGNORE</b> SER</p> <p>eg add carbohydrate groups / sugars or fold protein</p> <p>modifies and packages proteins into vesicles = 2 marks</p> <p><b>ACCEPT</b> make glycolipids</p>
(b)	(i)	2 max	<p><b>Mark the first two answers only.</b></p> <p><b>IGNORE</b> membrane bound organelles, lysosomes, free ribosomes, ref to ribosome size</p>
	(ii)		<p><b>Mark the first answer.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b></p> <p><b>IGNORE</b> 'chromosomes', 'chromatin'</p> <p><b>IGNORE</b> mesosome (as this is an infolding of plasma membrane and not <u>in</u> the cytoplasm)</p>
		<b>Total</b>	<b>10</b>

3)

(a)	<p>(i)</p> <p>1 cell (cytoplasm) has a <u>lower water potential</u> than (distilled) water / ORA ;</p> <p>2 water moves (into cells) , down water potential <u>gradient</u> / from high <math>\Psi</math> to low <math>\Psi</math> ;</p> <p>3 (water) enters the cell by <u>osmosis</u> ;</p> <p>4 <i>idea of: cell surface / plasma, membrane</i> (of blood cell) weak so, bursts / cannot withstand pressure / <u>haemolyses</u> ;</p> <p>5 <i>idea of: (plant) cell wall</i> , strong / provides support, so, does not burst / can withstand pressure ;</p> <p>6 (plant) cell becomes <u>turgid</u> / <u>turgidity</u> increases, which reduces water uptake ; <b>4 max</b></p> <p>QWC – <u>two</u> technical terms used in context and spelt correctly ; <b>1</b></p>	<p><b>CREDIT</b> mps 1-3 in context of either blood cell or plant cell Comparative statement must be made.</p> <p><b>1 ACCEPT</b> <math>\Psi</math> <b>ACCEPT</b> more negative water potential</p> <p><b>2 IGNORE</b> 'along' or 'across' <b>IGNORE</b> definition of osmosis in isolation, must be in context of explaining observations</p> <p><b>3 ACCEPT</b> 'water osmoses into cell' <b>IGNORE</b> ref to diffusion</p> <p><b>5 IGNORE</b> ref to rigid wall, wall acts as barrier</p> <p><b>6 IGNORE</b> ref to plasmolysis anywhere in response</p> <p>any two from: <b>gradient, water potential, osmosis, cell surface membrane / plasma membrane, turgid / turgidity, (derivatives of) haemolysed</b> (note: only allow turgid for plant cells)</p>
		5 max
	<p>(ii)</p> <p>use a, salt / sugar, solution <b>OR</b> add solute to water ;</p> <p>use a solution with the, same / similar / lower, water potential as blood cells ;</p>	<p><b>ACCEPT</b> saline solution</p> <p><b>ACCEPT</b> isotonic / hypertonic <b>ACCEPT</b> same solute concentration / potential <b>IGNORE</b> same water concentration <b>IGNORE</b> use less water / solution with low water potential</p>
		1 max
(b)	<p><u>diffusion</u> ;</p>	<p><b>DO NOT CREDIT</b> facilitated diffusion</p>
		1
(c)	<p>1 active, transport / uptake ;</p> <p><i>plus any two from:</i> 2 cells have, extensions / hairs ;</p> <p>3 thin cell wall ;</p> <p>4 large / increased, <u>surface area</u> ;</p> <p>5 many / more, mitochondria ;</p> <p>6 (many) carrier proteins in cell (surface) membrane ;</p>	<p><b>1 ACCEPT</b> facilitated diffusion <b>IGNORE</b> transport using ATP <b>DO NOT CREDIT</b> osmosis</p> <p><b>Allow max two marks for specialised features</b></p> <p><b>2 ACCEPT</b> cells have root hairs <b>IGNORE</b> roots have root hair cells</p> <p><b>4 ACCEPT</b> high, <u>surface area</u> to volume ratio / SA:vol credit in context on root hair cell or root having large surface area</p> <p><b>6 ACCEPT</b> transport proteins / protein pumps <b>ACCEPT</b> channel protein in context of facilitated diffusion</p>
		3 max
	<b>Total</b>	<b>10</b>

4)

(a)	<p>(i)</p> <p><u>sucrose</u> <b>and</b> <u>phloem</u> ;</p>	<p>Both needed for one mark <b>Mark the first answer on each line.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b> <b>DO NOT CREDIT</b> sucrose <b>DO NOT CREDIT</b> phloem sieve tubes / companion cells</p>
		1
	<p>(ii)</p> <p>1 hydrogen ions / <math>H^+</math> / protons, pumped out of companion cells ;</p> <p>2 increases, hydrogen ion / <math>H^+</math> / proton, concentration (gradient) (outside companion cell) ;</p> <p>3 hydrogen ions, re-enter / flow back into, companion cells ;</p> <p>4 sucrose / sugar, moves with hydrogen ions / AW ;</p> <p>5 down <u>concentration</u> gradient ;</p> <p>6 ref. cotransporter proteins / cotransport(ation) ;</p> <p>7 by <u>facilitated</u> diffusion ;</p> <p>8 sucrose / sugar, diffuses into sieve tube (element) ;</p> <p>9 through plasmodesmata ;</p>	<p><b>1 ACCEPT</b> hydrogen ions leave companion cells using ATP</p> <p><b>2 ACCEPT</b> creates gradient <b>2 DO NOT CREDIT</b> increase, hydrogen ion / <math>H^+</math> / proton concentration, in sieve tube element</p> <p><b>3 ACCEPT</b> diffuse / move</p> <p><b>4 DO NOT CREDIT</b> glucose (penalise once) <b>4 DO NOT CREDIT</b> sucrose follows <math>H^+</math></p> <p><b>8 IGNORE</b> sucrose diffuses into <i>phloem</i></p>
		3 max

(b)	<p>1 active transport requires ATP ;</p> <p><i>at low temperatures:</i></p> <p>2 (molecules have) little kinetic energy ;</p> <p>3 (therefore) less, respiration / ATP made ;</p> <p>4 less active transport or less, movement / loading, of sugars into sieve tube (element) ;</p> <p>5 less, osmosis / movement of water, into sieve tube (element) ;</p> <p>6 low (hydrostatic) pressure created ;</p> <p><i>as temperature increases:</i></p> <p>7 (molecules have) more kinetic energy ;</p> <p>8 (therefore) more, respiration / ATP made ;</p> <p>9 more active transport or more, movement / loading, of sugars into sieve tube (element) ;</p> <p>10 more , osmosis / movement of water, into sieve tube (element) ;</p> <p>11 higher / more (hydrostatic) pressure created ;</p> <p>12 at high temperature (plant), enzymes / proteins, denatured ;</p>	3 max	<p>1 <b>ACCEPT</b> loading / uptake for transport</p> <p>3 <b>IGNORE</b> no respiration / no ATP made / no loading of sucrose</p> <p>4 <b>ACCEPT</b> slow active transport / slow loading</p> <p>9 <b>ACCEPT</b> faster active transport / faster loading</p> <p>12 <b>DO NOT CREDIT</b> cells denatured</p> <p>12 <b>CREDIT</b> change to tertiary structure, damage to proteins</p>
<b>Total</b>		<b>7</b>	

5)

(a)	(i)	<p>A <u>substrate</u> ;</p> <p>B <u>active site</u> ;</p>	2	<p><b>Mark the first answer on each prompt line.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b>.</p>
	(ii)	<p><i>idea of simple representation of the , process / structure or idea of showing people how it works ;</i></p>	1	<p><b>Examples of acceptable responses</b></p> <p>'to make the process easy to understand'</p> <p>'it is a visual representation'</p> <p><b>IGNORE</b> 'because you don't know exactly what is happening'</p> <p><b>IGNORE</b> ' because that's the way it works'</p> <p><b>IGNORE</b> 'because it is still unproven'</p>
	(iii)	<p>supported by , more evidence / new research / more work ;</p> <p><i>idea of fitting evidence more closely (than lock &amp; key) ;</i></p>	1 max	<p><b>ACCEPT</b> example, e.g. X-ray crystallography</p> <p><b>ACCEPT</b> e.g. 'it has <u>now</u> been found that the enzyme shape changes during the reaction'</p> <p><b>IGNORE</b> responses in terms of 'because that is how it happens'. Answers must refer to evidence.</p> <p><b>ACCEPT</b> 'in the lock and key model the lock changes rather than the key'</p>

(b)	(i)	<p>1 enzyme / LDH , concentration / volume ;</p> <p>2 substrate / lactate, concentration / volume ;</p> <p>3 time ;</p> <p>4 <i>idea that fish should be as closely <u>related</u> as possible ;</i></p> <p>5 pH ;</p>	3 max	<p><b>Mark the first answer on each prompt line.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b>.</p> <p>1 <b>IGNORE</b> 'amount / number'</p> <p>2 <b>IGNORE</b> 'amount / number'</p> <p>2 <b>IGNORE</b> 'reactants'</p> <p>1 or 2 <b>CREDIT</b> 'volume / concentration , of solution' once if no reference to enzyme <b>or</b> substrate</p> <p>4 <b>ACCEPT</b> e.g. 'same type of fish'</p> <p>4 <b>IGNORE</b> size / age / sex</p>
	(ii)	<p>L ;</p>	1	<p><b>Do not award mark if more than one letter given.</b></p> <p><b>ACCEPT</b> lactate and water at all temperatures</p>

(iii)	<p>1 (1°C is) below the <u>optimum</u> temperature / <u>optimum</u> temperature is higher , for this enzyme ;</p> <p>2 (at 1°C) low <u>kinetic</u> energy / KE , of , enzyme / substrate ;</p> <p>3 less chance of substrate entering active site / less chance of ESC formation / fewer collisions between substrate and active site ;</p> <p>4 <i>idea</i> of activation energy harder to reach ;</p>	<p>2 max</p> <p>1 <b>ACCEPT</b> '<u>optimum</u> is 10°C'</p> <p>1 <b>IGNORE</b> '1°C is not the <u>optimum</u> temperature'</p> <p>1 <b>ACCEPT</b> '1°C is further away from the <u>optimum</u> (than 10°C)'</p> <p>2 <b>ACCEPT</b> 'molecules' / 'particles'</p> <p>3 <b>ACCEPT</b> 'fewer ESC formed'</p> <p>3 <b>ACCEPT</b> 'slower ESC formation'</p> <p>3 <b>IGNORE</b> denatured</p> <p>4 <b>ACCEPT</b> 'activation energy is greater'</p>	
(iv)	<p><u>easier</u> for / increased chance of , substrate, entering <u>active site</u> ;</p> <p><u>more</u> bonds can form / greater surface area for contact (between active site and substrate) ;</p> <p><u>easier</u> for <u>active site</u> to <u>change shape</u> (as part of induced fit) ;</p> <p>the <u>induced fit</u> , will be easier / AW ;</p>	<p>1</p> <p>Answers must imply 'easier' or 'quicker'</p> <p><b>ACCEPT</b> 'fitting into' 'joining' 'binding'</p> <p><b>IGNORE</b> refs to 'binding to a larger range of substrates'</p> <p><b>IGNORE</b> refs to ESC</p> <p><b>ACCEPT</b> 'different bonds can form'</p> <p><b>ACCEPT</b> '(named) bonds form more easily'</p> <p><b>DO NOT CREDIT</b> if a candidate thinks that flexibility increases kinetic energy</p>	
(c)	(i)	<p>different, amino acids / amino acid sequence / primary structure ;</p> <p>different, (named feature of) secondary / (named feature of) tertiary / quaternary, structure ;</p>	<p>2</p> <p><b>ACCEPT</b> 'different R groups present'</p> <p><b>ACCEPT</b> e.g. more <math>\alpha</math>-helices / different or fewer (named) bonds / (different) prosthetic group / co-factor / ion / co-enzyme / R-groups in different orientation / polypeptide OR chain will fold differently</p> <p><b>IGNORE</b> 3D</p> <p><b>IGNORE</b> protein / enzyme , will fold differently</p>
	(ii)	<p>different , base / nucleotide , sequence ;</p> <p>different , proportion / ratio , of bases / nucleotides ;</p> <p>different , allele / gene (would code for the polypeptide) ;</p>	<p>2</p> <p><b>IGNORE</b> 'different gene sequence'</p> <p><b>IGNORE</b> mutation</p> <p><b>ACCEPT</b> different triplet / codon</p> <p><b>ACCEPT</b> 'number of bases / nucleotides'</p> <p><b>ACCEPT</b> 'different numbers of A or T / C or G'</p> <p><b>ACCEPT</b> 'more adenines' etc</p> <p><b>ACCEPT</b> 'mRNA will be different'</p> <p><b>IGNORE</b> chromosome</p>
(d)	(i)	<p>enzyme could have potential / future , application ;</p> <p>any example of potential application ;</p>	<p>1 max</p> <p><b>IGNORE</b> refs to enzyme being useful to the Antarctic fish</p> <p><b>IGNORE</b> genetic resource or any ref to biodiversity</p> <p><b>ACCEPT</b> 'could be of use to humans'</p> <p>eg medical use, low temperature washing powder, scientific research</p>
(ii)	<p>1 ban fishing (in this area / Antarctic) ;</p> <p>2 <i>idea</i> of quotas / limits on numbers caught ;</p> <p>3 <i>idea</i> of protecting (this) habitat (from drilling etc) ;</p> <p>4 <i>ex situ</i> (conservation) / captive breeding ;</p> <p>5 <i>idea</i> of promoting other species (for eating) ;</p> <p>6 educating people in the fishing industry ;</p>	<p>2 max</p> <p>1 Answers must refer to banning or legislating (and fishing)</p> <p>1 <b>IGNORE</b> 'legislation' unqualified,</p> <p>1 <b>IGNORE</b> less fishing unqualified</p> <p>1 <b>IGNORE</b> 'ban hunting' unqualified</p> <p>2 <b>ACCEPT</b> refs to net / mesh size</p> <p>2 <b>ACCEPT</b> idea of patrolling / enforcing</p> <p>3 <b>CREDIT</b> in terms of maintaining fish's food source</p> <p>3 <b>IGNORE</b> 'feeding fish'</p> <p>3 <b>IGNORE</b> refs to 'in National Parks' unqualified</p> <p>3 e.g. 'protect habitat by banning fishing' = 2 marks (mp1 and mp 3)</p> <p>4 <b>ACCEPT</b> 'in captivity' / AW</p> <p>4 <b>ACCEPT</b> 'fish farming'</p> <p>4 <b>ACCEPT</b> ref to sperm / egg, banks</p> <p>6 <b>IGNORE</b> education unqualified</p>	
<b>Total</b>		<b>18</b>	

6)

(a) (i)	<p>polysaccharide ;</p>	1	<p><b>Mark the first answer.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>ACCEPT phonetic spelling IGNORE polymer IGNORE oligosaccharide</p>
(ii)	<p><i>similarity</i> chain / unbranched / glycosidic bonds / (contain) hexose / hex ring / O in each ring / CHO ;</p> <p><i>difference</i> agarose has:</p> <p>two types of (glycosidic) bond</p> <p>or</p> <p>two different, sugars / sugar residues / monosaccharides</p> <p>or</p> <p>disaccharide, monomer / subunit / AW</p> <p>or</p> <p>(residues) are alternately rotated / AW</p> <p>or</p> <p>straight chain ;</p>	2	<p>IGNORE polysaccharides IGNORE 6-carbon ring ACCEPT 5-carbon ring</p> <p>Assume answer refers to agarose unless otherwise stated ACCEPT ora for any point</p> <p>DO NOT CREDIT references to any incorrect bond ACCEPT any suggestion of bonding to different numbered carbon atoms (as numbers are not given in diagram) ACCEPT 'alternating bonds'</p> <p>IGNORE refs to glucose</p> <p>ACCEPT 'flipped' / 'reflected'</p> <p>ACCEPT 'amylose is coiled'</p>
(b)	<p>(bacteria) do not, make / have, correct <u>enzyme</u> (to digest agarose) ;</p> <p>agarose, does not fit / not complementary to, <u>active site</u> (of bacterial enzymes) ;</p> <p>bacteria unable to transport , substrate / enzyme , across membrane ;</p>	1 max	<p>DO NOT CREDIT in incorrect context e.g. 'bacteria do not have amylase' or 'bacterial enzyme cannot break down amylose'</p>
(c) (i)	<p><u>control</u> ;</p> <p>compare with tube A / see what happened when there was no bacteria / show it was bacteria doing it / to show it does not break down on its own / to show that the nutrient solution does not break it down ;</p>	2	<p>ACCEPT 'compare it with the other tube' IGNORE 'compare the tubes'</p>
(c) (ii)	<p><i>idea that</i></p> <p>some, starch / other polysaccharide / (reducing) sugar present in , nutrient solution / culture solution / bacteria (at start) ;</p> <p>presence of some mutated , <i>E. coli</i> / bacteria , (that can break it down) ;</p> <p>presence of (other) microorganism that can break it down ;</p>	1 max	<p>IGNORE experimental error unqualified IGNORE any reference to temperature</p> <p>IGNORE other carbohydrate</p>
(iii)	<p>replicate(s) / repeat(s) ;</p> <p>more than one sample tested from each tube / sample each tube twice ;</p>	2	<p><b>Mark the first answer on each prompt line.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>IGNORE 'do more tests'</p> <p>IGNORE 'disregard anomalous results' IGNORE 'compare with other results' IGNORE 'calculate mean'</p>

(d)	(i)	<p>1 add, Benedict's (reagent) / <math>\text{CuSO}_4 + \text{NaOH}</math> / alkaline copper sulphate ;</p> <p>2 heat ;</p> <p>3 (forms) precipitate ;</p> <p>4 (colour changes from blue to), green / yellow / orange / brown / (brick) red ;</p> <p>concentration estimated from</p> <p><b>EITHER</b></p> <p>5a degree of colour change / use different colours ;</p> <p>6a comparison (of final colour) with , standard / known, solution ;</p> <p><b>OR</b></p> <p>5b filter / centrifuge , and weigh precipitate ;</p> <p>6b greater mass = more sugar present / use of a standard curve ;</p> <p><b>OR</b></p> <p>5c centrifuge ;</p> <p>6c size , of pellet / colour of supernatant (liquid), indicates concentration ;</p>	5 max	<p>1 <b>ACCEPT</b> 'do Benedict's test'</p> <p>1 <b>DO NOT CREDIT</b> if adding acid / hydrolysing</p> <p>2 <b>ALLOW</b> boil</p> <p>2 <b>IGNORE</b> warm</p> <p>2 <b>ACCEPT</b> any temperature between 80°C and 100°C</p> <p>2 <b>ACCEPT</b> gently heat</p> <p>Read as prose and mark the best suggestions</p> <p>5/6 <b>DO NOT AWARD</b> if candidate is using a colorimeter</p> <p>5a <b>ACCEPT</b> 'the darker / redder , the more reducing sugar'</p> <p>5a <b>ACCEPT</b> in context of precipitate or supernatant</p> <p>6a Answers must include the idea of comparison</p> <p>6a <b>ACCEPT</b> ref to calibration curve as long as not in context of colorimeter</p> <p>6b <b>ACCEPT</b> weight</p> <p>6b <b>ACCEPT</b> amount</p> <p>6c <b>ACCEPT</b> mass</p>
(ii)		<p>1 add (hydrochloric) acid and boil ;</p> <p>2 add, (named) alkali / (sodium) carbonate / (sodium) hydrogencarbonate ;</p> <p>3 <u>then</u> carry out reducing sugar test (again) / described ;</p>	3 max	<p>Max 2 if any point out of sequence</p> <p>1 <b>CREDIT</b> add hydrolytic enzyme</p> <p>1 <b>ACCEPT</b> heat</p> <p>2 <b>CREDIT</b> 'neutralise' if not contradicted by named chemical</p>
<b>Total</b>		<b>17</b>		