Cambridge Assessment International Education

Cambridge IGCSE™

BIOLOGY **9700/51**

Paper 5 Planning, Analysis and Evaluation **October/November 2022**

MARK SCHEME

Maximum Mark: 30

Published

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Generic Marking Principles

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- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

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Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
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- marks are not deducted for errors
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2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
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Question	Answer	Marks
1(a)(i)	to allow, oxygen / air, to enter for respiration **or** because, bacterium / *B. subtilis,* respires aerobically / AW **;**	**1**
1(a)(ii)	as, population growth of bacteria / bacterial growth, increases / AW, the, cloudier / more turbid, the culture broth **or** measuring the, turbidity / cloudiness, by eye against a cross in background / with a colorimeter / turbidity meter / colour chart **;**	**1**
1(b)	replace antibiotic with, (distilled) water / nutrient solution **;**	**1**
1(c)	*can improve:* add, catalase / peroxidase / manganese(IV) oxide **;** *explain why:* results / effect / killing, *B. subtilis* / bacteria , is only due to, honey / MGO **or** results / effect / killing, *B. subtilis* / bacteria, is not due to hydrogen peroxide **;**	**2**
1(d)	*description or table or diagram for 10%:* 1 Correct method to dilute stock (honey) solution to 10% **;** *table* 2 At least five dilutions including 10% all with correct volumes of stock and nutrient solution including units **;**	**2**
1(e)	*independent variable* MGO / Manuka / honey, concentration **;** *dependent variable* turbidity **;**	**2**

Question	Answer	Marks
1(f)	*predict:* lower concentration, tubes / AW, will be, turbid / cloudy **or** higher concentration, tubes / AW, will be, clear / not cloudy **or** the lower the concentration the more, turbid / cloudy, the tubes / AW **; ora** *explain:* MGO / (Manuka) honey, inhibits the growth of / kills, *B. subtilis / bacteria* **or** lower concentrations have less, ability / MGO, to, inhibit the growth of / kill, *B. subtilis / bacteria* ***;*** **ora**	**2**

<table>
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<tr><td>1(g)</td><td>
any five from:

1 same / stated, volume of, culture / broth used ;

2 same / stated, volume of Manuka honey ;

3 mix / stir, honey (concentrations) and, culture / broth (prior to starting) ;

4 method to measure turbidity ;

5 idea that: write down / note / record, which concentration(s) the broth, is clear / is clearest ;

any two from 6–8 ;;
6 method of maintaining temperature (10°C – 50°C if stated)

7 same / stated, time (left in incubator) (12–48 hours if stated)

8 use a buffer to maintain pH (pH 4–10 if stated)

9 repeat at least twice / 3 replicates and finding mean ;

10 named hazard and risk and precaution ;

<table>
<tr><th>Hazard</th><th>Risk</th><th>Precaution</th></tr>
<tr><td>Live cultures / bacterium / B. subtilis</td><td>Allergy / Infection / irritation / toxic</td><td>Wear gloves / goggles / mask / PPE</td></tr>
<tr><td>Honey</td><td>Allergy</td><td>Wear gloves / goggles / mask / PPE</td></tr>
<tr><td>Broth</td><td>Irritant / allergy</td><td>Wear gloves / goggles / mask / PPE</td></tr>
</table>
</td><td>5</td></tr>
<tr><td>1(h)(i)</td><td>there is no difference in the effect / effectiveness, of Manuka (honey) and Germania (honey) ;</td><td>1</td></tr>
</table>

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Question	Answer	Marks
1(h)(ii)	yes yes **;** no	**1**
1(h)(iii)	*results:* Manuka honey, kills more bacteria / is more effective (than Germania) **; ora** statistical analysis: first three / 1, 2 and 3, are significantly different **or** last two / 4 and 5, not significantly different against MRSA **or** 1 is only significant at p = 0.05 **or** 2 / 3, are significant at the, p = 0.01 / p = 0.001 **;**	**2**

<table>
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<tr><td>2(a)</td><td>any one from:

To ensure no gossypol in any of the cows / to remove gossypol from cows
or
idea of: feeding on same diet standardises cows (for start of experiment) ;</td><td>1</td></tr>
<tr><td>2(b)(i)</td><td>any three from:

1 the (mean) milk yields are, very close / similar, between groups ;

2 no statistical test
or
should carry out a, statistical test / t-test ;

3 overlap of SE (then no significant difference) ;

4 detail of which groups, are not / may be, significantly different ;

<table><tr><th>not significantly different</th><th>may be significantly different</th></tr><tr><td>A and B</td><td>A and E</td></tr><tr><td>A and C</td><td>B and E</td></tr><tr><td>A and D</td><td>C and E</td></tr><tr><td>B and C</td><td>D and E</td></tr><tr><td>B and D</td><td></td></tr><tr><td>C and D</td><td></td></tr></table></td><td>3</td></tr>
</table>

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Question	Answer	Marks
2(b)(ii)	*any **two** from:* *enough evidence because:* 1 trend that as gossypol (in diet) increases, milk yield increases **; ora** 2 paired data quote (to support) **;** *not enough evidence because:* 3 *idea that:* no information that differences in milk yield are caused by (differences in) gossypol **;** 4 *idea that:* no information on, nutritional content / AW, of , no gossypol diet / GM cottonseed **;** 5 *idea that:* there is no cottonseed in A so cannot compare with (diets) B to E **or** There is only soybean in A so cannot compare with (diets) B to E **;** 6 no statistical test **or** should carry out a, statistical test / *t*-test **;**	**2**
2(c)(i)	*there is a relationship because:* as free (gossypol) intake increases, plasma (gossypol) concentration increases **or** shows a positive correlation **;**	**1**

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Question	Answer	Marks
2(c)(ii)	*allow description of diet instead of group* **B**, etc. *any **three** from:* 1 (Group) E has the highest risk (of toxicity) **or** (Group) C has the lowest risk (of toxicity) **;** 2 sequence of risk, highest to lowest, is **E →B →D →C ;** 3 *ref. to* higher free gossypol **and** (–) isomer values for highest risks **or** *ref. to* lower free gossypol **and** (–) isomer values for lower risks **;** 4 paired data quote from Table 2.2 to support mp 2 or 3 **;** 5 free gossypol will be easily absorbed and more toxic (than bound gossypol) **or** Bound gossypol is less easily absorbed and less toxic / not toxic **;** 6 *idea that:* uncertain how much free gossypol turns into bound gossypol when eaten **;** 7 AVP **;**	**3**

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Question	Answer	Marks
1(a)	*any **two** from:* 1 use coloured filter / set wavelength **;** 2 calibrate colorimeter / <u>set</u> colorimeter (absorbance) to zero **;** 3 water (used to calibrate colorimeter) **;**	**2**
1(b)(i)	*From description **or** table:* 1 Correct method to dilute stock solution with water to 0.1% **;** *Table:* 2 At least five stated concentrations including 0.1%, **all** with correct volumes of stock **and** water including volume units and concentration unit **;**	**2**
1(b)(ii)	*independent variable* <u>protein</u> concentration **and** *dependent variable* absorbance **;**	**1**
1(b)(iii)	1 *x-axis* protein <u>concentration</u> **and** % **and** *y-axis* absorbance **and** au **or** no units added **;** 2 line drawn showing positive correlation **;**	**2**
1(b)(iv)	copper(II) ions, binding with the nitrogen atoms, that form peptide bonds **;** will have same number of peptide bonds **;**	**2**

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Question	Answer	Marks
1(c)	*any **six** from:* 1 same / stated, volume of protein concentrations **and** egg **;** 2 same / stated, volume of biuret solution **;** 3 add / mix / stir, protein (concentrations) / egg and, biuret **;** 4 measure **/** record, absorbance / colorimeter reading, for (known) protein (concentrations) / egg **;** 5 use calibration curve to find protein conc. in egg **;** 6 dilute egg (suspension) by factor of 10 **;** 7 same / stated, concentration of biuret solution **;** 8 same / stated, time (for colour development) before taking reading **;** 9 3 replicates **and** finding mean **;**	**6**

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<tr><td>1(c)</td><td>10 named hazard and risk and precaution ;
<table>
<tr><th>Hazard</th><th>Risk</th><th>Precaution</th></tr>
<tr><td rowspan="3">Biuret solution</td><td>Corrosive</td><td rowspan="7">Wear gloves / goggles / mask / PPE</td></tr>
<tr><td>Irritant</td></tr>
<tr><td>Moderate / medium, hazard / risk</td></tr>
<tr><td rowspan="2">Sodium hydroxide</td><td>Corrosive</td></tr>
<tr><td>Irritant</td></tr>
<tr><td rowspan="4">Copper sulphate</td><td>Corrosive</td></tr>
<tr><td>Irritant</td></tr>
<tr><td>Moderate / medium, hazard / risk</td></tr>
<tr><td>Hazardous to the aquatic environment</td><td>Do not pour down sink</td></tr>
<tr><td>Egg / Albumin / Protein</td><td>Allergen</td><td>Wear gloves / goggles / mask / PPE / do not consume</td></tr>
</table>
11 multiply protein concentration in egg, by dilution factor (to obtain actual concentration of protein) ;</td><td></td></tr>
</table>

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Question	Answer	Marks
2(a)	*any **two** from:* 1 same number of each sex **;** 2 same / similar, age **or** five years old **;** 3 same, breed / type / AW (of sheep) **;** 4 same / similar, mass / size **;** 5 do not have, mutation / mutant allele / Huntington's (disease / allele) / neurological disease **;**	**1**
2(b)	*any **two** from:* 1 DNA (sequencing), only identifies presence of genes **;** 2 RNA (sequencing) identifies, active / switched on / expressed, genes **or** DNA (sequencing) does not identify, active / switched on / expressed, genes **;** 3 more copies of (m)RNA (compared to DNA) **;** 4 quantity of RNA indicates level of gene expression **;**	**2**
2(c)(i)	*t*-test **;** comparing means / continuous data / data has a normal distribution / comparing two samples with fewer than 30 values **;**	**2**
2(c)(ii)	there is **no** difference in the mean counts between the *OVT73* and control **;**	**1**

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Question	Answer	Marks
2(c)(iii)	*any **two** from:* 1 to make a comparison **;** 2 to identify if *OVT73* (mean) counts was higher / lower (than control) **;** 3 use of data from Table 2.1 to support mp2 **;**	**2**
2(d)	*max **one** from contribute* 1 two different testing kit used **;** 2 commercial kits used, so (presumably) accurate **;** 3 statistical tests / analysis were carried out **;** *max **one** from improves* 4 (test) more sheep **;** 5 reanalyse the 10 genes using kit 1, to confirm there was significant difference **;** 6 (test) more tissue samples / test the same (tissue) samples again **;**	**2**
2(e)(i)	1.33 **;**	**1**
2(e)(ii)	For anterior striatum, SE (ranges) **do not** overlap, suggesting there **is** a significant difference **or** For cerebellum / motor cortex, SE (ranges) **do** overlap, so there **is not** a significant difference **;**	**1**
2(e)(iii)	more urea (in cell), so more transport proteins, more removal of urea **;**	**1**

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Question	Answer	Marks
2(f)	*any **two** from:* 1 none of the genes coded for enzymes in the urea cycle **;** 2 no loss of (striatal) neurones (in OVT73 / transgenic sheep) **;** 3 <u>more</u>, urea produced / transport proteins made / gene expression **so** cells require more energy **;**	**2**

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1(a)(ii)	as, population growth of bacteria / bacterial growth, increases / AW, the, cloudier / more turbid, the culture broth **or** measuring the, turbidity / cloudiness, by eye against a cross in background / with a colorimeter / turbidity meter / colour chart **;**	**1**
1(b)	replace antibiotic with, (distilled) water / nutrient solution **;**	**1**
1(c)	*can improve:* add, catalase / peroxidase / manganese(IV) oxide **;** *explain why:* results / effect / killing, *B. subtilis* / bacteria , is only due to, honey / MGO **or** results / effect / killing, *B. subtilis* / bacteria, is not due to hydrogen peroxide **;**	**2**
1(d)	*description or table or diagram for 10%:* 1 Correct method to dilute stock (honey) solution to 10% **;** *table* 2 At least five dilutions including 10% all with correct volumes of stock and nutrient solution including units **;**	**2**
1(e)	*independent variable* MGO / Manuka / honey, concentration **;** *dependent variable* turbidity **;**	**2**

Question	Answer	Marks
1(f)	*predict:* lower concentration, tubes / AW, will be, turbid / cloudy **or** higher concentration, tubes / AW, will be, clear / not cloudy **or** the lower the concentration the more, turbid / cloudy, the tubes / AW **; ora** *explain:* MGO / (Manuka) honey, inhibits the growth of / kills, *B. subtilis / bacteria* **or** lower concentrations have less, ability / MGO, to, inhibit the growth of / kill, *B. subtilis / bacteria* ***;*** **ora**	**2**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(g)</td><td>
any five from:

1 same / stated, volume of, culture / broth used ;

2 same / stated, volume of Manuka honey ;

3 mix / stir, honey (concentrations) and, culture / broth (prior to starting) ;

4 method to measure turbidity ;

5 idea that: write down / note / record, which concentration(s) the broth, is clear / is clearest ;

any two from 6–8 ;;
6 method of maintaining temperature (10°C – 50°C if stated)

7 same / stated, time (left in incubator) (12–48 hours if stated)

8 use a buffer to maintain pH (pH 4–10 if stated)

9 repeat at least twice / 3 replicates and finding mean ;

10 named hazard and risk and precaution ;

<table>
<tr><th>Hazard</th><th>Risk</th><th>Precaution</th></tr>
<tr><td>Live cultures / bacterium / B. subtilis</td><td>Allergy / Infection / irritation / toxic</td><td>Wear gloves / goggles / mask / PPE</td></tr>
<tr><td>Honey</td><td>Allergy</td><td>Wear gloves / goggles / mask / PPE</td></tr>
<tr><td>Broth</td><td>Irritant / allergy</td><td>Wear gloves / goggles / mask / PPE</td></tr>
</table>
</td><td>5</td></tr>
<tr><td>1(h)(i)</td><td>there is no difference in the effect / effectiveness, of Manuka (honey) and Germania (honey) ;</td><td>1</td></tr>
</table>

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Question	Answer	Marks
1(h)(ii)	yes yes **;** no	**1**
1(h)(iii)	*results:* Manuka honey, kills more bacteria / is more effective (than Germania) **; ora** statistical analysis: first three / 1, 2 and 3, are significantly different **or** last two / 4 and 5, not significantly different against MRSA **or** 1 is only significant at p = 0.05 **or** 2 / 3, are significant at the, p = 0.01 / p = 0.001 **;**	**2**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)</td><td>any one from:

To ensure no gossypol in any of the cows / to remove gossypol from cows
or
idea of: feeding on same diet standardises cows (for start of experiment) ;</td><td>1</td></tr>
<tr><td>2(b)(i)</td><td>any three from:

1 the (mean) milk yields are, very close / similar, between groups ;

2 no statistical test
or
should carry out a, statistical test / t-test ;

3 overlap of SE (then no significant difference) ;

4 detail of which groups, are not / may be, significantly different ;

<table><tr><th>not significantly different</th><th>may be significantly different</th></tr><tr><td>A and B</td><td>A and E</td></tr><tr><td>A and C</td><td>B and E</td></tr><tr><td>A and D</td><td>C and E</td></tr><tr><td>B and C</td><td>D and E</td></tr><tr><td>B and D</td><td></td></tr><tr><td>C and D</td><td></td></tr></table></td><td>3</td></tr>
</table>

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Question	Answer	Marks
2(b)(ii)	*any **two** from:* *enough evidence because:* 1 trend that as gossypol (in diet) increases, milk yield increases **; ora** 2 paired data quote (to support) **;** *not enough evidence because:* 3 *idea that:* no information that differences in milk yield are caused by (differences in) gossypol **;** 4 *idea that:* no information on, nutritional content / AW, of , no gossypol diet / GM cottonseed **;** 5 *idea that:* there is no cottonseed in A so cannot compare with (diets) B to E **or** There is only soybean in A so cannot compare with (diets) B to E **;** 6 no statistical test **or** should carry out a, statistical test / *t*-test **;**	**2**
2(c)(i)	*there is a relationship because:* as free (gossypol) intake increases, plasma (gossypol) concentration increases **or** shows a positive correlation **;**	**1**

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Question	Answer	Marks
2(c)(ii)	*allow description of diet instead of group* **B**, etc. *any **three** from:* 1 (Group) E has the highest risk (of toxicity) **or** (Group) C has the lowest risk (of toxicity) **;** 2 sequence of risk, highest to lowest, is **E →B →D →C ;** 3 *ref. to* higher free gossypol **and** (–) isomer values for highest risks **or** *ref. to* lower free gossypol **and** (–) isomer values for lower risks **;** 4 paired data quote from Table 2.2 to support mp 2 or 3 **;** 5 free gossypol will be easily absorbed and more toxic (than bound gossypol) **or** Bound gossypol is less easily absorbed and less toxic / not toxic **;** 6 *idea that:* uncertain how much free gossypol turns into bound gossypol when eaten **;** 7 AVP **;**	**3**

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