



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

**Leaving Certificate 2016**

**Marking Scheme**

**Agricultural Science**

**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

### General points

- The marking scheme is a guide to awarding marks.
- Examiners must conform to this scheme, and may not allow marks for answers outside the scheme.
- In many cases only key phrases are given in the marking scheme. These points contain the information and ideas that must appear in the candidate's answer in order to merit the assigned marks.
- The descriptions, methods and definitions given in the marking scheme are not exhaustive and alternative valid answers are acceptable.
- If the examiner determines that a candidate has presented a valid answer, and where there is no provision in the scheme for accepting said answer, then the examiner must first consult with his/her advising examiner before awarding marks. In general, if the examiner is any doubt if a particular answer is correct he/she should consult their advising examiner before awarding marks.
- The detail required in any answer is determined by the context, the phrasing of the question and by the number of marks assigned to the answer in the examination paper. This may vary from year to year.
- Words, expressions or statements separated by a solidus (/) are alternatives which are equally acceptable for a particular point. A word or phrase given in brackets is an acceptable alternative to the preceding word or phrase. Note, however, that words, expressions or phrases must be correctly used in context and not contradicted and where there is evidence of incorrect use or contradiction, the marks may not be awarded.
- In general, names and formulas of elements are equally acceptable. However, in some cases where the name is asked for, the formula may be accepted as an alternative. This is clarified within the scheme.

### Cancelled answers

- If the only answer offered is cancelled ignore the cancelling and mark as usual.
- If an answer is cancelled and a second version of the answer is given, you should accept the cancelling and award marks, where merited, for the un-cancelled version only.
- If two un-cancelled versions of an answer are given to the same question or part of a question, mark both and accept the answer that yields the greater number of marks. You may not, however, combine points from both versions to arrive at a manufactured total.

## Conventions

- The mark awarded for an answer appears in the marking scheme next to the answer on the right hand side.
- Where there are several parts in the answer to a question, the mark awarded for each part appears as e.g.  $3 \times 4$  marks. This means there are three parts to the answer, each part allocated 4 marks.
- Award unit marks separately, e.g. if an answer merits 3(3), write: three separate '3's, under each other, in the first column in the right-hand margin.
- The answers to subsections of a question may not necessarily be tied to a specific mark e.g. there may be three parts to a question - (i), (ii), (iii) and a total of 12 marks are allocated to the question. The marking scheme might be as follows: 6 marks + 3 marks + 3 marks. This means that any first correct answer is awarded 6 marks and each subsequent correct answer is awarded 3 marks.
- Square brackets or *italics* are used where the examiner's attention is being drawn to an instruction relating to the answer or to some qualification of the answer.
- The total mark for each question should be written beside the question number, and circled.
- The cumulative total should be written in the bottom right-hand corner of each page on which a question total appears.
- All blank pages should be marked to indicate they have been inspected.

Q1 (Any 6 parts) 6 × 10 marks

(a)	(i) Spermatophyta or Angiospermae or Leguminosae or Papilionaceae or Fabaceae. (ii) Flowering plants/ reproduce by seeds/ seeds in a fruit/ roots or stems or leaves/ gametophyte dominant over sporophyte/ nitrogen-fixing/ seed pods/ root nodules/ flower parts in 5s/high in protein.	(2 × 4m) + (2 × 1m)
(b)	(i) The amount of dissolved oxygen needed to break down organic matter in (a litre) water sample or the amount of dissolved oxygen used by (a litre) sample of water at 20° C in darkness for five days. (ii) Slurry application at correct time or away from waterways or in suitable weather conditions/ use of slurry tanks/ collect dairy washings/ avoid milk spills/ silage effluent tanks/ correct fertiliser applications/ safe disposal of dead animals or FYM or sheep dip or pesticides.	4m  3+2+1m
(c)	Diagram: Labels: Spores/sporangium/columella/sporangiphore/stolon/rhizoid/hyphae.	4,2,0m 3+2+1m
(d)	(i) A disease of national importance/ must notify authorities/ highly contagious/ risk to humans/ quarantine/ animals slaughtered or depopulated. (ii) Scrapie/ Aujeszky disease/ sheep scab/ swine fever/ rabies/ Newcastle disease/ anthrax/ brucellosis/ foot and mouth/ BSE/ TB/ BVD/ bluetongue/ avian 'flu/ Johne's disease/ contagious bovine pleural pneumonia.	2 + 2m  3+2+1m
(e)	Rhizomes/ cultivation spreads it/ same family as cereals/ spreads from or to headlands/ needs specific weed-killers/ not controlled by rotation.	6+3+1m
(f)	(i) Small intestine or duodenum or ileum (absorption of nutrients). (ii) Kidney (produce urine/ filter blood/ absorb/ reabsorb/ osmoregulation). (iii) Neck of uterus or top of vagina (seals womb/ dilates or role at birth/ allows sperm into uterus/ allows fluids to exit uterus).	(4 × 2m) + (2 × 1m)
(g)	Humus more fertile (clay less fertile)/holds more water (clay holds less water)/ higher CEC (clay has lower CEC)/ higher soil temperature (clay lower soil temperature)/ increases earthworm activity (no effect on earthworms)/ more beneficial for soil structure or more negative charges (less beneficial or fewer negative charges).	6+3+1m
(h)	(i) A crop grown between two main crops. (ii) Provides fodder/ good crop rotation/ break between grass and cereals/ prevents nitrogen leaching/ early bite in spring/ prevents soil erosion or makes use of idle land/ high protein content/ high yield/ fast growing/ can be grazed in situ or strip grazed (outwintering)/ utilisation of nutrients.	4m 3+2+1m
(i)	Oxygen needed or aerobic respiration/ food reserves made soluble or useable/ provide energy for digestion/ named digestive product/ energy for growth.	6+3+1m
(j)	(i) <i>E. coli</i> scour/ <i>Erysipelas</i> / leptospirosis/ atrophic rhinitis/ farrowing fever/ mastitis/ navel ill. (ii) <i>E. coli</i> : dehydration/ diarrhoea/ weight loss/ loss of condition. <i>Erysipelas</i> : fever/ abortion/ mummification/ red lumps on skin. Leptospirosis: low conception rate/ abortion/ stillborn. Atrophic rhinitis: sneezing and sniffing/ distorted snout/ low growth rate. Farrowing fever: fever/ lack of milk. Mastitis: swollen or red udder/ fever/ clotted or reduced milk. Navel ill: swollen navel/ stiffness/ fever.	(2 × 4m) + (2 × 1m)

## Q2

(a)	<p style="text-align: center;"><i>Podzol (Brown Earth)</i></p> <p>(i) <i>Drainage</i>: waterlogged or bad (free-draining or good).  (ii) <i>Fertility</i>: leached or poor fertility (fertile).  (iii) <i>pH</i>: acidic (basic or slightly acidic).</p>	<p><b>(3×4m)</b> + <b>(3×2m)</b></p>
(b)	<p>Wetting and drying (breaks up soil or aggregates soil)/ freezing and thawing (breaks up soil or aggregates soil)/ root activity (small roots bind or large roots crack)/ earthworms or soil invertebrates (break up soil or aggregate soil)/ tillage (breaks up soil or aggregates soil)/ activity of livestock or machinery (compaction)/ parent material (limestone for aggregation)/ adding lime or organic matter (aggregation).  <i>[Cause (and effect) required]</i></p>	<p><b>(4×2m)</b> + <b>(4×1m)</b></p>
(c)	<p>(i) Dry soil sample/ crush aggregates/ weigh/ sieve/ with largest mesh on top/ weigh amount in each sieve/ method of calculation/ soil texture triangle.  (ii) Tillage crops or named tillage crop.  (iii) Early growth or heats up faster or higher temperature/ easily tilled/ good drainage/ good aeration/ not subject to drought/ retains nutrients or high in nutrients.</p>	<p><b>3×4m</b>  <b>3m</b> <b>3×1m</b></p>

## Q3 Option One

(a)	<p>Housing/ hygiene specified/ avoiding predators/ correct feeding programme or steaming up or scanning/ supervision or vet/ individual pens (bonding)/ fostering/ prevent chill/ colostrum/ disease prevention/ removing mucus from mouth or nose.</p>	<p><b>6+6+4m</b></p>
(b)	<p style="text-align: center;"><i>Lowland (Hill)</i></p> <p>(i) Named breed/ terminal sires/ crossbred ewes/ meat-producing/ twins (pure-breeding/named breed/single lambs/hardiness)/ poorer mothering ability (better mothering ability).  (ii) 10-15 per ha. or high (2-7 per ha. or low).  (iii) Housing/ creep feeding/ flushing/ sponging/ grazing system or named, any one (reference to the opposite of each of these points must be stated for hill sheep).  <i>[Breed and mortality not accepted]</i>  (iv) 120-180% or more twins (70-100% or mostly singles) or correct ratios.</p>	<p><b>(4×3m)</b> + <b>(4×1m)</b></p>
(c)	<p>Productivity: yield of grass.  Aggressive: competes well.  Persistent: keeps growing every year.  Digestible: easily digested by the animal or high DMD.  Nutritious: provides a well-balanced diet.  Palatability: taste or animals are likely to eat it.</p>	<p><b>(4×3m)</b> + <b>(4×1m)</b></p>

### Q3 Option Two

(a)	(i) Housing time or type/ parasite or disease control/ 1.4 m <sup>2</sup> floor space/ 7 m <sup>3</sup> air space/ good ventilation/ clean water/ monitor for illness or poor thrift/ group similar size together/ feed silage/ supplement with meals.	<b>6+6+4m</b>
(b)	Rotational grazing system (example strip or paddock)/ two points of operation (accept diagram)/ leader-follower system/ best leafy grass/ fewer parasites.	<b>6+6+4m</b>
(c)	(i) Is a grading system/ used in factories/ to grade carcasses for fat/ conformation/ 1-5 <b>and</b> E-P. (ii) <i>Highly productive</i> : E1 or E2 or U1 or U2. <i>British crossbred</i> : R4 or R5 or O4 or O5. (iii) Cross breeding/ using high quality beef bulls/ continental bulls/ named breed/ slaughter at correct age or at maturity/ animal finished on grass.	<b>3×2m</b> <b>2m</b> <b>2m</b> <b>3+3m</b>

### Q4

(a)	Seeds or seedlings/nutrient tablet (Sach's) or control or soil containing all nutrients/ without Mg or soil deficient in Mg/ aerate/ tinfoil/ correct time/ compare growth/ (Mg) chlorosis or (Mg) yellowing of leaves/ same conditions with one named.	<b>6×4m</b>
(b)	Named crop*/quadrat 1m <sup>2</sup> plot or measured area/ place at random/ dig crop/ wash or remove foliage/ weigh/ repeat no. of times/ average/ ×10000 for ha. or correct calculation or correct result. [*Compulsory point]	<b>6×4m</b>
(c)	Dry sample of feed/ weigh sample/ 100 g or 100 cm <sup>3</sup> or known volume of water in test tube or calorimeter/ initial temp./ burn feed under test tube or in calorimeter/ reweigh or burn to completion/ record new temp./ note temperature change/ calculation or $\Delta H = mc\Delta t$ .	<b>6×4m</b>
(d)	Quadrat or line transect or belt transect/ ×10 times or stations/ light meter/ shaded area/ record composition/ repeat in unshaded area/ record composition/ compare/ correct conclusion.	<b>6×4m</b>

## Q5

(a)	(i) A. Jersey. B. Holstein or Holstein cross or Montbéliarde. C. Friesian or Friesian cross or Jersey cross or Norwegian Red. (ii) A: Lower yield/ higher solids. B: Higher yield/ lower solids. C: Intermediate yield/ intermediate solids. (iii) Fat: 4 - 7%. Protein: 14 - 16%.	2m 2m 2m 2m 2m 2m 2m
(b)	Age of cow (decreases with age)/ stage of lactation (lower during early or higher at end)/ stage of milking (increases with milking)/ feed (high quality feed or fibre increases)/ health (mastitis reduces)/ milking interval (lower with long interval). [Cause (effect)]	4×(5+1m)
(c)	*Age: 15 months/ 280-320 kg at mating / target weight 500-580 kg at calving/ 24-month calving. *Condition: 2.8-3.2 for heat/ 3.2-3.4 at calving/ poor condition causes irregular heat/ calving difficulties or should not be put in calf. [*At least one point from each]	(4×2m)

## Q6

(a)	(i) Any method of control that is effective despite not being targeted at the affected species. [Accept 'a method that does not use chemicals'] (ii) Stubble cleaning (uproots weed seedlings)/ crop rotation (interrupts life cycle)/ growth encouragement (gives crop growth advantage)/ early harvest (less chance of attack on crop)/ resistant varieties (less susceptible to attack)/ eliminate host plants (interrupts life cycle)/ biological control (explained example within definition)/ drainage (affects habitat of pest)/ liming (affects the life-cycle of liver fluke).	2m  (3×3m) + (3×1m)
(b)	Characteristics: texture/ pH/ organic matter/ structure/ clay content or CEC/ drainage/ depth/ colour/ fertility. [One correct effect required per characteristic].	(4×3m) + (4×1m)
(c)	(i) Wind/ rain/ excessive N/ tall varieties/ disease/ pest attack/ Ca, P, or K deficiency/ weakness of straw/ sowing too early or late harvesting. (ii) Frost (soggy or rot)/ water (mould or rot)/ sprouting (shrivel)/ rodents (eaten)/ bruised (rot)/ light (greening)/ high humidity (mould)/ heat (sprouting). [Cause (effect)]	5+3+1+1m  (2×3m) + (2×1m)

Q7

(a)	<p>(i) <i>F1 hybrids</i>: progeny of two purebred parents/ parents are genetically different/ progeny are heterozygous/ inbred parents</p> <p>(ii) <i>Continuous variation</i>: Characteristic controlled by a number of genes/ genes interact/ gives a range of phenotypes.</p> <p>(iii) <i>Back cross</i>: Breeding a cross-breed offspring/ with a pure-breeding recessive (plant or animal)/ used to identify the genotype of the parent.</p> <p>(iv) <i>Incomplete dominance</i>: Neither allele dominant (co-dominant or of equal dominance)/ both expressed in phenotype/ results in intermediate trait.</p>	<p><b>2+2m</b></p> <p><b>2+2m</b></p> <p><b>2+2m</b></p> <p><b>2+2m</b></p>
(b)	<p>(i) BbPp.</p> <p>(ii) BbPp, Bbpp, bbPp, bbpp.</p> <p>(iii) 25%</p> <p>(iv) 50% chance. Half of the offspring have genotype pp or two recessive genes (for horns)</p> <p>(v) <i>Law of Segregation</i>: when gametes are formed only one allele from a pair (of alleles) is carried in the gamete.</p>	<p><b>4m</b></p> <p><b>4×2m</b></p> <p><b>4m</b></p> <p><b>2m</b></p> <p><b>2m</b></p> <p><b>4m</b></p>
(c)	<p><i>EBI</i>:            Production index: fat/ protein/ yield of milk.            Fertility index: calving interval/ survival.            Calving index: calving difficulties/ mortality/ gestation.            Maintenance index: cull cow weight.            Management index: milking time/ temperament.            Health index: lameness/ SCC mastitis/ health.            Beef index: carcass weight/ conformation/ carcass fat</p>	<p><b>2×(2+2m)</b></p>

Q8 Any two parts from (a), (b), (c).

(a)	<p>(i) 1. Cranefly or daddy longlegs 2. Clickbeetle</p> <p>(ii) <i>Leatherjacket</i>: underground stem/ soil level/ roots. <i>Wireworm</i>: base of stem/ seeds/ tubers/ roots</p> <p>(iii) Arthropoda.</p> <p>(iv) Jointed limbs/ exoskeleton/ chitin/ triploblastic coelomate/ bilateral symmetry/ segmented body.</p> <p>(v) <i>Complete (incomplete)</i>: larva (nymph)/ pupa (no pupa or nymph continues to grow or (nymphal) instars or regular ecdyses)</p>	<p>2m 2m 2m 2m 3×2m 2×(2+2m)</p>
(b)	<p>*<i>Benefits of nitrogen</i>: stimulates growth of leaf and stem/ increases tillering/ improves establishment/ photosynthesis or chlorophyll/ protein synthesis/ cell division/ yield increase.</p> <p>*<i>Negative effects</i>: increased lodging/ delayed ripening/ increased disease susceptibility/ reduced quality potatoes/ lowers malting quality/ inhibits clover/ affects silage preservation/ water pollution or eutrophication or leaching/ more frost-prone/ burning.</p> <p>*[At least one point from each].</p>	<p>(4×6m)</p>
(c)	<p>Any three parts from (i), (ii), (iii), (iv).</p> <p>(i) <i>Cross breeding</i>: mating of animals of different breeds/ to get the best characteristics of both in the offspring or hybrid vigour or heterosis/ F1 seed varieties. <i>Crossing over</i>: process in which (homologous) chromosomes exchange genetic material/ occurs during meiosis/ results in genetic variation or mutation.</p> <p>(ii) <i>Active transport</i>: movement of a substance from area of low concentration/ to an area of high concentration/ requires energy. <i>Active immunity</i>: animal creates antibodies/ exposure to antigen or to disease/ vaccination.</p> <p>(iii) <i>Transpiration</i>: loss of water vapour from leaves/ through stomata. <i>Translocation</i>: movement of products of photosynthesis/ through phloem/ to storage organs or named.</p> <p>(iv) <i>Nitrification</i>: conversion of ammonium (ions) or urea/ into nitrite and- or nitrate (ions)/ by <i>Nitrobacter</i> (spp.) or <i>Nitrosomonas</i> (spp.). <i>Denitrification</i>: loss of nitrogen from soil/ nitrates converted/ to nitrogen gas/ by <i>Thiobacillus</i> (spp.).</p>	<p>2+2m 2+2m 2+2m 2+2m 2+2m 2+2m</p>

Q9 Any four parts from (a), (b), (c), (d), (e).

(a)	Absence of snail/ <i>Lymnaea</i> or <i>Galba</i> or mud snail or water snail/ secondary host/ larval stages need water/ named larval stages (miracidium or cercarium).	<b>7+3+2m</b>
(b)	Root hairs/ root xylem (tissue)/ osmosis or diffusion/ root pressure/ adhesion or cohesion or capillarity/ transpiration stream/ evaporation/ exits stomata.	<b>7+3+2m</b>
(c)	Cross/ between two named breeds/ best qualities of both or hybrid vigour/ good FCR/ fast growth rate/ good meat quality/ good conformation/ prolific.	<b>7+3+2m</b>
(d)	Sulphuric acid or formic acid or propionic acid or acetic acid/ lowers pH/ inhibits fermentation/ prevents bacterial activity/ preservative/ used for poor-quality grass or low sugar levels or wet conditions.	<b>7+3+2m</b>
(e)	CO <sub>2</sub> needed for photosynthesis/ higher levels of CO <sub>2</sub> increase rate of photosynthesis/ converted to glucose/ glucose converted to starch/ more CO <sub>2</sub> means more starch.	<b>7+3+2m</b>

