



**Coimisiún na Scrúduithe Stáit**  
**State Examinations Commission**

**Leaving Certificate 2015**

**Marking Scheme**

**Biology**

**Higher Level**

### **Note to teachers and students on the use of published marking schemes**

Marking schemes published by the State Examinations Commission are not intended to be standalone documents. They are an essential resource for examiners who receive training in the correct interpretation and application of the scheme. This training involves, among other things, marking samples of student work and discussing the marks awarded, so as to clarify the correct application of the scheme. The work of examiners is subsequently monitored by Advising Examiners to ensure consistent and accurate application of the marking scheme. This process is overseen by the Chief Examiner, usually assisted by a Chief Advising Examiner. The Chief Examiner is the final authority regarding whether or not the marking scheme has been correctly applied to any piece of candidate work.

Marking schemes are working documents. While a draft marking scheme is prepared in advance of the examination, the scheme is not finalised until examiners have applied it to candidates' work and the feedback from all examiners has been collated and considered in light of the full range of responses of candidates, the overall level of difficulty of the examination and the need to maintain consistency in standards from year to year. This published document contains the finalised scheme, as it was applied to all candidates' work.

In the case of marking schemes that include model solutions or answers, it should be noted that these are not intended to be exhaustive. Variations and alternatives may also be acceptable. Examiners must consider all answers on their merits, and will have consulted with their Advising Examiners when in doubt.

### **Future Marking Schemes**

Assumptions about future marking schemes on the basis of past schemes should be avoided. While the underlying assessment principles remain the same, the details of the marking of a particular type of question may change in the context of the contribution of that question to the overall examination in a given year. The Chief Examiner in any given year has the responsibility to determine how best to ensure the fair and accurate assessment of candidates' work and to ensure consistency in the standard of the assessment from year to year. Accordingly, aspects of the structure, detail and application of the marking scheme for a particular examination are subject to change from one year to the next without notice.

## Introduction

The marking scheme is a guide to awarding marks to candidates' answers. It is a concise and summarised guide and is constructed so as to minimise its word content. Examiners must conform to this scheme and may not allow marks for answering outside this scheme. The scheme contains key words, terms and phrases for which candidates may be awarded marks. This does not preclude synonyms or terms or phrases which convey the same meaning as the answer in the marking scheme. Although synonyms are generally acceptable, there may be instances where the scheme demands an exact scientific term or unequivocal response and will not accept alternatives. The descriptions, methods and definitions in the scheme are not exhaustive and alternative valid answers are acceptable. If it comes to the attention of an examiner that a candidate has presented a valid answer and there is no provision in the scheme for accepting this answer, then the examiner must first consult with his/ her advising examiner before awarding marks. As a general rule, if in doubt about any answer, examiners should consult their advising examiner before awarding marks.

Key words or terms or phrases may be awarded marks, only if presented in the correct context e.g.

Question: Outline how water from the soil reaches the leaf.

Marking scheme: Concentration gradient/ root hair/ osmosis/ cell to cell/ root pressure/ xylem/ cohesion (or explained)/ adhesion (or capillarity or explained)/ Dixon and Joly/ transpiration **or** evaporation/ tension *any six* **6(3)**.

Answer: "Water is drawn up the xylem by osmosis" Although the candidate has presented two key terms (xylem, osmosis), the statement is incorrect and the candidate can only be awarded 3 marks for referring to the movement of water through the xylem.

## Cancelled Answers

The following is an extract from S.63 *Instructions to Examiners, 2015* (section 7.3, p.22) "Where a candidate answers a question or part of a question once only and then cancels the answer, you should ignore the cancelling and treat the answer as if the candidate had not cancelled it."

e.g. Question: What is pollination?

Marking scheme: Transfer of pollen/ from anther/ to stigma **3(3)**.

Sample Answer: ~~transfer of pollen/ by insect/ to stigma.~~

The candidate has cancelled the answer and has not made another attempt to answer the question and may be awarded 2(3) marks.

If an answer is cancelled and an alternative version given, the cancellation should be accepted and marks awarded, where merited, for the uncanceled version only. If two (or more) uncanceled versions of an answer are given to the same question or part of a question, both (or all) should be marked and the answer accepted that yields the greater (greatest) number of marks. Points may not, however, be combined from multiple versions to arrive at a manufactured total.

## Surplus Answers

**In Section A, a surplus wrong answer cancels the marks awarded for a correct answer.**

e.g. # 1 *Question*: The walls of xylem vessels are reinforced with .....

Marking Scheme: lignin **4 marks**

*Sample answers:*

- chitin, lignin – there is a surplus answer, which is incorrect, therefore the candidate scores 4 – 4 marks = 0.
- ~~lignin~~ – the answer, which is correct, has been cancelled, but there is no additional or surplus answer, therefore the candidate may be awarded 4 marks.

- lignin, ~~chitin~~ - there is a surplus answer, which is incorrect, but it has been cancelled and as the candidate has given more than one answer (i.e. the candidate is answering the question more than once only), the cancelling can be accepted and he/ she may be awarded 4 marks.

e.g. # 2. *Question:* Name the **four** elements that are always present in protein.

Marking Scheme: Carbon/ hydrogen/ oxygen/ nitrogen **4(3)**

*Sample answers:*

- Carbon, hydrogen, oxygen, nitrogen, calcium – there is a surplus answer, which is incorrect, and which cancels one of the correct answers, therefore the candidate is awarded **3(3)** marks.
- Carbon, hydrogen, oxygen, calcium – there is no surplus answer, there are three correct answers, therefore the candidate is awarded **3(3)** marks.
- Carbon, hydrogen, oxygen, calcium, aluminium – there is a surplus answer, which is incorrect, and which cancels one of the three correct answers, therefore the candidate is awarded **2(3)** marks.
- Carbon, hydrogen, oxygen, calcium, ~~aluminium~~ – there is a surplus answer, which is incorrect, but it has been cancelled so the candidate may be awarded **3(3)** marks.

In the other sections of the paper, there may be instances where a correct answer is nullified by the addition of an incorrect answer. This happens when the only acceptable answer is a specific word or term. Each such instance is indicated in the scheme by an asterisk \*.

## Conventions

- Where only one answer is required, alternative answers are separated by ‘or’.
- Where multiple answers are required each word, term or phrase for which marks are allocated is separated by a solidus ( / ) from the next word, term or phrase.
- The mark awarded for an answer appears in bold next to the answer.
- Where there are several parts in the answer to a question, the mark awarded for each part appears in brackets e.g. **5(4)** means that there are five parts to the answer, each part allocated 4 marks.
- The answers to subsections of a question may not necessarily be allocated a specific mark; e.g. there may be six parts to a question – (a), (b), (c), (d), (e), (f) and a total of 20 marks allocated to the question. The marking scheme might be as follows: **2(4) + 4(3)**. This means that the first two correct answers encountered are awarded 4 marks each and each subsequent correct answer is awarded 3 marks.
- A word or term that appears in brackets is not a requirement of the answer, but is used to contextualise the answer or may be an alternative answer.

**1. 10 + 7 + 3(1) i.e. best five answers from (a) – (f)**

- (a) Monosaccharides
- (b) Digestion
- (c) 6
- (d) Cellulose
- (e) Starch
- (f) Deoxyribose

**2. 8 + 7 + 5(1)**

- (a) All (individuals) get some of a (scarce) resource
- (b) Water **or** minerals **or** space
- (c) Water **or** mate(s) **or** shelter **or** territory (or space)
- (d) Different food **or** feed on different parts of the plant
- (e) (i) Frequency **or** cover **or** transect **or** quadrat
- (ii) Throw (object) over shoulder (and place quadrat) **or** random numbers matched to a Grid
- (iii) pH **or** temperature **or** air content **or** water content **or** mineral content **or** humus content **or** soil type **or** particle size **or** soil texture **or** soil microorganisms

3.

Best 6: 8 + 8 + 4(1)

- (a) Protein
- (b) Can only replicate (or reproduce) in a cell  
or can only replicate using a cell
- (c) RNA or DNA
- (d) mosaic (virus)
- (e) Shape (of protein coat) or type of nucleic acid or antibody  
(antigen) reaction or size or host species or structure
- (f) Non cellular or no (cell) organelles
- (g) Manufacture of vaccines or enhancement of plant phenotype (or  
example) or used in medical research or control of bacteria  
or genetic engineering (or described) or pathogenic  
or biological control or harms plants (or harms animals)

4. 8 + 7 + 5(1)

- (a) T
- (b) F
- (c) T
- (d) T
- (e) T
- (f) T
- (g) F

5.

8 + 8 + 4(1)

- (a) (Equivalent to ) 0.3 – 0.35 (% sucrose solution)
- (b) They lost water / by osmosis / because sucrose was more concentrated *Any Two*
- (c) Salting (or curing) meat (or fish) or making fruit products such as jam or use of sugar for  
(preserving) fruit
- (d) Water taken in / (water) into vacuole (or into cytoplasm) / protoplast (or membrane)  
presses against cell wall / wall prevents bursting *Any Two*

6.

8 + 7 + 5(1)

(a) X correctly placed on adipose tissue

(b) A = erector muscle

B = sweat gland

(c) (i) *Piloerection*: Hair stands up

Air is trapped **or** (air) insulates **or** reduces (or prevents)  
heat loss

(ii) *Vasoconstriction*: Blood vessels (or arteries or arterioles) narrow

Reducing (or preventing) heat loss **or** less blood to skin

7	(a)	<b>5 + 1</b>															
7.	(a) (i) DNA and protein (ii) Non-coding (DNA)																
7.	(b) + (c)	<b>8 + 8 + 8(1)</b>															
	<p>(b) (i) 1. To breakdown the (cell) membrane(s)</p> <p>2. To cause the DNA to clump</p> <p>3. To breakdown (or remove or digest) the protein in the chromosomes</p> <p>4. To bring the DNA out of solution <b>or</b> to make the DNA visible</p> <p style="padding-left: 40px;"><b>or</b> to separate the DNA</p>																
	<p>(c) (i) 1.</p> <p>2.</p> <p>3.</p>	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="border: 1px solid black; padding: 10px; text-align: center;">Catalase</td> <td style="padding: 0 10px;"><b>or</b></td> <td style="border: 1px solid black; padding: 10px; text-align: center;">Pepsin (or protease)</td> <td style="padding: 0 10px;"><b>or</b></td> <td style="border: 1px solid black; padding: 10px; text-align: center;">Amylase (or diastase)</td> </tr> <tr> <td style="border: 1px solid black; padding: 10px; text-align: center;">Hydrogen peroxide</td> <td></td> <td style="border: 1px solid black; padding: 10px; text-align: center;">Protein</td> <td></td> <td style="border: 1px solid black; padding: 10px; text-align: center;">Starch</td> </tr> <tr> <td style="border: 1px solid black; padding: 10px; text-align: center;">Oxygen (and water)</td> <td></td> <td style="border: 1px solid black; padding: 10px; text-align: center;">Peptides (or amino acids)</td> <td></td> <td style="border: 1px solid black; padding: 10px; text-align: center;">Maltose</td> </tr> </table>	Catalase	<b>or</b>	Pepsin (or protease)	<b>or</b>	Amylase (or diastase)	Hydrogen peroxide		Protein		Starch	Oxygen (and water)		Peptides (or amino acids)		Maltose
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Hydrogen peroxide		Protein		Starch													
Oxygen (and water)		Peptides (or amino acids)		Maltose													
	(ii) Boil <b>or</b> heat to high temperature ( $\geq 60$ °C)																
	(iii) negative result for named test for product																
	<b>or</b> positive result for named test for substrate																
	<i>[must match enzyme <b>or</b> product in c (i) above]</i>																
	(iv) To maintain (a constant) pH <b>or</b> to vary pH																

8 (a)	<b>5 + 1</b>
8. (a)	<p>(i) *Saprophytic <span style="float: right;">[accept *saprobic]</span></p> <p>(ii) <i>Diagram:</i> cell + nucleus + attached bud with bud (or a nucleus) labelled</p>
8. (b) + (c)	<b>9 + 9 + 6(1)</b>
8. (b)	<p>(i) Malt (extract)</p> <p>(ii) Attach leaves (or leaf pieces) to (inside of) lid</p> <p style="text-align: center;">Replace lid (on dish) <b>or</b> (dish) upright for 24 hours</p> <p style="text-align: center;"><b>or</b> one aseptic technique described</p> <p>(iii) Pink colonies <b>or</b> pink with 'colonies' described</p> <p>(c) (i) Some exposed to IAA and some not exposed to IAA</p> <p style="text-align: center;"><b>or</b> tissue exposed to different concentrations of IAA</p> <p style="text-align: center;">Leave for at least 2 days</p> <p style="text-align: center;">Measure (or record) growth <b>or</b> compare growth</p> <p>(ii) Description of how concentration (or IAA) changed growth (of tissue)</p>

9. (a)

5 + 1

9. (a) (i) To form the basis of a prediction **or** to give a starting point for an experiment **or** (to attempt) to explain an observation

(ii) Neither the experimenter nor the test group knows who gets what (or described)

9. (b)

9 + 9 + 6(1)

9. (b) (i) So they are genetically similar **or** they are likely to respond in the same way (to iodine)

(ii) 1. To (provide a standard or baseline to) compare with the experiment

2. A larger sample makes allowance for illness (or death)

**or** to make the results more statistically significant

3. Different concentrations of iodine (solution) / made up using pond water /

25 tadpoles in each (solution) / leave for a time / record changes in tadpoles /

(control) no iodine

*Any Three*

(iii) Temperature / amount of food / oxygen concentration / light (exposure) /

volume of water / duration of exposure

*Any Two*

**Section C****Best 4****4(60)**

<b>10.</b>	(a)	(i)	Mendel	<b>3</b>
		(ii)	Separation of homologous chromosomes <b>or</b> separation of alleles	<b>3</b>
		(iii)	Haemophilia <b>or</b> (red-green) colour-blindness	<b>3</b>
	(b)	(i)	(Two bases joined by) hydrogen bonds / purine with pyrimidine / Cytosine with Guanine / Adenine with Thymine in DNA / Adenine with Uracil in RNA <b>or</b> Thymine replaced by Uracil in RNA	<b>3(3)</b>
		(ii)	Sequence(s) of three bases / on DNA / on mRNA <b>or</b> on tRNA / (each codon) codes for one amino acid / that codes for a start (or stop)	<b>3(3)</b>
		(iii)	mRNA is formed / using a (single) strand of DNA / (DNA acts) as a template (or described) / in nucleus / (catalysed by) RNA polymerase	<b>3(3)</b>
	(c)	(i)	*E	<b>3</b>
		(ii)	*C	<b>3</b>
		(iii)	*E	<b>3</b>
		(iv)	*C	<b>3</b>
		(v)	*B	<b>3</b>
		(vi)	*C	<b>3</b>
		(vii)	gIX / gIY	<b>2(3)</b>

11.	(a)	(i)	<i>Heterotrophic:</i> must consume food <b>or</b> eats other organisms <b>or</b> cannot make their food	3
			<i>Omnivorous:</i> eats both animal and plant (material)	3
		(ii)	Correct amounts of each food type (for health)	3
	(b)	(i)	<i>Diagram:</i> continuous tube + stomach + intestines + a gland	6, 3, 0
			1. Liver / salivary glands / pancreas	2(2, 1, 0)
			2. Duodenum / ileum	2(2, 1, 0)
			3. Colon / caecum (or appendix) / rectum	2(2, 1, 0)
	(b)	(ii)	1. Enzyme that digests lipids (or fats or oils)	3
			2. Stomach <b>or</b> duodenum	3
			[ <i>accept</i> small intestine or ileum or salivary glands or pancreas]	
			3. <i>Stomach:</i> (pH) < 7	
			<i>Duodenum or small intestine or ileum:</i> (pH) 7 – 9	3
	(c)	(i)	1. I $\frac{2}{2}$ C $\frac{1}{1}$ PM $\frac{2}{2}$ M $\frac{3}{3}$	3
			2. (Humans have) fewer incisors (or fewer canines) <b>or</b> Animal shown has more incisors (or more canines)	3
			3. <i>Type of food:</i> meat <b>or</b> flesh <b>or</b> other animals	3
			<i>Explanation:</i> long (or sharp or pointed or large or extra) canines (or incisors)	3
		(ii)	Absorption of water / peristalsis / egestion / absorb vitamins	2(3)
		(iii)	Production of vitamins / compete with other micro-organisms / digestion / benefit immune system	2(3)

12.	(a)	(i)	$6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$	6, 3, 0								
		(ii)	*Chloroplast(s)	3								
	(b)	(i)	*ATP	3								
		(ii)	NADPH supplies $\text{H}^+$ and $\text{e}^-$ (or NADPH supplies hydrogen or NADPH is reducing agent) / $\text{CO}_2$ is reduced (or converted) / to form carbohydrate (or named carbohydrate or 6C compound) / NADP (or ADP) regenerated	3 + 6								
		(iii)	Respiration (or described)	3								
			Conversion to starch (or to other named carbohydrate)									
			<b>or</b> provides food (for other organisms)	3								
		(iv)	Temperature / light intensity / $\text{CO}_2$ conc.	2(3)								
		(v)	Greater crop yield <b>or</b> resistant to disease <b>or</b> resistance to drought <b>or</b> not affected by pesticides <b>or</b> example of nutritional advantage <b>or</b> example of commercial advantage	3								
	(c)	(i)	<i>Name:</i> *Glycolysis	3								
			<i>Location:</i> *Cytosol (or *cytoplasm)	3								
		(ii)	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Number of carbon atoms</th> <th>Compound</th> </tr> </thead> <tbody> <tr> <td>6</td> <td>Glucose <b>or</b> (Compound C)</td> </tr> <tr> <td>3</td> <td>Pyruvic acid</td> </tr> <tr> <td>2</td> <td>Acetyl CoA <b>or</b> (Compound A)</td> </tr> </tbody> </table>	Number of carbon atoms	Compound	6	Glucose <b>or</b> (Compound C)	3	Pyruvic acid	2	Acetyl CoA <b>or</b> (Compound A)	3
Number of carbon atoms	Compound											
6	Glucose <b>or</b> (Compound C)											
3	Pyruvic acid											
2	Acetyl CoA <b>or</b> (Compound A)											
				3								
				3								
		(iii)	<i>Gas X:</i> *Carbon dioxide [accept $\text{CO}_2$ ]	1								
			<i>Gas Y:</i> *Oxygen [accept $\text{O}_2$ ]	1								
		(iv)	<i>Compound D:</i> *Water [accept $\text{H}_2\text{O}$ ]	1								
			Two functions solvent / biochemical reactant / maintain (constant) temperature / maintain shape / transport / medium for chemical reactions	2(3)								

13.	(a)	(i)	<i>Ecosystem:</i> Organisms (interacting) with their environment	3
		(ii)	<i>Community:</i> All (or groups) of organisms found in an ecosystem	3
		(iii)	<i>Fauna:</i> *Animals	3
	(b)	(i)	Named predator <b>and</b> matching ecosystem	3
			Matching (behavioural) adaptive technique	3
		(ii)	1. Differences within a population (or within a species or between individuals)	3
			2. Differences in a named factor	3
		(iii)	1. D = Parasite C = Named larger carnivore B = Named smaller herbivore A = Named (large) producer	3, 2, 0
			2. B <b>or</b> herbivore named in (iii) B, above	3
		(iv)	1. Limits the length (or described)	3
			2. Limits the number (or described)	3
		(v)	May not be suitably adapted (or described)	3
	(c)	(i)	Can become pests <b>or</b> can spread disease <b>or</b> native organisms have reduced or no immunity to their parasites <b>or</b> eat native plants <b>or</b> eat native animals <b>or</b> eat crops <b>or</b> compete with native species or extinction of native species	6
		(ii)	Young (or small) fish trapped <b>or</b> reduced reproduction rates (or depletes fish stocks) <b>or</b> extinction of species	6
		(iii)	Disrupts (bird) nesting <b>or</b> endangering animals <b>or</b> disrupts food chains (or described)	6
		(iv)	Toxic <b>or</b> risk of infection <b>or</b> pollution of waterways (or described)	6

<b>14.</b>	Any two of (a), (b), (c)	<b>(30, 30)</b>
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<b>14.</b>	(a)	(i)	Feature named	<b>3</b>
			Mechanism described	<b>3</b>
		(ii)	Thymus / spleen / lymph nodes / tonsils	<b>2(3)</b>
		(iii)	<i>Antigen:</i> (foreign particle that) causes an antibody response	
			<b>OR</b>	
			<i>Antibody:</i> (protein) produced in response to an antigen (or to infection)	<b>3</b>
		(iv)	1. <i>Killer T cells:</i> recognise infected cell (or cancer or antigen) <b>or</b> produce perforin <b>or</b> perforates (cell) membrane <b>or</b> kill the infected cell <b>or</b> kill cancer cell	<b>6</b>
			<i>Helper T cells:</i> produce interferon <b>or</b> recognise antigens <b>or</b> stimulate B-cell (or antibody production) <b>or</b> activate Killer T cells	<b>6</b>
			2. *Suppressor (T cells)	<b>3</b>

14.	(b)	(i)	A = *grey matter	1
			B = *white matter	1
			C = *central canal <b>or</b> *cerebrospinal fluid (CSF)	1
		(ii)	A: consists (mainly) of cell bodies <b>or</b> (mostly) no myelin	3
			B: consists (mainly) of axons <b>or</b> (mostly) myelin	3
		(iii)	1. Protection (of CNS)	3
			2. *Three	3
		(iv)	1. Automatic (or involuntary) response to a stimulus	3
			2. Stimulus at receptor / (causes) impulse along sensory neuron / (impulse) through interneuron / (impulse) through motor neuron / to effector (or muscle or gland) or effector reacts / (another impulse is sent) to the brain.	
			<i>Any Two</i>	<b>2(6)</b>

14.	(c)	(i)	<i>Diagram:</i> testis + prostate (or seminal vesicles or Cowper's gland) + sperm duct & urethra + penis	<b>6, 3, 0</b>
			<i>Labels:</i> testis, epididymis, sperm duct, seminal vesicle, Cowper's gland, prostate gland, urethra, penis, scrotum	<b>3 + 2</b>
		(ii)	X on testes	<b>1</b>
		(iii)	Named gland + function	<b>3</b>
		(iv)	1. (Sperm cells) need a lot of energy <b>or</b> (sperm cells) need to swim long distances (or described) (compared to their size)	<b>3</b>
			Mitochondria produce energy <b>or</b> mitochondria carry out (aerobic) respiration	<b>3</b>
			2. Only the head (of the sperm) enters the egg <b>or</b> no sperm mitochondria enter the egg	<b>3</b>
		(v)	<i>Egg:</i> 12 – 48 hours	<b>3</b>
			<i>Sperm:</i> 0 – 7 days	<b>3</b>

<b>15.</b>	Any two of (a), (b), (c)	<b>(30, 30)</b>
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<b>15.</b>	(a)	(i) *Ovule	<b>3</b>
		(ii) One seed leaf	<b>3</b>
		(iii) Lipids (or fats or oils) / protein / carbohydrate (or named) / vitamin(s)	<b>2(3)</b>
		(iv) How to store (seeds) <b>or</b> when to sow (seeds) <b>or</b> maximise the growing season <b>or</b> seed treatment before sowing (or examples)	<b>3</b>
		(v) 1. Water content could vary between seeds	<b>3</b>
		2. Food is transferred to the embryo <b>or</b> respiration <b>or</b> loss of CO <sub>2</sub>	<b>3</b>
		3. *Photosynthesis	<b>3</b>
		4. (No as) it will lose mass	<b>3</b>
		(Due to) respiration <b>or</b> loss of CO <sub>2</sub>	<b>3</b>

15.	(b)	(i)	<p><i>Diagram:</i> rhizoids + hypha + sporangiophore + sporangium</p> <p><i>Labels:</i> Rhizoids / hypha(e) or stolon / apophysis / sporangium / sporangiophore / columella / spores / mycelium</p>	3, 0
		(ii)	1. Decomposer (or description of decomposition)	3
			2. (To allow) recycling of nutrients (or minerals or elements)	3
		(iii)	(Fungi) have (cell wall of) chitin <b>or</b> (Plantae) have (cell wall of) cellulose <b>or</b> (Fungi) have no chloroplasts <b>or</b> (Plantae) have chloroplasts	3
		(iv)	Sporulation	3
		(v)	Different strains of <b>or</b> '+' and '□' (hyphae) which produce / progametangia / (formation of) gametangia (and suspensors) / fertilisation / zygospore / meiosis or germination (of zygospore)	4(3)

15.	(c)	(i)	Rod (or bacilli) / spherical (or cocci) / spiral (or spirilla)	3(1)
		(ii)	Disease-causing (agent or organism)	3
		(iii)	<i>Asepsis:</i> Free of pathogens	3
			<i>Sterility:</i> Free of (micro)organisms	3
		(iv)	(Endo)spore formation	3
		(v)	1. B = *log (phase)	1
			C = *stationary (phase)	1
			D = *decline (or *death) (phase)	1
			2. Limited space (or food or O <sub>2</sub> ) <b>or</b> waste (or toxin) accumulating <b>or</b> death rate = birth rate	3
			3. <i>Batch processing:</i> Fixed amount of nutrients added at beginning <b>or</b> (bioreactor) emptied at end of production	3
			<i>Continuous flow:</i> Nutrients continuously fed into (bioreactor) <b>or</b> product removed continuously	3
			<i>Stage Reference:</i>	
			<i>Batch:</i> All stages occur	
			<b>OR</b>	3
			<i>Continuous flow:</i> Stage B (or C) (or log or stationary phase) maintained	

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