PRACTICE SAC 3.2 (B) 2022

TOTAL MARKS = 46

Score:_____

Part A – Theoretical Application (Multiple Choice) – 12 MARKS

Circle the most correct answer for each question.

Question 1

The genetic code is considered degenerate. Which of the following options describes degeneracy?

A. Proteins have over-lapping functions, ensuring no single protein is critical for survival
B. Genes possess a back-up copy on the other set of chromosomes
C. A single amino acid is coded for by several different codons
D. DNA can mutate, resulting in a novel phenotype

Question 2

A change in the tertiary structure of a protein can be caused by:

A. The inability of multiple monomers to orientate correctly to form the quaternary structure
B. A mismatched base pairs in the mRNA
C. A change in the genetic sequence of the gene
D. An extension of the poly-A tail at the 3' end of the mRNA

Question 3

A particular DNA double helix is 100 nucleotide pairs long and contains 10 Thymine bases. The number of Guanine bases in this DNA double helix would be

A. 10
B. 20
C. 40
D. 80

Question 4

Under what conditions would the *Lac* operon become repressed?

A. In the absence of Lactose
B. In the presence of Glucose
C. In the absence of Glucose

D. At temperatures well above the optimal temperature of the protein

Question 5

The optimal pH of a protein in an organism:

A. Is the same for all organisms
B. Is the same for all proteins within an organism
C. May be as low as pH 3 for some proteins
D. Is around pH 7 – neutral

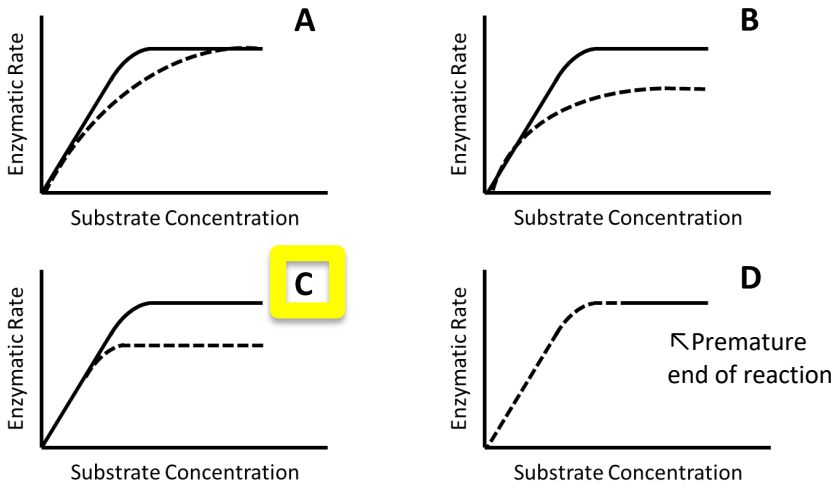
Question 6

According to D'Amico *et al*.(2006), Nitric Acid poisons humans by binding to the active site of cytochrome-c, a key protein in the Electron Transport Chain. Patients exhibiting Nitric Acid poisoning display symptoms such as:

A. Dangerously increased blood oxygen, leading to retinopathy and blindness
B. Hypophosphatemia, resulting in a ≈10-fold decrease in ATP levels despite adequate cellular oxygenation
C. Substantially increased Lactic Acid build-up, leading to hypertrophy and cellular death
D. Decreased circulating blood oxygenation, eventuating in hypoxia and death

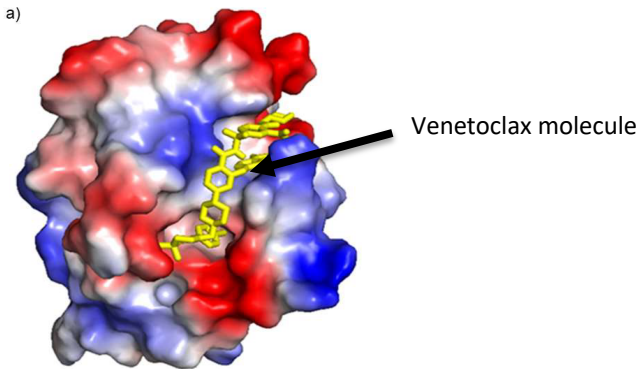
Question 7

The graphs below indicate the reaction rate in the presence of an enzyme as the substrate concentration is increased. The solid indicates an *enzyme* concentration of 100 units. Which dotted line indicates a decreased concentration of enzyme?



Question 8

The image below is the novel cancer therapeutic agent 'Venetoclax'. As seen in the image, the molecule inserts itself within the active site of the oncogene (cancer-causing protein) and causes the cell to die. Venetoclax acts as a:



A. Competitive Inhibitor
B. Non-competitive Inhibitor
C. Co-factor
D. Co-enzyme

Question 9

During the experiment performed in class, an example of a systematic error might be:

A. Inherent inaccuracy of measuring volumes of substances using measuring cylinders and beakers
B. A student accidentally transcribes the data incorrectly into their notebook
C. An incorrectly calibrated weigh-scale
D. Variation between liver samples such as enzyme concentration or cellular density

Question 10

One student suggested that rather than utilising the complex 'over-water' gas collection technique, an oxygen probe would be a better method for determining the volume of gas produced. The company producing the probe claims it is ≈100x more sensitive than the over-water technique. If a probe was used, the results could be considered:

A. More accurate
B. More reliable
C. More precise
D. More valid

Question 11

An important controlled variable to consider for the catalase experiment may be:

A. The amount of light illuminating the liver samples
B. The volume of Hydrogen Peroxide
C. A sample containing no liver
D. The pH of the solution of liver

Question 12

The most appropriate hypothesis for this experiment may be:

A. A pH of 9 will produce the greatest volume of oxygen, as bile in the liver increases the pH of catalase under normal conditions
B. A pH of 7 will produce the greatest volume of oxygen
C. A pH of 7 will produce the greatest volume of oxygen, as mammalian bodies require neutral pH to survive
D. More repeats will be necessary to make a final conclusion

Part B – Cellular Respiration Practical – 16 MARKS

1. Write a worded equation for cellular respiration occurring in the absence of oxygen (2):

Glucose → Ethanol and CO_2 or Glucose → Lactic Acid (1 mark reactant, 1 mark product)

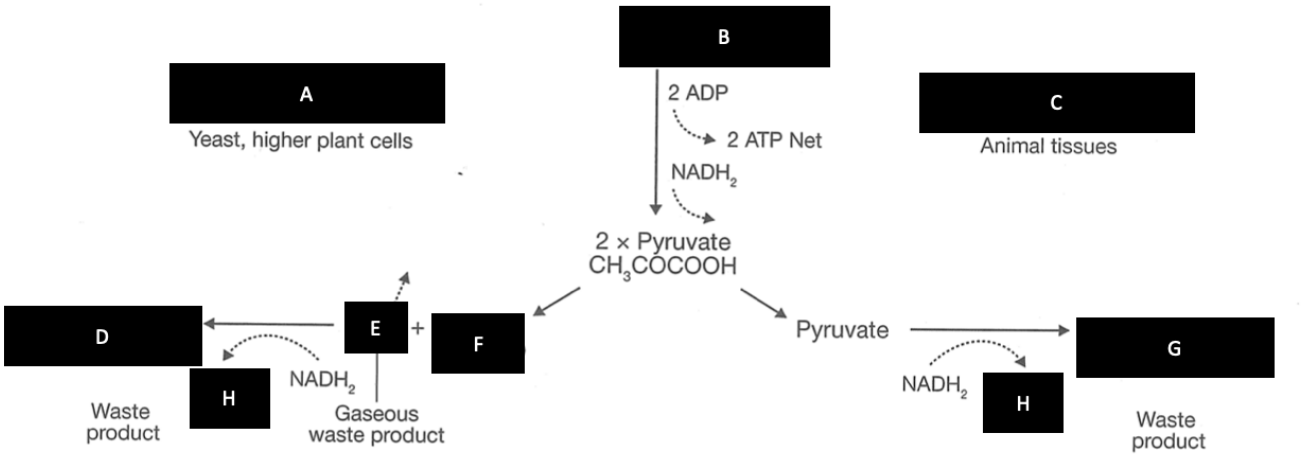
2. This is a type of chemical reaction that is important for an organism's biochemical pathway. Describe this type of reaction in terms of energy (1).

Catabolic / Exogonic reaction

3. State, with reason, two *important* variables that would need to be controlled for your investigation (2):

Must have clear links to the DV – general room temp. not accepted

4. The flow chart below represents a part of the cellular respiration process. Use this flow chart to answer the following (5):



a) Identify the term given to processes A and C collectively. Fermentation / anaerobic resp.
b) Identify the product G. Lactic acid
c) What type of molecule is H? NAD^+
d) Molecule H is also required when oxygen is present. Name one process where molecule H is an input. Glycolysis, link reaction, Krebs/Citric acid cycle
e) What is the difference between molecule H and NADH? NAD^+ is unloaded while NADH is loaded. Or More energy in NAD^+ than NADH. Or NADPH is a coenzyme involved in photosynthesis.

5. Andy and Ben carry out the practice practical task involving yeast and glucose. Andy suggests that the experiment is a demonstration of aerobic cellular respiration, whilst Ben argues that the experiment is a demonstration of cellular respiration in the absence of oxygen.

   Provide evidence that could be collected supporting:

   a. Andy's hypothesis (2): decrease in oxygen due to oxygen being an input to aerobic cell resp.

   b. Ben's hypothesis (2): increase in ethanol as ethanol is an output for yeast anaerobic cell. Resp.

6. Consider the graph you constructed from the results of your investigation. Justify the type of graph you chose and give a benefit of using this type of graph. (2)

The data collected was continuous numerical (1) so a scatter plot with a line of best fit was used (1). This allows trends to be identified (1) / interpolation and extrapolation (1).

(2 + 1 + 5 +2 + 4 + 2= 16 marks)

Part C – Catalase Practical – 18 MARKS

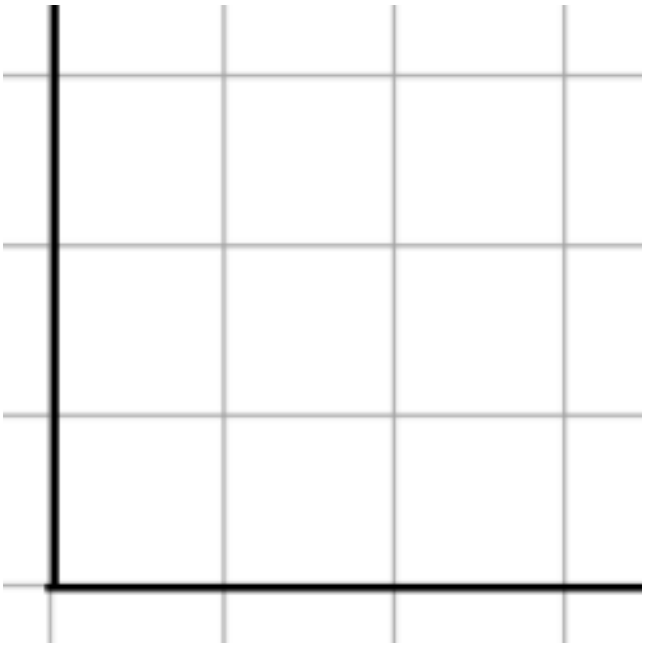
1. State the variables for the catalase practical (2):

    a. Independent Variable: Condition of the liver / types of inhibitors

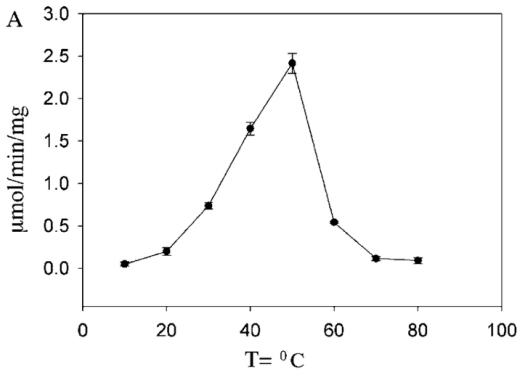
    b. Dependent Variable: volume of gas produced (mL) as determined by change in water level in measuring cylinder.

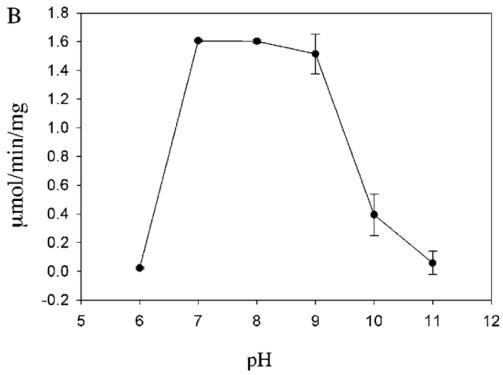
Maja modified the experiment to monitor the peroxide concentration over time at temperatures starting at $5^{O}C$ and reaching a maximum of $75^{O}C$. In her set-up, she utilized a more precise oxymeter, a small probe measuring oxygen concentration in real-time. This allowed her to make continuous readings every 5 minutes.

2. Using the axes below, carefully graph the expected concentration of oxygen produced *over time,* including appropriate labels (5):



3. The graphs below were developed by a group of scientists attempting to identify catalase from an unknown species.





a. State the optimum temperature and pH for the newly discovered catalase (1):

Temp: __50 c +/- 1___ pH: _____7-8 +/- 0.2_____

b. Explain why the activity of the enzyme is so low at pH 6 (2):
At pH levels lower than the optimum, the enzyme's active site has changed shape and denatured (1) – therefore decreasing productivity (1).

4. It was noticed that when the peroxide was deliverd into the test tube, bubbles occurred before the reaction took place.
   a. Explain whether this a random or systematic error (1)

As this observation occurred in every trial, it is a systematic error.

b. Devise an improvement to your method to reduce the impact of this error on your results.(1)

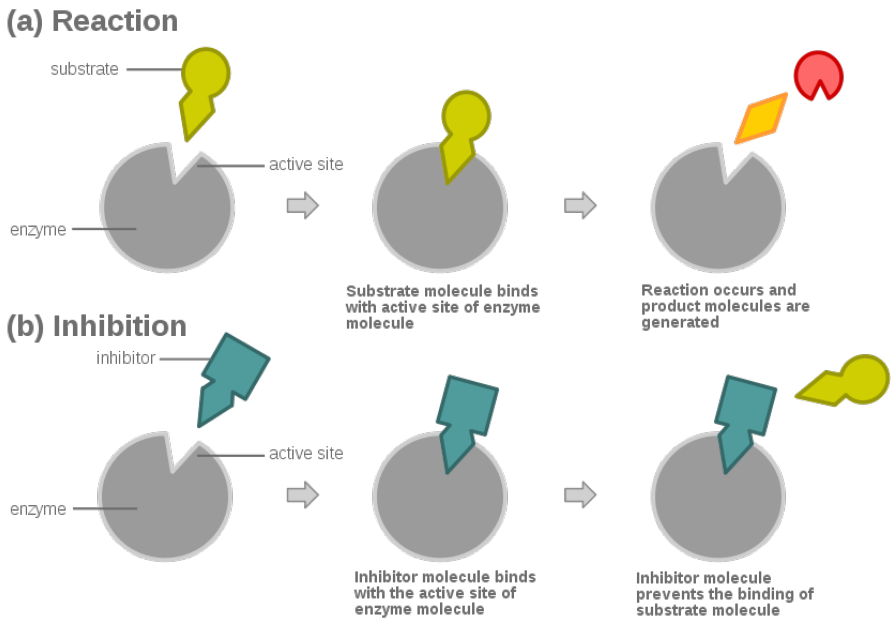
Calibrating the apparatus / ensuring the syringe has no gas in it before delivery of H_2O_2

5. Identify two pieces of qualititaive data that are important to consdier when discussing this experiment. (2)

Temperature change of test tubes / colour of liver / appearance of bubbles /speed of water level drop / any other reasonable response

6. Draw and label (be specific) what an enzyme would look like in the presence of its substrate and one of the inhibitors you used in your investigation. (4)

(2 + 5 + 3 + 2 + 2 + 4 = 18 marks)



Something like this – with specific and correct labelling of the following:
Catalse enzyme (1)
Active site (1)
Copper sulphate (competitive) or cyanide (non-competitive) (1)
H_2O_2 as substrate (1)