Please paste the barcoded label here	TOTAL MARKS

NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2020

LIFE SCIENCES: PRACTICAL ASSESSMENT TASK

EXAMINATION NUMBER													

Time: 1½ hours 50 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. Write your examination number in the blocks above.
2. This Practical Assessment Task (PAT) consists of 11 pages and a separate yellow Information Sheet of 2 pages (i–ii). Please check that your PAT is complete.
3. You have ten minutes reading time before you begin. You are advised to read carefully and spend time planning your work. Pay particular attention to the information in the Information Sheet.
4. Perform the task with care. You will be assessed on your ability to follow instructions.
5. Standard accommodations will apply to this PAT.
6. Please answer the questions in the spaces provided. Should you need more space for your responses, use the last pages in this question paper ONLY. No extra paper may be added to this booklet.

Invigilators are asked to please complete this after the PAT.

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

FOR MARKERS' USE ONLY

Procedure	P	1	2	Total	Initials
Marker					
Internal Moderator (optional)					
IEB Moderator					

Please read the Information Sheet very carefully before you start and refer to it during your investigation.

There are two parts to this PAT: **Part 1 – Investigation**
Part 2 – Experimental Design

A craft-beer brewer has a particular yeast strain they use to brew beer. The company would like you to investigate the following:

To determine the optimum concentration of sugar for maximum fermentation to occur in 10 minutes.

Before you begin your investigation, please make sure that you have the following equipment and solutions at your workstation:

- Four identical test tubes in a test tube rack
- 2 × pipettes or droppers
- Syringe (20 ml)
- Syringe (10 ml)
- A thermometer
- Cup or beaker containing 100 ml distilled water and bicarbonate of soda (labelled 'D')
- One empty cup or beaker for preparing a water bath (labelled 'M')
- Sugar solution (2%) in a cup or beaker (labelled 'S')
- Cup or beaker containing 50 ml yeast solution (labelled 'Y')
- Polystyrene cup or beaker containing rinsing water (labelled 'R')
- Polystyrene cup or beaker containing tap water (labelled 'T')
- Access to boiling water
- Access to hydrogen peroxide
- Bromothymol blue
- Paper towel
- Permanent marker
- One A4 sheet of plain white paper
- Access to a wall clock or watch
- Stirring rod or kebab stick

Remember:

Please read the Information Sheet very carefully before you start and refer to it during your investigation.

PART 1 INVESTIGATION

1.1 Using a marker, label the test tubes 1, 2, 3 and 4.

1.2 Using a syringe, place 10 ml of distilled water ('D') into each test tube.

1.3 Using a syringe, place 5 ml of bromothymol blue solution into each test tube.

1.4 Using a syringe, place the following volumes of sugar solution ('S') into the tubes:

- 10 ml into tube 2
- 5 ml into tube 3
- 1 ml into tube 4

1.5 Rinse the syringe with the rinsing water in beaker 'R'.

CALL THE INVIGILATOR TO ASSESS YOUR WORK

1.6 Using a thermometer, record the room (air) temperature accurately to one decimal place.

Room (air) temperature: _____ °C (1)

1.7 Using the cup or beaker labelled 'M' collect approximately 100 ml boiling water from the kettle or urn.

1.8 At your workstation, slowly add the cold tap water ('T') to beaker M such that the final temperature of the water is between 40 °C and 50 °C. Your cup should only be half full of water.

1.9 Using a thermometer, record the temperature of the water in beaker 'M' accurately to one decimal place.

Temperature of water in beaker 'M': _____ °C (1)

1.10 Using a syringe, place 5 ml of yeast solution ('Y') into each test tube. Stir using the kebab stick or stirring rod.

1.11 Place the four test tubes into the warm water (beaker M) for 10 minutes. While you wait, read paragraph 1.17 and answer the questions from 1.18 onwards.

1.12 After 10 minutes, remove the test tubes from the water bath, place in a rack, and place a piece of white paper behind the tubes. Record your results in the table below. Record the final volume of the solutions in each tube. If there is any blue colour in the test tube, place a (+) and if there is no blue colour in the tube, place a (–) in the right-hand column. Provide a suitable heading for the table.

Heading: _____

_____

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

(5)

1.13 Write a conclusion to explain the observations in your table. In your answer, include a comment about the optimum concentration of sugar to achieve maximum fermentation in 10 minutes.

_____

_____

_____

_____

(3)

1.14 There is a flaw in this experimental design with a variable that was not adequately controlled.

(a) Identify the variable that should have been controlled.

_____

(1)

(b) Without changing any of the other original contents in the test tubes, explain clearly how this flaw could be corrected.

_____

_____

(1)

1.15 Recording a colour change provides qualitative results. How could one record the appearance of a colour change in a more quantitative way? Refer to the Information Sheet.

_____

(1)

1.16 Identify any potential hazard of the investigation you performed, and briefly describe how one could take precautions.

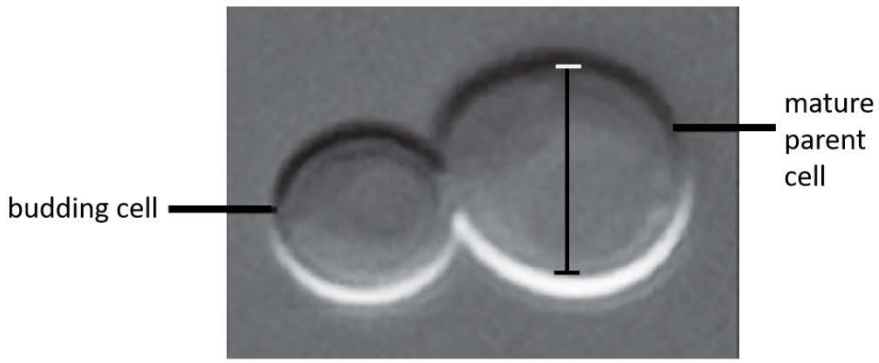
_____

_____

(2)

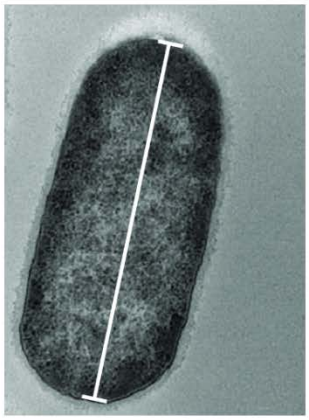
1.17 Craft-beer brewers struggle with contamination of their products by bacteria such as *Lactobacillus* strains. Below is a micrograph of a yeast, *Saccharomyces cerevisiae*, (A) and a bacterium, *Lactobacillus brevis* (B). Use the micrographs to answer questions 1.18 to 1.20.

A: *Saccharomyces cerevisiae*



Magnification = 5 000 X

B: *Lactobacillus brevis*



Magnification = 35 000

[Adapted: <https://www.chegg.com/homework-help/campbell-biology-11th-edition-chapter-6-solutions-9780134505589> and <https://www.researchgate.net/figure/The-morphological-and-molecular-characterization-of-natural-FFAs-absorbing-Lactobacillus_fig3_288073763>]

1.18 Measure the diameter of the following and record your answer correct to the nearest whole number:

(a) the mature parent cell (A) _____ mm (1)

(b) the bacterium (B) _____ mm (1)

1.19 Calculate the actual (real) length of the yeast parent cell in mm. Show all working in the space below.

(3)

1.20 Use all the information provided in 1.17 to 1.19 to decide which of the two microorganisms is in reality the largest.

_____

_____

(1)

1.21 A measure of a successful brew is determined by the amount of carbon dioxide released, as well as the concentration of ethanol produced. Study the graphs (X and Y) on the Information Sheet and answer the following questions.

(a) Describe the general relationship between the total sugars and ethanol concentration.

_____

_____

_____

(2)

(b) What is the concentration of ethanol at 20 hours (Graph X)?

_____

(2)

(c) Calculate the decrease in the total sugar concentration per hour between 4 and 8 hours (Graph X). Show all working. Express your answer in % per hr.

(3)

(d) Provide a suitable heading for Graph Y.

(3)

(e) How long did it take for the mass of CO_2 to be 5,5 g for all three sugars (Graph Y)?

(1)
[35]

PART 2 EXPERIMENTAL DESIGN

Different sugars are used by yeasts at different rates. Some are broken down more quickly than others to release CO_2 and ethanol. Making use of a yeast solution, three different sugars and bromothymol blue, design a simple test for the following hypothesis:

The type of sugar used by yeast will affect the fermentation rate.

2.1 State the aim of the experiment.

(2)

2.2 State the independent variable used in this experiment.

(2)

2.3 Identify any ONE variable that will need to be kept constant (fixed/ controlled) in this experiment.

(1)

2.4 State the dependent variable used in this experiment.

(2)

2.5 Outline your method in the simplest way, using **numbered** points.

(8)
[15]

Total: 50 marks

ADDITIONAL PAGES (use only if necessary)