



NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2025

**LIFE SCIENCES
PRACTICAL ASSESSMENT TASK (PAT)**

MARKING GUIDELINES

Time: 1½ hours

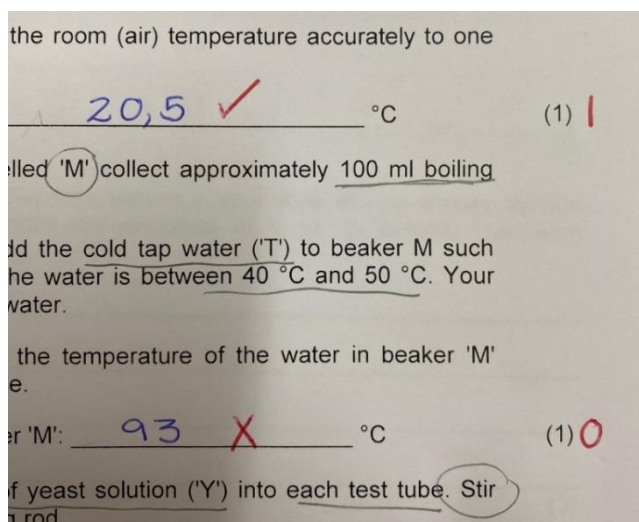
50 marks

These marking guidelines are prepared for use by examiners and sub-examiners, all of whom are required to attend a standardisation meeting to ensure that the guidelines are consistently interpreted and applied in the marking of candidates' scripts.

The IEB will not enter into any discussions or correspondence about any marking guidelines. It is acknowledged that there may be different views about some matters of emphasis or detail in the guidelines. It is also recognised that, without the benefit of attendance at a standardisation meeting, there may be different interpretations of the application of the marking guidelines.

General instructions

1. Mark PAT Booklets in red pen.
2. Place the tick (✓) where the mark is allocated, NOT at the end of the answer / sentence / line. Make a cross (✗) if incorrect.
3. Write the subtotal for each question in red pen next to the bracketed () mark allocation. If the mark is zero, please write '0'.
4. Please do NOT circle any marks when marking, e.g. (1).
5. For an example, see the image below:



6. Remember to look at pages 8, and 11–12 for answers; mark them and carry the marks over to the particular questions.
7. Answers must be read in their entirety. Alternative or equivalent wording that correctly expresses the concept or the meaning of the concept must be accepted.
8. Write the skills mark and the subtotals for Part 1 and Part 2 into the blocks as shown below. Calculate the total and initial next to it.

Example:

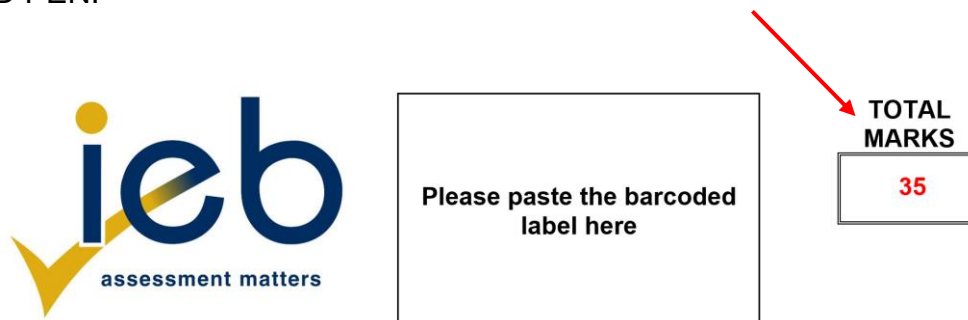
Invigilators must please complete this after the PAT.

CRITERIA		
Following instructions	0	(1)
Procedural skills	(0)	1
Manipulative skills	0	(1)
TOTAL	2	(3)

FOR MARKERS' USE ONLY

	Skills	Part 1	Part 2	Total	Initials
Marker	2	21	12	35	SJR
Internal Moderator					
IEB Moderator					

9. Should you moderate a script in a cluster (external), use a PENCIL and record the marks on the front cover of the PAT Booklet in the 'Internal Moderator' row.
10. Write the FINAL mark in the box at the top of the PAT Booklet (TOTAL MARKS) in RED PEN.



11. Make use of the codes provided for certain questions in the marking guidelines.

PART 1 INVESTIGATION

Following instructions:

- Five test tubes, labelled A, B, C, D and E at the top of the test tube, in a rack **AND**
- Four beakers/containers labelled 1, 2, 3 and 4 ✓

Procedural skills:

1 ml of GUS solution from beaker/container 4 accurately measured using the 2 ml syringe. ✓

Manipulative skills:

Equal volumes (10 ml) in test tubes A, B, C, D, and E. ✓

(3)

1.13 Completing the table:

Table showing the effect that different concentration(s) of GUS stain have on the colour change of the (genetically modified) cells.

Note: Use below codes when marking the heading.

- ✓ IV = Independent variable correctly identified ((different) concentration(s) of GUS)
- ✓ DV = Dependent variable correctly identified (colour change of the (genetically modified) cells)
- ✓ R = **Correct relationship between the correct variables/heading** makes logical sense (the concentration of the GUS affects whether the genetically modified cells change to blue).

Examples of headings that are incorrect in terms of relationship:

Table showing the GUS stain concentration **and** the colour change of genetically modified cells

Table showing the GUS stain concentration **VS** the colour change of genetically modified cells

Table showing the **relationship** between the GUS stain concentration and the colour change of genetically modified cells

Test Tube	GUS stain concentration (%)	Number of drops added to test tubes	Colour change of genetically modified cells
A	100	2	Colourless to Blue
B	25	5	Colourless to Blue
C	6,25 6,3 ✓	10	Colourless to Blue
D	1,56 1,563 1,5625 1,575 1,58 1,6 ✓	15	Colourless no change colour change slight change none blue light blue yes no✓
E	0,39	15	Colourless/no change

(6)

1.14 The candidate must include why it is qualitative and not quantitative in their answer in order to get both marks.

- Qualitative – the colour change/quality or feature that can be observed ✓
- Quantitative – will be numerical data / numbers / can be measured. ✓

The candidate must relate the results of this investigation to these terms. If they just give the definitions of qualitative and quantitative, they may not be awarded the marks.

For example:

- The results are a colour change ✓ and not a numerical value. ✓
- The results are a colour change ✓ and cannot be measured. ✓
- The results are observable change ✓ and not numerical/measured. ✓ (2)

1.15 Must have the following three components in the conclusion:

- A **specific** concentration of GUS stain from the table (independent variable). ✓ **Candidates must mention one of their two lowest concentration of GUS stain that can still change the genetically modified cells to blue.**
- A **specific** colour change of the genetically modified cells to blue (dependent variable). ✓
- **Links back** to the aim – confirm that cells have been genetically modified/the success of GUS stain in detecting the GUS reporter gene. ✓ **Candidates must mention one of their two lowest concentration of GUS stain that can still change the genetically modified cells to blue, therefore, indicating the presence of the GUS gene.**

Marked in conjunction with the candidate's results. Check the test tube(s) that did or did not produce colour change to blue that the candidate recorded in Question 1.13's table.

Example:

The GUS stain concentration of 6,25% ✓ (they must mention one of the concentrations, not just a test tube letter like test tube C) changed the genetically modified cells to blue. ✓ Therefore, can still detect the GUS gene/to confirm that the cells have been genetically modified ✓.

OR

The higher concentrations of GUS stain above 1,56% ✓ are still blue, ✓ therefore, lower concentrations are not able to detect the GUS gene/cannot confirm that the cells have been genetically modified. ✓

Note: If the candidate writes a description of the relationship between the variables, no marks should be awarded. E.g. As the concentration of the GUS stain decreases, then the blue gets lighter. (3)

1.16 The lowest concentration of GUS stain was in beaker/container 4.

- Started from lowest (to highest) concentration. ✓ Therefore, it did not alter successive concentrations / no mixing / no cross-contamination of different concentrations. ✓

Note: Only accept cross-contamination if linked to altering concentration.

(2)

- 1.17 1.17.1 Different number / size / amount of drops / volume ✓ of GUS stain. ✓
No stirring ✓ after GUS stain added. ✓
No stirring ✓ All cells don't come into contact with stain. ✓

(2)

1.17.2 No mark allocation for decision. Two marks are allocated to the reasoning.

No: The fixed/controlled variable GUS stain ✓ was not adequately controlled/correctly measured. ✓

OR

One fixed/controlled variable ✓ was not kept constant. ✓

OR

The number of drops of GUS stain ✓ should have been a fixed variable / precise measurement / controlled quantity, ✓ so it is not a fair test.

OR

There is more than one/two ✓ independent variables. ✓

(Any 2)

Error carried forward:

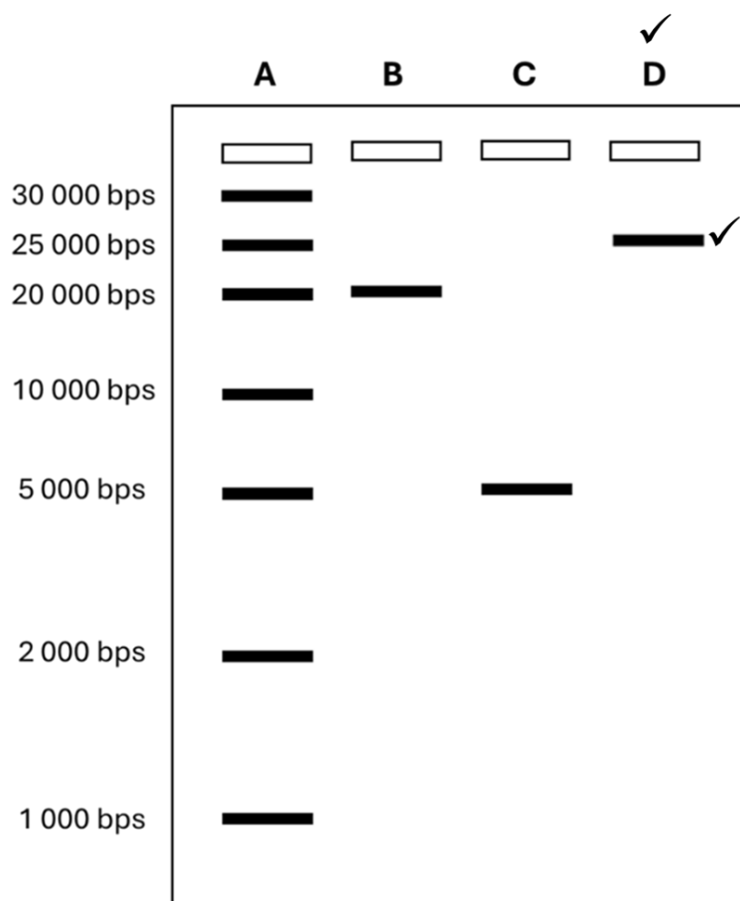
Yes: Only one/the independent variable changed ✓ and the controlled variables remained the same. ✓

(2)

- 1.17.3 Repeat the experiment ✓ and see if similar results ✓ are achieved each time it is repeated.

(2)

1.18



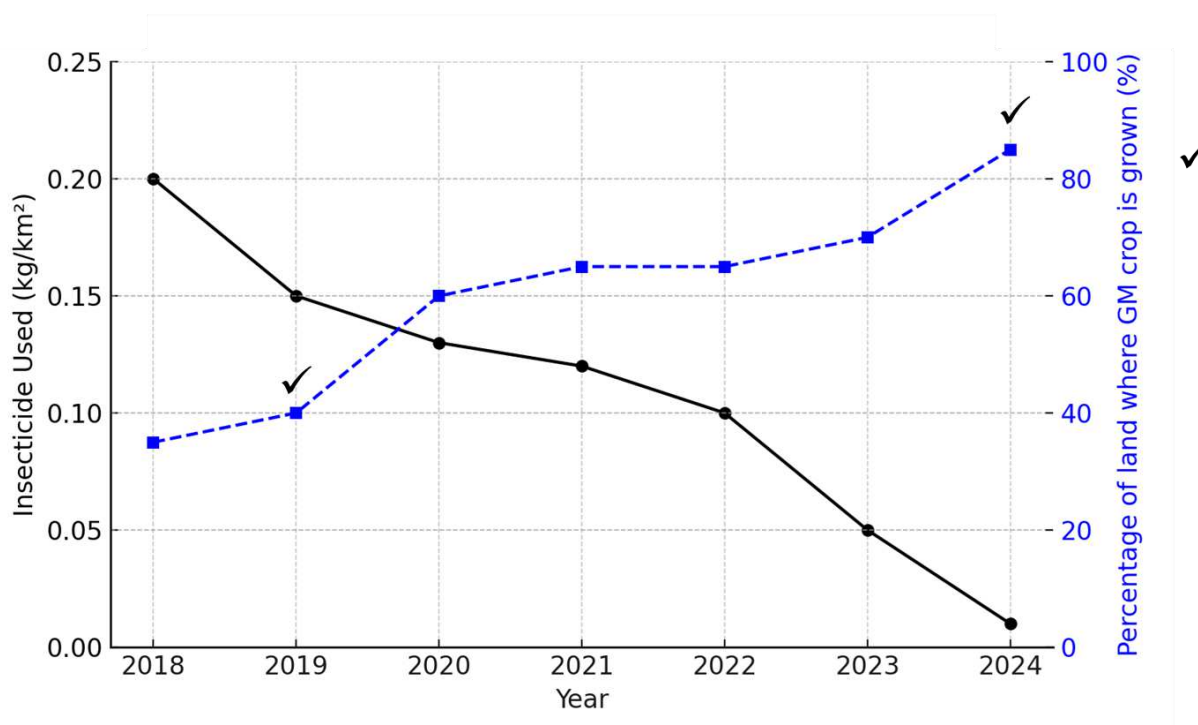
- Band drawn in well D ✓
- lines up with 25 000 bps ✓

(NOT in line with 20 000 or 30 000 bps, but accept placement between these two values.)

Note: If more than one band drawn, mark first band starting from top of image.

(2)

1.19 (a)



- ✓ Second point plotted correctly – 2019 and 40
- ✓ Last point plotted correctly – 2024 and 85
- ✓ Points are connected with a line forming the correct shape/trend

Note: This mark is not awarded if bar graph or histogram is plotted.

(3)

(b) **less insecticide/pesticide used. ✓ (compulsory mark)**

When (more) GM crops ✓ are cultivated (grown/used); there will be a decrease in cost / increase in yield / more environmentally friendly. ✓

(2)

(c) 2023 ✓

(1)

(d) 2018 – 35%
2024 – 85%

$$\frac{85}{35}$$

Correct values identified ✓; Correct method according to formula ✓
= 2,42/2,43/2.4 ✓ times (X)

(3)

[33]

PART 2

- 2.1
- Wording of aim (to determine / find / investigate / test / demonstrate) ✓
 - Independent variable (minimum time / length of time / number of days) ✓
 - Dependent variable (genetically modified / transformed / colour change / change to blue) ✓

Examples

To determine ✓ if the plant cells will be successfully **transformed** ✓ after **2 days**. ✓

To investigate ✓ the **length of time** ✓ required to expose plant cells to *Agrobacterium* for successful **genetic modification**. ✓

To test ✓ the **length of time** ✓ to cause the genetically modified plant cells to undergo a **colour change/change to blue**. ✓

Note: if candidates simply rewrite the hypothesis (e.g. the plant cells will be successfully transformed after being exposed to *Agrobacterium* for two days). (Max 1 mark.)

(3)

- 2.2 The different/length ✓ of time(s) ✓
OR Time/days ✓ of exposure ✓
OR Number / amount / 2 / 4 ✓ of days ✓

(2)

- 2.3 Colour change ✓ of the (genetically modified) cells. ✓
Colour changed ✓ to blue. ✓
Whether the cells changed from colourless ✓ to blue. ✓
Transformation/genetic modification ✓ of cells. ✓
Positive result ✓ for the presence of the GUS gene. ✓

(2)

- 2.4 Plant cells that are not exposed ✓ to *Agrobacterium* ✓
Plant cells that are exposed ✓ to *Agrobacterium* for less than 2 days ✓
Already transformed plant cells ✓ with *Agrobacterium* ✓
Distilled water added ✓ instead of plant cells/*Agrobacterium* ✓

Note: If definition of control is given e.g. same steps followed without independent variable = 1 mark

(2)

2.5 Sample method:

1. Using a marker, label two test tubes two- and four days (or 1 and 2, or A and B), respectively.
2. Using a syringe, measure 10 ml of the plant cells exposed to *Agrobacterium* for two days into the test tube labelled two days.
3. Repeat step 2, measuring 10 ml of the plant cells exposed to *Agrobacterium* for four days into the test tube labelled four days.
4. Using the dropper/pipette, add 15 drops of GUS stain into each test tube.
5. Swirl each of the test tubes and observe colour changes of the plant cells (if any).
6. Record the colour change of the plant cells (if any) in a table.

Note: Do not penalise candidates for adding an additional control, having replicates or repeating the experiment for reliability.

Layout (L): neat (orderly, easy to follow), numbered (if not numbered, then no marks). ✓

Aim (A): (A1) Must use **BOTH** the plant cells exposed (to *Agrobacterium*) for two- and four-days samples. ✓

(A2) must use GUS stain (GUS) **AND** observe a colour change ✓ of the plant cells.

Method (M):

- **Original (O) – must include both points: ✓**
 - Plant cells/samples exposed for two and four days.
 - No dilution of GUS stain is made.
- **Equipment (E) – look for correct use of ALL of the following: syringe / pipette / dropper ✓**
 - **E1** Syringe/measuring cylinder is used to measure the volume of **both** the plant cells/samples.
 - **E2** Pipette / dropper / syringe is used to add the number of drops/ volume of GUS stain (GUS).
- **Measuring (M) – must include both points: ✓**
 - **M1** Same specified amount / volume of plant cells / samples added.
 - **M2** Same specified amount/volume of GUS stain added to all test tubes.
- **Valid (V) – must include both points: ✓**
 - Must use 10 ml or less for the plant cells/samples (were provided with 10 ml of each).
 - Volume of plant cells/samples and GUS stain must be realistic for the volume of apparatus used (e.g. must not exceed 50 ml in a test tube).
- **Measurable results (R) – recording/tabulating the colour change ✓ of the plant cells.**

The rubric has been interpreted in this way for this experimental design. Please do NOT attach a copy of the rubric. Use the following key when marking:

Do NOT place any other ticks in the method. Instead of ticks, write the letter of the code in the appropriate place in the candidate's answer where the mark is being awarded. See below.

1. Using a marker, label two test tubes two- and four days (or 1 and 2, or A and B), respectively.
2. Using a syringe, ^{E1} measure ^V 10 ml of the plant cells exposed to ^{M1} *Agrobacterium* for two days into the test tube labelled two days. ^{A1} ^O
3. Repeat step 2, measuring ^V 10 ml of the plant cells exposed to ^{M1} *Agrobacterium* for four days into the test tube labelled four days. ^{A1} ^O
4. Using the dropper/pipette, add 15 drops of GUS stain into each test tube. ^{E2} ^{M2} ^{A2} ^O
5. Swirl each of the test tubes and observe colour changes of the plant cells (if any). ^{A2}
6. Record the colour change of the plant cells (if any) in a table. ^R

You may circle or underline elements in the candidate's method to indicate that a mark will be awarded or highlight a sentence or phrase when an element is missing from the method.

A short explanation MUST be given when a mark is not awarded for a particular element of the method (next to the cross), for example:

L ✓

A1 x, did not use the plant cells exposed (to *Agrobacterium*) for two days.

A2 x, did not use GUS stain/did not observe colour change.

M (O) x, made a dilution of the GUS stain before adding to the cells.

(E) ✓

(M) x, the same volume / amount of sample / GUS stain was not used.

(V) x, added 20 ml of sample exposed (to *Agrobacterium*) for four days.

(R) x, no recording of the colour change.

(8)
[17]

METHOD RUBRIC

Method Rubric Criteria	5	4	3	2	1	0
L Layout – appearance of method					Layout meets criteria below: Neat, tidy and numbered.	The layout is untidy and hard to read. OR Method is not formatted correctly with numbers.
A Aim – method relates to prescribed experiment.				Method clearly tests an aim that relates to the prescribed experiment and achieves the required result.	Method relates to the prescribed aim but is a little confusing and does not achieve the required result.	Method neither relates to the prescribed aim nor achieves the desired result. Method given is the same as the experiment given.
M Method – this must be appropriate, and relevant to the aim, clearly logical, and sequential. If apparatus is given in the PAT, the method should resemble the one given in the marking guidelines.	All five criteria given below are met: 1. An original experiment is provided. 2. Equipment is appropriate and used correctly. 3. Measuring of solutions, reagents, and marking of equipment are explained, and this assists in the control of variables. 4. Instructions are scientifically valid and ordered. 5. Instructions are complete to produce measurable results that are recorded.	An original experiment provided. Three or more criteria are met.	An original experiment provided. Two or more criteria are met.	An original experiment provided. One or more criteria are met.	An original experiment provided.	None of the five criteria are met. OR Method is a copy of the original, provided experiment.

Total: 50 marks