A-Level Biology

Paper 5

Unsolved Topical

Past Papers with Marking Schemes

All Variants

2014-2021

Title A-LEVEL TOPICAL BIOLOGY PAPER 5

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PREFACE

Excellence in learning cannot be claimed without application of concepts in a dexterous way. In this regard one of the logical approach is to start in chunks; like chapter wise learning and applying the concept on exam based questions.

This booklet provides an opportunity to candidates to practice topic wise questions from previous years to the latest. Extensive working of Team MS Books has tried to take this booklet to perfection by collaborating with top of the line teachers.

We have added answer key / marks scheme at the end of each topic for the candidate to compare the his/her answer to the best.

MS Books strives to maintain actual spacing between consecutive questions and within options as per CAIE format which gives students a more realistic feel of attempting question.

Review, feedback and contribution in this booklet by various competent teachers of a subject belonging to renowned school chains make it most valuable resource and tool for both teachers and students.
With all belief in strength of this resource material I can confidently claim that it is worth in achieving brilliance.

TABLE OF CONTENTS

Respiration

Q1/52/O/N/14

1 (a) The enzyme ethanol dehydrogenase occurs in a wide variety of organisms. It is able to catalyse a reversible reaction that converts ethanol to ethanal or ethanal to ethanol.

Ethanol is toxic and in some tissues the ethanol can be converted to ethanal and then to ethanoate (acetate) which is used as an energy source.

Fig. 1.1 shows these reactions.

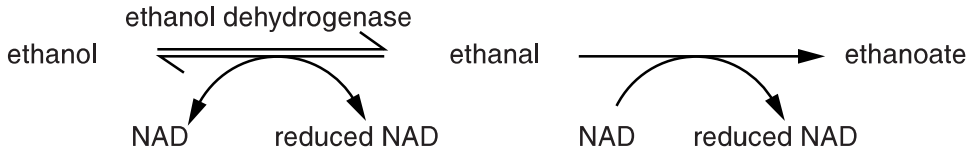

Fig. 1.1

In industry ethanol is converted to ethanal, which is used to make a variety of compounds, such as dyes, flavourings and perfumes.

A student carried out an investigation to find out if the activity of immobilised ethanol dehydrogenase differed from that of non-immobilised (free) ethanol dehydrogenase.

The student:

- immobilised a 1 mg dm^{-3} ethanol dehydrogenase solution
- used both the NAD and the ethanol at concentrations of 10^{-3} mol dm^{-3}
- used methylene blue as an indicator of enzyme activity. Methylene blue becomes colourless when oxidised
- measured the time for methylene blue to become colourless.

(i) Identify the independent and dependent variables in this investigation.

independent .....

dependent .....[2]

(ii) Outline how the student could immobilise the enzyme ethanol dehydrogenase.

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.....[3]

(iii) Suggest a suitable control for this investigation.

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.....[1]

(b) Describe a method the student could use to find the activity of the immobilised and free ethanol dehydrogenase.

Assume that the immobilisation traps all of the available enzyme from the solution.

Your method should be detailed enough for another person to use.

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(c) The results of the student's investigation are shown in Table 1.1.

Table 1.1

rate of reaction / arbitrary units ±*s*			
experimental		control	
free enzyme	immobilised enzyme	free enzyme	immobilised enzyme
0.0333 ± 0.0024	0.0222 ± 0.0022	0.00012 ± 0.0001	0.00010 ± 0.0002

(i) Describe how the student could calculate the rate of reaction, taking into account the results of the control experiments.

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(ii) State what standard deviation (*s*) shows about the results of this investigation.

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(d) The student carried out a statistical test to find out if the difference in the rate of reaction between the immobilised and free enzyme was significant.

The results were significant at P< 0.05. Explain what this means.

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.....[2]

[Total: 19]

Q1/53/O/N/19

2 A group of students investigated the growth of different varieties of yeast.

The students learned that the rate of respiration in a yeast culture is proportional to the biomass of the culture. Respiration rate can be used as a measure of the growth of a yeast culture.

Respiration rates can be measured using the redox indicator TTC.

- During respiration, hydrogen ions are removed from glucose to reduce hydrogen carriers such as NAD and FAD.
- A redox indicator can be used as a hydrogen carrier in experimental conditions instead of NAD or FAD.
- The colour change of the redox indicator can be measured using a colorimeter.

(a) The students carried out a preliminary experiment using a redox indicator to monitor the growth of a yeast culture over time.

The yeast was grown in a liquid culture in a conical flask, as shown in Fig. 1.1.

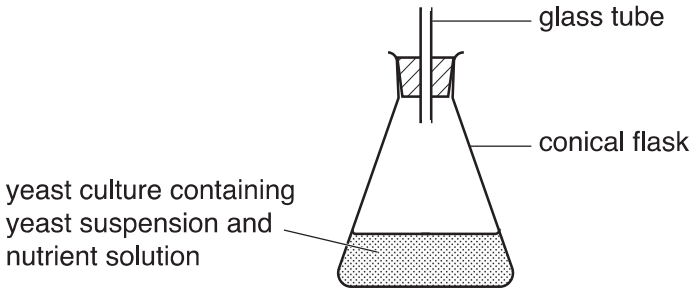

Fig. 1.1

- Different masses of yeast were added to a fixed volume of distilled water to give different concentrations of yeast in suspension.
- Each yeast suspension was added to a separate flask of nutrient solution containing glucose.
- A redox indicator was added to each flask and the flasks were incubated at a constant temperature for a fixed period of time.
- The colour of each suspension was monitored over the incubation period using a colorimeter.
- A colorimeter passes a beam of light through a coloured filter into a solution and measures the light absorbance of that solution.
- A standard solution is used to set the colorimeter scale to zero (0) before taking any measurements.

(i) State the independent variable **and** the dependent variable in this investigation.

independent .....

dependent .....

[2]

(ii) Identify **two** variables that the students have standardised in their investigation.

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..... [2]

(iii) Suggest a suitable control for this investigation.

..... [1]

(iv) Samples were taken from the flask at intervals and the absorbance was measured in the colorimeter.

As the yeast respires, the redox indicator TTC changes from colourless to pink.

Sketch a graph on Fig. 1.2 to show the expected change in absorbance over time during the incubation of yeast. Label the axes.

[2]

Fig. 1.2

(b) Three different varieties of yeast, commonly used in food manufacture, are compressed yeast, active dry yeast and instant yeast.

The students decided to compare the growth rates of the three different varieties of yeast by measuring their respiration rate. They decided to use TTC as the redox indicator.

Describe a method that students could use to compare the respiration rates of the three varieties of yeast.

Your method should be set out in a logical order and be detailed enough to let another person follow it.

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(c) The students found that compressed yeast gave the highest rate of respiration.

The students then carried out two further experiments to find the best conditions for growth of compressed yeast.

In both experiments absorbance was measured in arbitrary units (a.u.). The higher the absorbance the greater the respiration rate. Respiration is proportional to the growth rate of the yeast.

In the first experiment they investigated the effect of changing pH and incubation time at a constant temperature of 30 °C.

The results of the first experiment are shown in Fig. 1.3.

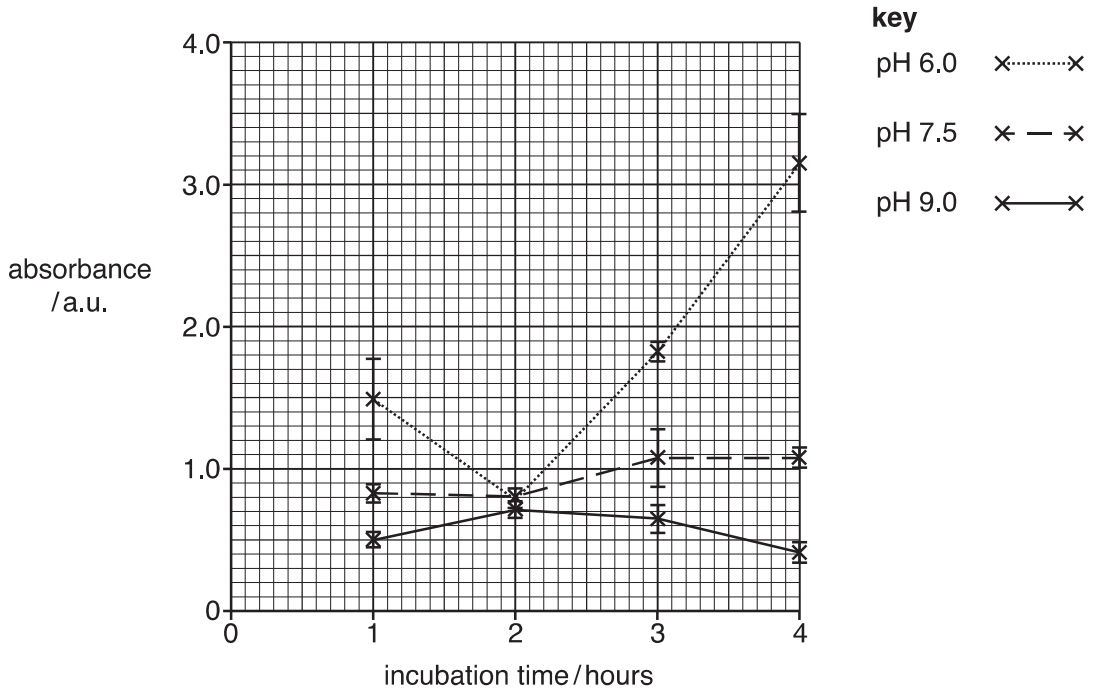

Fig. 1.3

In the second experiment the students investigated the effect of changing pH and temperature at a constant incubation time of 4 hours.

The results of the second experiment are shown in Table 1.1.

Table 1.1

temperature /°C	pH 6.0		pH 7.5		pH 9.0	
	absorbance /a.u.	S_M	absorbance /a.u.	S_M	absorbance /a.u.	S_M
22	2.28	+/– 0.60	1.10	+/– 0.28	1.40	+/– 0.72
30	3.16	+/– 0.28	0.50	+/– 0.04	0.94	+/– 0.02
40	1.10	+/– 0.52	0.40	+/– 0.04	0.54	+/– 0.04
50	0.48	+/– 0.08	0.40	+/– 0.04	0.28	+/– 0.02

(i) State what the standard error (S_M) shows.

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..... [1]

(ii) The graph in Fig. 1.3 shows the 95% confidence intervals for the data.

95% confidence interval = +/– 2 × S_M

State what this indicates about the data.

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..... [1]

(iii) After completing these two experiments the students concluded that the growth rate of yeast is highest when incubated at 30 °C and pH 6.0 for 4 hours.

State **two** ways in which the data support this conclusion.

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..... [2]

[Total: 18]

Q1/52/O/N/14 **Q 1**

Question	Expected answer	Extra guidance	Mark
1 (a) (i)	*independent variable*: free or immobilised enzyme ; *dependent variable*: time to decolourise(methylene blue) ;	**I** type / state of enzyme **A** time to change colour **R** rate	[2]
(ii)	*ref. to* first mixing the enzyme / it with (any) alginate ; *ref. to* then adding (alginate and enzyme) to <u>calcium</u> chloride ; *ref. to* method of dropping mixture (to form beads) ;	**I** any alginate concentrations **A** symbol Ca^{2+} / calcium ions e.g. using syringe or pipette **A** dropper	[3]
(iii)	*idea of* replacing the enzyme by boiled enzyme / water ;	**I** without enzyme unqualified **I** glass beads	[1]
(b)	7 of: *independent variable:* 1. same <u>volume</u> / stated <u>volume</u> of enzyme (for making beads and for testing free enzyme) ; *dependent variable*: 2. *ref. to* suitable equipment for measuring time taken for methylene blue / indicator to decolourise ; *standardised (controlled) variables: max 3* 3. *ref. to* same volume / concentration of methylene blue solution ; 4. *ref. to* same volume of ethanol / alcohol ; 5. *ref. to* same volume NAD ;	1. **I** mass of enzyme 2. e.g. stop clock / stop watch / timer **A** same number / stated number of drops	

Question	Expected answer	Extra guidance	Mark
	6. *ref. to* method of keeping constant temperature ;	6. e.g. water bath / temperature controlled room / incubator / environmental chamber **I** air conditioning / room temperature If temperature quoted must be maximum 40 °C	
	7. *ref. to* using buffer + maintaining pH ;		
	procedure: 8. *ref. to* adding ethanol (and NAD) to both types enzyme using same apparatus ;	8. e.g. in test-tube / boiling tube / beaker / flask. **R** if pour substrates through for the beads and mix in a beaker / AW for the free enzyme	
	9. *ref. to* temperature equilibration before mixing enzyme and substrate ;		
	10. correct sequencing so that enzyme or substrate is added last ;	10. **R** if methylene blue added last	
	reliability: 11. repeat at least 3 times **and** find mean / identify anomalies ;	11. **A** several / many repeats **A** average for mean	
	safety: 12. *ref. to* suitable hazard **and** precaution / low risk experiment ;	12. e.g. alcohol flammable and no open flames / methylene blue or enzyme irritant / allergen and gloves **I** allergic or toxic or irritant for NAD / ethanol	[max 7]

Question	Expected answer	Extra guidance	Mark
(c) (i)	subtract the control values from the raw data ; divide 1 by the time (taken for the methylene blue to become colourless) ;	**A** $\frac{1}{\text{time experimental}} - \frac{1}{\text{time control}} = 2$	[2]
(ii)	shows the spread of data / results from the mean ; indicates the reliability of the data / results or data is reliable as values of *s* are very small / **ora** ;	**R** reliability of the mean **R** accuracy / validity **A** correct data quotes **I** standard deviation is less than one	[max 2]
(d)	*significant:* *idea that* the (observed) result or difference is caused by another factor / factor other than chance / immobilisation / is not due to chance ; *P* < *0.05*: 5% or less than 5% chance / probability that the (observed) result or difference is not significant ; or 95 % or more than 95% chance / probability that the (observed) result or difference is significant ;	**A** 1 in 20 chance of the results being not significant **ora** *2 marks for :* 5% or <5% chance / probability that the (observed) result or difference occur by chance or 95% or >95% chance / probability that the (observed) result or difference are caused by an outside effect / not due to chance	[max 2]
			[Total: 19]

Q1/53/O/N/19 **Q 2**

Question	Answer	Marks
1(a)(i)	*independent:* mass / biomass, of yeast ; **or** concentration of, yeast / suspension / culture ; *dependent:* absorbance / colour (change / of indicator) ;	2
1(a)(ii)	*any two of:* volume of water (added) / volume of yeast suspension ; (same) indicator / TTC ; (same) temperature ; (same) time / period, of incubation ; colorimeter zeroed ;	2
1(a)(iii)	*one of:* *replace (live) yeast by:* boiled / dead / inactivated / AW, yeast (of the same mass) ; sterile / inert / glass beads / AW, material (of same mass) ;	1
1(a)(iv)	axes labelled *x* =, time / t, *y* =, absorbance / Ab ; line to show absorbance shows an increase ; **ecf** if axes inverted but shape (related to axes) correct = 1 **ecf** if axes wrong but shape correct (related to those axes) = 1	2

1(b)	*any seven of:* 1 same / stated / known, mass / volume (suspension), of each yeast (added to separate flasks) ; 2 same / stated / known, concentration of, nutrient solution / glucose ; 3 same / stated / known, volume of, nutrient solution / glucose ; 4 *ref. to* method to maintain temperature ; 5 suitable temperature in range 15 °C–80 °C ; 6 *idea of* equilibration / bringing yeast suspension **and** nutrient solution, to temperature, before mixing ; 7 add TTC / redox indicator, to yeast / yeast and nutrient mixture ; 8 *time for recording absorbance* **either** record (absorbance) at, regular / stated, time intervals **or** leave for set time (if stated max = 1 hour) **and** record (absorbance) ; 9 *ref. to* method of maintaining homogeneity (of yeast) ; 10 *ref. to* method of maintaining oxygen concentration ; 11 use (at least) 3 replicates / repeats **and** find mean **or** identify / eliminate / remove, anomalies ; 12 *ref. to* low risk ; **or** **A** named hazard and risk and precaution e.g. yeast **and** allergy **and** wear gloves / mask / goggles e.g. TTC **and** irritant **and** wear gloves / mask / goggles	**7**
1(c)(i)	*idea of* how close the (sample) mean, is to the, true / population, mean ;	**1**
1(c)(ii)	**either** 95% of, the / ~~all~~ / repeated, data, would be expected to lie within this range ; **or** At 1 / 3 / 4, hours, the (sample) mean, was reliable / AW, because the, confidence intervals / CI, do not overlap ;	**1**
1(c)(iii)	*from the graph / Fig. 1.3 / experiment 1* pH 6.0 gives the highest absorbance at 4 hours incubation ; **or** *from the table / Table 1.1 / experiment 2* at 30°C at pH 6 absorbance is highest ; *from the graph / Fig. 1.3 / experiment 1* the CI / (standard) error bars, (for pH 6), do not overlap (at 4 hours) ; **or** *from the table / Table 1.1 / experiment 2* standard errors / S_M, do not overlap (with other, temperatures / pHs) ;	**2**