CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/31**

Paper 3 Advanced Practical Skills 1 **May/June 2024**

MARK SCHEME

Maximum Mark: 40

Published

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AVP	alternative valid point (where a greater than usual variety of responses is expected)
ORA	or reverse argument
underline	actual word underlined must be used by the candidate (grammatical variants excepted)
MAX	indicates the maximum number of marks that can be awarded
+	statements on both sides of the **+** are needed for that mark
OR	separates two different routes to a mark point and only one should be awarded
ECF	error carried forward (credit an operation from a previous incorrect response)

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Question	Answer	Marks
1(a)(i)	1 heading for independent variable: solution / concentration of sodium chloride (before heading for dependent variable) ; 2 heading for dependent variable: number of cells showing plasmolysis ; 3 **U1** has the most plasmolysis ; 4 **U2** has the least plasmolysis ;	**4**
1(a)(ii)	correctly identifies the three concentrations of sodium chloride ; 0.10 mol dm^{-3} is **U2** 0.50 mol dm^{-3} is **U3** 1.00 mol dm^{-3} is **U1**	**1**
1(a)(iii)	1 minimum size and all lines sharp and continuous ; 2 draws only four whole cells and each cell touches at least two other cells ; 3 cell wall drawn as two lines around each cell and three lines where cells touch ; 4 draws correct shape of cells ; 5 label line and label to one cell surface membrane ;	**5**
1(a)(iv)	water potential lower in solution **U1** than the onion cells ; *any **two** from:* 1 water moves (out of the cells) from a high water potential to low water potential ; 2 (water moves out) by osmosis ; 3 cell membrane pulls away from the cell wall ; **ora** if no plasmolysed cells in **(a)(iii)**	**3**
1(b)(i)	shows 2.4 minus 2.3, divided by 2.3 and multiplied by 100 ;	**1**
1(b)(ii)	shows addition of 4.2 and 4.2 and the answer to **(b)(i)** and divided by 3 ;	**1**

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Question	Answer	Marks
1(b)(iii)	1 label on *x*-axis: sucrose concentration / mol dm^{-3} and label on *y*-axis: mean percentage change in mass ; 2 scale on *x*-axis: 0.2 mol dm^{-3} to 2 cm and labelled at least each 2 cm and scale on *y*-axis: 2% to 2 cm and labelled at least each 2 cm ; 3 correct plotting of all five points using small crosses or dots in circles ; 4 points joined with a thin ruled line of best fit ;	**4**
1(b)(iv)	correct estimate from the graph ;	**1**

Question	Answer	Marks
2(a)	1 uses most of the available space ; 2 correct section of the root drawn and no cells drawn ; 3 draws the correct number of tissues ; 4 draws the correct proportion of the vascular tissue to the whole of the root section ; 5 label line and label to xylem tissue ;	**5**
2(b)(i)	1 correct concentrations (0.1, 0.01, 0.001, 0.0001) and % at least once ; 2 shows transfer of 1 (cm^3) to each beaker from the previous beaker ; 3 shows 9 (cm^3) of water added to each beaker ;	**3**
2(b)(ii)	1 heading for independent heading and dependent variable: percentage concentration of starch (before heading for dependent variable) and no units in body of table and symbol ; 2 symbols for all concentrations ; 3 the number of symbols for the highest concentration more than the number of symbols for the lowest concentration ;	**3**
2(b)(iii)	colour ;	**1**
2(b)(iv)	records a higher number of symbols for **R1** than for **R2** ;	**1**
2(b)(v)	correct estimate for **R1** and **R2** based on candidate's results ;	**1**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(b)(vi)</td><td>any two suggestions:
1 repeat and find the mean ;
2 colorimeter ;
3 more concentrations with narrower intervals ;</td><td>2</td></tr>
<tr><td>2(b)(vii)</td><td>R2 and less starch present in R2 than in R1 ;</td><td>1</td></tr>
<tr><td>2(c)</td><td>three correct differences ;;;

e.g.
<table>
<tr><th>feature</th><th>Fig. 2.4</th><th>Fig. 2.5</th></tr>
<tr><td>root hairs</td><td>absent</td><td>present</td></tr>
<tr><td>size of vascular bundle</td><td>small(er)</td><td>large(r)</td></tr>
<tr><td>endodermis</td><td>thin(ner)</td><td>thick(er)</td></tr>
<tr><td>cortex</td><td>large(r)</td><td>small(er)</td></tr>
</table></td><td>3</td></tr>
</table>

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Question	Answer	Marks
1(a)(i)	1 four correct concentrations (80, 60, 40, 20) ; 2 correct volumes of **P** and **W** for each concentration ; **ecf**	**2**
1(a)(ii)	1 heading for independent variable: percentage concentration of protease (before heading for dependent variable) and no units in body of table ; 2 heading for dependent variable: time / seconds and no units in body of table ; 3 records two times for each concentration ; 4 time for clotting recorded for the highest concentration of protease is shorter than for the lowest concentration of protease; 5 records time in whole seconds ;	**5**
1(a)(iii)	difficult to judge when clots first appear ;	**1**
1(a)(iv)	to improve the accuracy of the results ;	**1**
1(a)(v)	1 (cm^3) ;	**1**
1(a)(vi)	records a time for **U** longer than the time recorded for 100% and seconds ;	**1**
1(a)(vii)	correct estimate for **U** based on candidate's results ;	**1**
1(a)(viii)	1 use more concentrations with narrower intervals ; 2 states concentrations both sides of the estimate ;	**2**
1(b)(i)	1 label on *x*-axis: pH and label on *y*-axis: protease activity / $\mu mol\ min^{-1}\ mg^{-1}$; 2 scale on *x*-axis: 2 pH units to 2 cm and labelled at least each 2cm and scale on *y*-axis: 5 $\mu mol\ min^{-1}\ mg^{-1}$ to 2 cm and labelled at least each 2 cm ; 3 correct plotting of all six points using small crosses or dots in circles ; 4 six plots joined with a thin line passing through all points ;	**4**

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Question	Answer	Marks
1(b)(ii)	*any **three** from:* 1 optimum pH around 6.1 ; 2 (away from optimum) shape of the active site is changed ; 3 (from pH1.8 to pH6.1) more enzyme substrate complexes/(from pH6.1 to pH8.5) less enzyme substrate complexes / (at optimum pH) maximum number of enzyme substrate complexes ; 4 low activity at extreme pH ;	**3**

Question	Answer	Marks
2(a)(i)	1 uses most of the available space and no shading ; 2 correct section of the leaf drawn and no cells drawn ; 3 draws the correct number of tissues and trichomes ; 4 draws one vascular bundle in each fold ; 5 label line and label to vascular bundle ;	**5**
2(a)(ii)	1 suitable size and all lines sharp and continuous ; 2 draws only three whole cells and one trichome and each cell touches at least one other cell ; 3 two lines around each cell and three lines where cells touch ; 4 draws correct shape of trichome ; 5 label line and label to the cell wall of the trichome;	**5**
2(a)(iii)	*any **one** from:* 1 rolled leaf ; 2 thick epidermis ; 3 cuticle ; 4 sunken stomata ; 5 hinge cells ;	**1**
2(b)(i)	1 correct measurement of the width of the paired guard cells (**P**–**Q**) and units ; 2 correct measurement of the width of the stoma (**R**–**S**) and units ; 3 shows the width of the stoma divided by the width of the paired guard cells and multiplied by 100 ; 4 answer to two significant figures ;	**4**

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<tr><td>size of epidermal cells</td><td>large(r)</td><td>small(er)</td></tr>
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Question	Answer	Marks
1(a)(i)	1 one line drawn on test-tube **S** at the same height as the line at the top of test-tube **R** ; 2 another line drawn on test-tube **S** with the label 'sediment' ;	**2**
1(a)(ii)	1 states three additional concentrations of ethanol ; 2 correct volumes of ethanol and water for each concentration stated ;	**2**
1(a)(iii)	1 heading for independent variable: percentage concentration of ethanol ; 2 heading for dependent variables: height of sediment / mm ; 3 records a height for each concentration stated in (a)(ii) and height in test-tube **C**, for every 4 minutes ; 4 records height of sediment at 20 minutes ; 5 all heights recorded as whole millimetres ;	**5**
1(a)(iv)	states a conclusion with reference to the concentration of ethanol and height of sedimentation ;	**1**
1(a)(v)	states whether supports or rejects the hypothesis and explains how results provide evidence ;	**1**
1(a)(vi)	1 from candidate's results states the concentration of ethanol that caused the most sedimentation at 20 minutes ; *modifications* 2 use concentrations of ethanol either side of concentration stated ; 3 use narrower intervals close to the concentration that caused the most sedimentation ;	**3**
1(a)(vii)	identifies a source of error, e.g. the test-tubes were not left for the same length of time ;	**1**
1(a)(viii)	systematic and no effect on the trend ;	**1**
1(b)(i)	1 label on *x-axis*: source of carbohydrate and each bar labelled with a substrate and label on *y-axis*: percentage ethanol produced per 100 g of carbohydrate ; 2 scale on *x*-axis: bars of the same width and evenly spaced and scale on *y*-axis: 1 to 2 cm and labelled at least every 2 cm ; 3 correct plotting of all five bars ; 4 five bars plotted with straight horizontal lines and vertical lines join exactly ;	**4**

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Question	Answer	Marks
1(b)(ii)	*any **two** from* **:** 1 the optimum pH for *S. pombe* not the same as for *S. cerevisiae* **;** 2 the optimum temperature for *S. pombe* not the same as for *S. cerevisiae* **;** 3 *S. pombe* was unable to ferment all the sources of carbohydrate **;**	**2**

Question	Answer	Marks
2(a)(i)	1 uses most of the available space and no shading **;** 2 draws the correct shape of the whole section and no cells included **;** 3 draws a correct number of tissue layers **;** 4 draws the epidermis as two lines **;** 5 label line and label to the cortex **;**	**5**
2(a)(ii)	1 uses most of the available space and lines continuous, thin and sharp **;** 2 draws only four cortex cells and each cell touches at least two other cells **;** 3 two lines around each cell and three lines where cells touch **;** 4 detailed shapes of the cortex cells **;** 5 label line and label to the cell wall **;**	**5**
2(b)	records only observable differences **;** three correct differences between **L1** and **Fig. 2.1** **;;;** *e.g.*	**4**

feature	L1	Fig. 2.1
shape of section	oval	wavy
number of tissue layers	more	fewer
position of vascular bundles	arranged in a circle	scattered
size of vascular bundles	all the same size	some large and some small

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Question	Answer	Marks
2(c)	1 takes at least two measurements and uses appropriate units ; 2 shows addition of least two measurements and division by the number of measurements ; 3 shows the mean measurement divided by the magnification (× 40) ; 4 correct answer and uses appropriate units ;	**4**

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OR	separates two different routes to a mark point and only one should be awarded
ECF	error carried forward (credit an operation from a previous incorrect response)

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Question	Answer	Marks
1(a)(i)	1 states at least three additional concentrations of salicylic acid **;** 2 states the correct volumes of salicylic acid for each concentration **;** 3 all volumes of salicylic acid (**A**) and water (**W**) add up to 10 cm^3 ;	**3**
1(a)(ii)	1 heading for independent variable: percentage concentration of salicylic acid **;** 2 heading for dependent variables: intensity (of colour) **;** 3 a result for each concentration stated in **(a)(i) ;** 4 correct trend: at the highest concentration of salicylic acid the colour is more intense than at the lowest concentration **;**	**4**
1(a)(iii)	states the intensity of **S1** and **S2** using symbols **;**	**1**
1(a)(iv)	correctly estimates the concentration of **S1** and **S2** from the candidate's results **;**	**1**
1(a)(v)	reference to **S1** or **S2** and correctly matches the concentration of salicylic acid in blood or urine with statements concerning metabolism or excretion of salicylic acid **;**	**1**
1(a)(vi)	concentration of salicylic acid **;**	**1**
1(a)(vii)	judgement of colour is, subjective / AW **;** use a colorimeter **;**	**2**
1(b)(i)	1 label on *x-axis*: time / minutes and label on *y-axis*: concentration of salicylic acid in urine / μg mL^{-1} **;** 2 scale on *x*-axis: 30 to 2 cm and labelled at least every 2 cm and scale on *y*-axis: 10 to 2 cm and labelled at least every 2 cm **;** 3 correct plotting of all five points using small crosses or dots in circles **;** 4 five plots joined with thin line passing through all points and line is either a smooth curve or joined point-to-point **;**	**4**
1(b)(ii)	shows an intercept on *x*-axis at 105 minutes **;** correct answer according to candidate's graph **;**	**2**
1(b)(iii)	concentration of salicylic acid decreases and reference to 65.5 μg mL^{-1} and 31.5 μg mL^{-1} **;**	**1**

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Question	Answer	Marks
1(b)(iv)	*any **two** from*: 1 aspirin acts an inhibitor **;** 2 aspirin changes the shape of the active site of the enzyme **;** 3 (so) fewer enzyme substrate complexes form **;**	**2**

Question	Answer	Marks
2(a)(i)	1 uses most of the available space and no shading **;** 2 draws only the region indicated and no cells included **;** 3 draws at least four whole vascular bundles**;** 4 draws each epidermis as two lines **;** 5 label line and label to vascular bundle **;**	**5**
2(a)(ii)	1 uses most of the available space and lines are continuous, thin and sharp **;** 2 draws only four cells and each cell touches at least one other cell **;** 3 two lines drawn around each cell and three lines where cells touch **;** 4 for all the cells drawn, each cell is not taller than they are wide **;** 5 label line and label to a cell wall **;**	**5**
2(b)	records only observable differences **;** three correct differences between **M1** and **Fig. 2.2 ;;;** *e.g.*	**4**

feature	M1	Fig. 2.2
number of vascular bundles	many	less
trichomes	none	present
shape of section	spirals	rectangular

2(c)(i)	measures the width of the stem section and uses appropriate units **;** measures width of central region and uses appropriate units **;**	**2**

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Question	Answer	Marks
2(c)(ii)	states the correct ratio of the width of the stem section to the width of the central region **;**	**1**
2(c)(iii)	takes at least two measurements to determine the mean width of the central region of the stem **;**	**1**

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CAMBRIDGE
International Education

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BIOLOGY **9700/35**

Paper 3 Advanced Practical Skills 1 **May/June 2024**

MARK SCHEME

Maximum Mark: 40

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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ECF	error carried forward (credit an operation from a previous incorrect response)

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1(a)(i)	1 states at least three additional concentrations of ethanol ; 2 states the correct volumes of ethanol and water to make 20 cm^3 for each concentration ;	**2**
1(a)(ii)	1 heading for independent variable: percentage concentration of ethanol ; 2 heading for dependent variables: colour intensity / symbol ; 3 states results for all the concentrations made ; 4 correct trend for results: the highest concentration has a more intense colour than lowest concentration ; 5 records results using scale provided ;	**5**
1(a)(iii)	describes the trend to match candidate's results ;	**1**
1(a)(iv)	1 (ethanol) denatures the proteins in the cell surface membrane ; 2 (ethanol) dissolves the phospholipids (and cholesterol) ; 3 causing, increase in permeability / increase in fluidity ;	**3**
1(a)(v)	intensity of colour ;	**1**
1(a)(vi)	states one variable that was standardised and a description of how it was standardised ; e.g. amount of beetroot and cutting 10 discs of beetroot time the beetroot was left in the ethanol for and a stated time (e.g. 10 minutes) ;	**1**
1(a)(vii)	states a suitable source of error ; e.g. difficulty of judging the final colour of the solution	**1**
1(a)(viii)	uses one stated concentration of ethanol ; states using at least five different temperatures ;	**2**
1(b)(i)	*1* label on *x-axis*: time after drinking / minutes and label on *y-axis*: difference in mean blood pressure compared to control group / kPa ; *2* scale on *x*-axis: 50 to 2 cm and scale on *y*-axis: 0.2 to 2 cm and labelled at least every 2 cm ; 3 correct plotting of all six points using small crosses or dots in circles ; 4 points joined with a smooth, thin line and joined point-to-point through all the points ;	**4**

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Question	Answer	Marks
1(b)(ii)	1 shows interpolation on graph at 100 minutes ; 2 shows 15.79 (mean blood pressure for control group) minus the value from interpolation ;	**2**

Question	Answer	Marks
2(a)(i)	1 uses most of the available space and no shading ; 2 draws the draws at least four vascular bundles and no cells included ; 3 draws the correct number of tissue layers ; 4 draws at least one large air space ; 5 label line and label to one vascular bundle;	**5**
2(a)(ii)	1 uses most of the available space and lines continuous, thin and sharp ; 2 draws only four cells and each cell touches at least one other cell ; 3 two lines around each cell and three lines where cells touch ; 4 both guard cells smaller than adjacent cells ; 5 label line and label to cell wall of one guard cell ;	**5**
2(b)(i)	records only observable differences ; three correct differences between **N1** and **Fig. 2.1** ;;; *e.g.*	**4**

feature	N1	Fig. 2.1
shape of section	spiral	angular
number of vascular bundles	more	fewer
position of vascular bundles	peripheral / close to edges	central
palisade mesophyll layer	thin	thick / bilayer

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Question	Answer	Marks
2(b)(ii)	1 correct measurements of the scale bar and the line **A**–**B** **;** 2 shows the length of **A**–**B** divided by the length of the scale bar and multiplied by 100 3 correct answer and uses appropriate units **;**	**3**
2(b)(iii)	correct answer and recorded to two significant figures **;**	**1**

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