NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2020

LIFE SCIENCES: PRACTICAL ASSESSMENT TASK

MARKING GUIDELINES

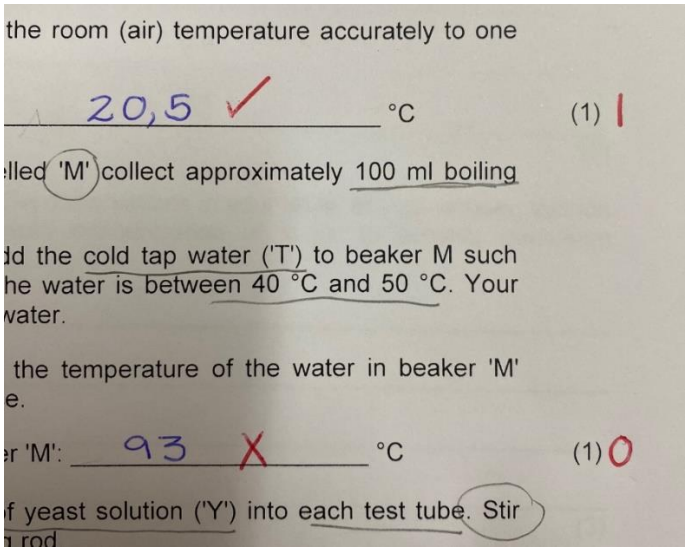
Time: 1½ hours 50 marks

These marking guidelines are prepared 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.

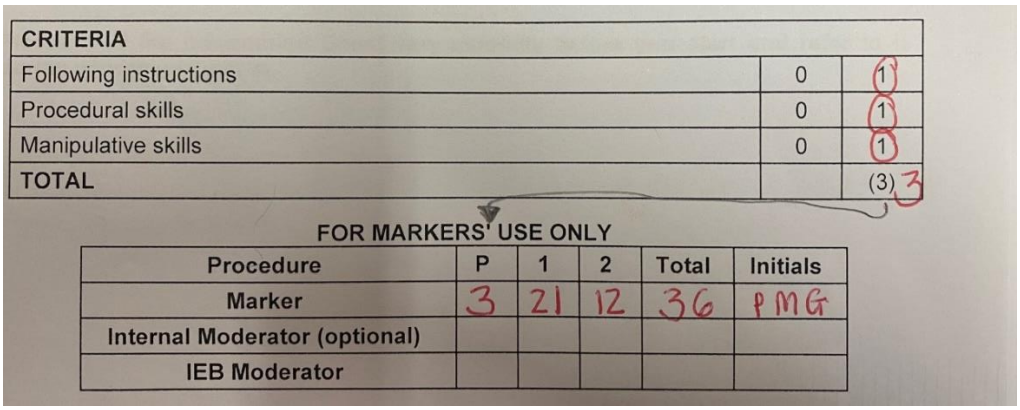
General Instructions

1. Please mark scripts in red pen.
2. Please place the tick where the mark is allocated in the answer, NOT at the end of the answer/sentence/line. Also place a cross if incorrect.
3. Write each 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 image below:



6. Remember to look at and mark the additional back page for answers and carry forward marks to the respective question.
7. Answers must be read in their entirety and alternate wording or equivalent wording expressing the concept or meaning of the concept are acceptable.
8. Please place the skills mark into the block as shown below, and then the subtotals for Part 1 and Part 2 (also as indicated below). Record the total and initial next to the total.

For an example see image below:



9. Should you moderate a script in a cluster (external) please use PENCIL and record marks on the front cover of the script in the "Internal Moderator (optional)" block.
10. Please place the FINAL mark in the box at the top of the answer script (TOTAL MARKS) in RED pen.
11. When returning scripts, exclude all loose pieces of paper (e.g. information sheets).
12. However, please DO include the skills mark sheets in a separate envelope.

PART 1 INVESTIGATION

Following instructions: four test tubes labelled 1 to 4

Procedural skills: Level of solutions NOT the same in each tube

Manipulative skills: All test tubes are either blue or blue/green before the addition of the yeast solution

1.6 Room temperature: reasonable room temperature. Both whole numbers and one decimal place are acceptable. Educator should measure the temperature of the room. Each school can determine an acceptable room temperature range.

1.9 Temperature of water: between 40 and 50 °C. Both whole numbers and one decimal place are acceptable.

1.12 Heading: Table showing the colour change/presence of blue colour of the bromothymol blue (or indicator) for all / different / final sugar concentrations in the fermentation of yeast.

Tube	**Final volume (ml)**	**Final concentration of sugar in solution (%)**	**Presence of blue colour after 10 minutes (+ or -)**
1	20	0	+
2	30	0,6	+/-
3	25	0,4	+/-
4	21	0,1	+/-

1.13 Conclusion: This question MUST be marked in accordance with each candidate's recorded results to question 1.12.
Please do not accept solutions to change the experimental design.

Any one of the following are acceptable:

- The concentration of sugar e.g. 0,4% and 0,6% where the blue colour disappeared is required for optimum fermentation to take place.
- The concentration of sugar must be greater than or equal to 0.6% for optimum fermentation to take place, in order to see the disappearance of blue colour.
- no conclusion can be drawn due to the variables not being controlled/incorrectly controlled variables therefore no fermentation took place (in 10 minutes).
- None of the concentrations of sugar allows for fermentation (in 10 minutes), as no tubes changed colour in that time. (3)

Candidates should:

1. make reference to a specific concentration of sugar from the table
2. to obtain an optimum / no fermentation (in 10 minutes)
3. and mention a colour change (or lack of colour change) based on their table

1.14 (a) Identification of the variable: Either one of the following:

(i) Final/total volume in each test tube or
(ii) the water (bath) temperature.

(b) Either one of the following as per 1.14 (a):

(i) Add proportionate volumes of sugar solution and/or distilled water so that all the tubes have the same final volume
OR Extract different volumes of solutions so that the final volumes are equal
OR take out 10 ml, 5 ml and 1 ml from Tubes 2–4, respectively

(ii) Maintain the temperature between 40–50 ^{o}C (using a thermometer) by adding warm/cold water to the water bath
OR use electric water bath with thermostat / Bunsen Burner to maintain the temperature between 40–50 ^{o}C.

NOTE: Emphasis for this question is on *HOW* the flaw is corrected.

1.15 Making data more quantitative – any one of the following:

- measuring the time (rate) taken for blue colour to disappear
- measuring the pH when the colour changes at time intervals
- comparing the colour changes to CO_2 concentration/ mass/volume/ number of bubbles of CO_2

1.16 Hazard identification: Any one of the following

- hot/boiling water – used gloves or tongs to handle
- glassware could break – if breaks – dispose of safely
- yeast – is a living organism/exposed to environment and should be disposed of safely (treated with bleach/sodium hypochlorite, etc.)
- rinse hands with water if accidently spill yeast/bromothymol blue/ hydrogen peroxide
- also accept any of the COVID-19 precautions: sanitisation of hands/equipment; use of gloves; use of masks; adequate ventilation; physical distancing (if described as a precaution for not contracting SARS-CoV-2)

1.18 Measurements – based on final printed copy.

(a) A = 27 mm (accepted range ± 1 mm)

(b) B = 48 mm (accepted range ± 1 mm)

1.19 Calculation of actual length of yeast cell in mm.
Based on final printed copy.
Actual length = measured length/Magnification
Actual length = 27 (± 1 mm) / 5 000 = 0,0054 mm
(Accept 0,0052–0,0056 mm or 0,005–0,006 mm)
(Also accept 5,2–5,6 µm or 5 µm and answers in exponential form)
Please carry through an incorrect answer from 1.18 (a) and mark accordingly (candidate will not be penalised for this question if value in 1.18 (a) was measured incorrectly).

1.20 Largest is yeast (microorganism A)

1.21 (a) Trend of graph X:
As the sugar concentration decreases, the ethanol concentration increases. Also accept inversely proportional (one mark)

(b) Concentration of ethanol at 20 hours (based on final printed copy)
4.5 % (accept 4,3 – 4,7 %);
If candidate reads the value off the incorrect y-axis (e.g. 1,0–1,4%), no marks awarded, even if % unit given.

(c) Calculation of the decrease in sugar concentration per hour between 4 and 8 hours (based on final printed copy)
(1,4 – 1,2) / (8 – 4) = 0,2 / 4 = 0,05 % per hour
Initial values can be ±0,1 in the range of the accepted value. The acceptable final percentage range is between 0,045 % and 0,055 % per hour.

(d) Heading for graph Y.
Graph showing mass of CO_2 given off over time for different sugars (glucose, fructose, sucrose).

(e) Time at which CO_2 is 5,5 g (based on final printed copy)
240 minutes or 4 hours (accept 220–260 minutes or 3,6 hours to 4,3 hours)

PART B

2.1 Aim: To determine if the type of carbohydrate/sugar (e.g. fructose/glucose/ sucrose) used (by yeast) affects the fermentation rate/time taken to lose blue colour)/colour change with bromothymol blue
If candidates restate the hypothesis, award only ONE mark.

> ***NOTE to markers***: this is a typical example where the hypothesis is overarching, and the aim is more specific in terms of the dependent variable:
> Hypothesis: "rate of fermentation" and Aim: "time taken to lose blue colour". Both dependent variables are acceptable at school level.
>
> Reason: One can have numerous Aims to determine if the hypothesis is correct e.g. Aim 1: time taken for blue colour to disappear; Aim 2: number of CO_2 bubbles given off in a given amount of time; Aim 3: amount of ethanol produced → all point to the overarching fermentation rate/time.

2.2 Different type(s) of sugar/carbohydrate/(fructose, glucose, sucrose)
If only two sugars mentioned, then award ONE mark.
If only one sugar mentioned, then no marks awarded.

2.3 Any one of the following:
- concentration/amount/volume of each sugar (solution)
- temperature at which the experiment takes place (do not accept room temperature, as this is not physically controlled/manipulated)
- amount/volume/concentration of yeast solution used
- amount/volume/concentration of bromothymol blue used
  Note to markers:
  A controlled variable is more than just a reagent. So please do not accept "sugar" or "temperature" or "yeast". Answers need to be phrased correctly. Do not mark individual words.

2.4 Time taken (how long) for blue colour (of bromothymol blue) to disappear OR time taken for colour change OR fermentation (CO_2/ethanol produced) rate.

2.5 Sample method:
(a) Label three test tubes 1–3 using a marker.
(b) Label three beakers as follows: fructose, glucose and sucrose.
(c) Prepare three sugar solutions by measuring 5 ml (or g) of fructose, glucose and sucrose and placing in the three beakers.
(d) Using a syringe, add 100 ml of distilled water to each beaker and stir until the sugar has dissolved.
(e) Using a syringe, place 10 ml of fructose solution in test tube 1, 10 ml of glucose solution in test tube 2 and 10 ml of sucrose solution in test tube 3 (rinse syringe between transfers).
(f) Using a dropper, place 10 drops/5 ml of bromothymol blue into each tube.
(g) Place 5 ml of yeast solution in test tube 1 and start timing using a timer/stopwatch/watch/clock.
(h) As soon as the solution has no more observable blue colour, stop timing.
(i) Calculate and record the fermentation time for the fructose.

(j) Repeat steps (g) to (i) for test tubes 2 and 3 to calculate the fermentation time for glucose and sucrose respectively.

NOTE: *do not penalise candidates for adding a control. Also, either steps (c)–(e) can be followed or some indication that same quantity of equal concentration of three sugars were placed into each of the beakers/tubes.*

Layout (L): neat, numbered (if not numbered, then no marks)
Aim (A): must use of three sugar solutions (e.g. fructose, glucose and sucrose solutions) **and** yeast
must time the change of colour (using bromothymol blue) from blue to colourless

Method (M):

- Original – look for use of fructose, glucose and sucrose; if mention a dilution or different volume of sugar or different concentrations then no marks awarded.
- Equipment – looking for a syringe used correctly; must make use of a timing device for each test tube
- Measuring – equal volumes of fructose/glucose/sucrose, yeast and bromothymol blue added to each tube (temperature, although valid here, is not critical to the outcome so no marks awarded for this).
- Valid – order allows for achievable result; same concentrations of sugars made/used; sensible volumes used for test tubes e.g. no more than 40 ml; candidates must use beakers/test tubes with appropriate volumes.
- Measurable results – recording of time taken for loss of blue colour.

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.

e.g.
L
A
M
1 2 3 4 5
OR

L
A
M
1 2 3 4 5

Do NOT place any **other** ticks in the method.

METHOD RUBRIC

Method Rubric Criteria	5	4	3	2	1	0
L Layout – appearance of method					Layout meets criteria below: neat and tidy and bulleted/numbered.	Layout is untidy and hard to read. **OR** Method is not formatted correctly with bullet points or 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 given, 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 given experiment.
M Method – This needs to be appropriate and relevant to the aim, clearly logical and sequential. If apparatus is given in the examination paper, the method should resemble the one given in the marking guidelines.	All 5 criteria given below are met: 1. An original experiment 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. Plus 3 of 5 criteria are met.	An original experiment provided. Plus 2 of 5 criteria are met.	An original experiment provided. Plus 1 of 5 criteria is met.	An original experiment provided.	None of the 5 criteria are met. **OR** Method a copy of the original, given experiment.

Total: 50 marks