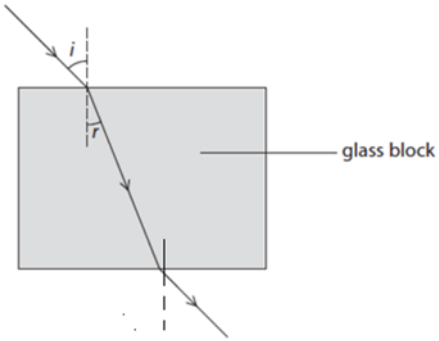
MJSO 2024 - Marking Scheme

Item		Description	Remarks	Mark
Section A: Physics				
Experiment A				
a		ON, IN		2
b		First try 6.2cm 3.9 cm Second try 6.3cm 4.0cm		2
c		Refractive index = $\frac{6.25}{3.95}$ = 1.58		2
d		n= $\frac{speed\ of\ light\ in\ a\ vacuum}{speed\ of\ light\ in\ perspex}$ 1.3 = $\frac{3\ 00000000}{speed\ of\ light\ in\ perspex}$ Speed of light in Perspex= $\frac{300000000}{1.3}$ = 2.3 x 10^8 m/s		2
Experiment B				
a			1 mark for the normal at air/glass boundary and at glass/air boundary 1 mark for marking angle of incidence and angle of refraction 2 marks to complete the light pathway	4

Item		Description	Remarks	Mark
b		Completion of table		6
c		Graph of sin (i) on the y axis and sin (r) on the x axis	1 mark for title 1 mark for labelling of axes 1 mark for correct scale 2 marks for plotting 1 mark for line of best fit	6
d		Gradient = $\frac{Change\ in\ y}{change\ in\ x}$ $= \frac{0.90630-0.25882}{0.57357-0.156434}$ $= \frac{0.64748}{0.417136}$ = 1.55		3
e		26.7°	+/- 0.5 degree	2
f		Graphs allow for a more accurate determination of the refractive index by providing a visual representation of the relationship between the angles of incidence and refraction. This visual representation allows for precise measurements and easier identification of patterns or trends in the data.		2
g		Making the beam of light as thin as possible. Being as accurate as possible when marking the beam of light and measuring the angles.		2
			Total	**33**
Section B: Biology				
a	i	Sugar Colour Standard - To the test tube add equal amounts of Benedict's solution and 1% glucose solution. Put test tube in a water bath. A red precipitate is formed. Protein colour standard – Add Biuret solution to albumen. A purple solution is produced.	1 ½ ½ 1 1	4

Item		Description	Remarks	Mark
a	ii	Repeat the above procedure with each milk and Benedict's solution. Put in water bath and compare colours obtained to sheet of concentration of sugars. Repeat the above procedure with each milk and Biuret's test. Compare colours obtained to sheet of concentration of proteins.	1 1 1 1	4
b		Use consistent formatting for headings. Titles and units Present data in a way that allows for easy comparison.	1 1 1	3
c		Correct axes with units Plotting of each bar chart correctly Separate bars	1 2 1 1 mark for each bar chart.	4
d	i	Concentration of glucose/protein in milk	½, ½.	1
	ii	Using same quantities of milk for each test (benedict's/ biurets) to be able to compare results. Use same quantities of Benedict's or biuret's for each test (benedict's/ biurets) to be able to compare results. For Benedict's - Heating the mixture slowly over a water bath rather than directly over a flame helps avoid rapid boiling and splattering./ allows for a more uniform reaction. For any of the experiments: Mixing solutions well to create a homogenous mixture. Using a blank paper background for comparing colours to allow true shade of colour to emerge.	1 1 Any one and its justification.	2
	iii	Inaccurate Measurements: Errors in measuring the reagents or sample volumes can affect the reaction's outcome, potentially yielding incorrect conclusions about protein presence. Improper Mixing may provide inaccurate results.	1 1	2
e	i	With the lowest sugar concentration.	1,1	2
	ii	That with the highest carbohydrate and protein concentration.	1,1	2
	iii	With the lowest sugar concentrations.	1,1	2

Item		Description	Remarks	Mark
f	i	Protein Accept Calcium		1
	ii	Protein- repair and formation of cells, build-up of muscles etc. Calcium- bone development etc.	Accept relevant answer to f i).	2
g		Increase Fruit and Vegetable Intake: Aim to fill half your plate with fruits and vegetables at each meal. This can be achieved by incorporating salads, fresh fruits as snacks, or adding vegetables to dishes like pasta or stir-fries. Choose Healthy Fats: Replace butter and margarine with olive oil for cooking and dressings. Additionally, incorporate sources of healthy fats such as nuts and seeds into snacks or meals.	Accept other relevant responses.	2 2
			Total	**33**
Section C: Chemistry				
a		• Since distilled water does not contain any calcium or magnesium ions, it forms a lather with soap with the first few drops of soap solution added whereas the other two samples will not form a lather immediately. • Both tap water and sea water will take much more soap to eventually form a lather. But we do not know whether they have temporary, permanent or a mix of both. This will be determined by boiling these samples of water. • If after boiling, the sample lathers almost immediately then that means that it contained mostly temporary hardness and so in this case it would indicate that we have identified the tap water. • If after boiling the solution, it still does not form a lather almost immediately, then that would mean that the sea water would be identified as having a mixture of both temporary and permanent hardness. • Also, sea water should be identified with respect to tap water as it takes a larger amount of soap to form a lather since sea water contains much more dissolved calcium and/or magnesium ions than tap water.		5

<table>
<tr><th colspan="2">Item</th><th>Description</th><th>Remarks</th><th>Mark</th></tr>
<tr><td>b</td><td></td><td>1. Fill a beaker with sample A up to a predetermined volume. Repeat this with samples B and C.
2. Add a few drops of soap solution to each of the beakers and stir for some time. Observe what happens.
3. If a lather forms immediately stop adding soap. Record your result.
4. If a lather does not form add 1 cm3 of soap solution and stir the contents of the beaker. Repeat until the sample forms a lather. Record your results.
5. To determine whether the samples contain temporary and/or permanent hardness, fresh samples of the remaining water samples need to be boiled for a few minutes. Then allow the samples to cool.
6. Repeat step 4 for tap and sea water. Record your results.</td><td>1 mark for each step.</td><td>6</td></tr>
<tr><td>c</td><td></td><td>1. Care was taken not to mix equipment between experiments to avoid contamination.
2. Equal quantities of the water samples were used for fair comparison.</td><td>1 mark for each point.
Accept other valid answers.</td><td>2</td></tr>
<tr><td>d</td><td></td><td><table><tr><td></td><td>A</td><td>B</td><td>C</td></tr><tr><td>Volume of soap solution until lather forms with unboiled water</td><td></td><td></td><td></td></tr><tr><td>Volume of soap solution until lather forms with boiled water</td><td></td><td></td><td></td></tr></table></td><td>1 mark for each set of values for samples A, B, and C.</td><td>3</td></tr>
<tr><td>e</td><td></td><td>A is tap water,
B is distilled water,
C is sea water.</td><td>1
1
1</td><td>3</td></tr>
</table>

Item		Description	Remarks	Mark
f		• Distilled water: **soft water.** • Tap water: **temporary** and **permanent hardness.** • Sea water: **temporary** and **permanent hardness.**	1 1 1	3
g		• Distilled water Since distilled water does not have any ions dissolved in it, then it forms a lather with very little amount of soap. • Tap water This source of water contains a mixture of temporary and permanent hardness. This conclusion was reached since it did not form a lather immediately after adding soap, then after boiling the sample of water still did not form a lather immediately. • Sea water Like tap water sea water also contains both temporary and permanent hardness, however the amount of soap required to produce a lather with sea water is much more than that with tap water.	1 1 1	3
h		$Ca(HCO_3)_2(aq) \rightarrow CaCO_3(s) + H_2O(l) + CO_2(g)$ **or** $Mg(HCO_3)_2(aq) \rightarrow MgCO_3(s) + H_2O(l) + CO_2(g)$	1 mark for formulae. 1 mark for balancing. 1 mark for state symbols.	3
i		Having sulfates and/or chlorides of calcium and/or magnesium present in water which cannot be removed by boiling constitutes permanent water hardness. This kind of water hardness can be removed by adding washing soda (Na_2CO_3).	1 1	2
j		$Ca^{2+}(aq) + CO_3^{2-}(aq) \rightarrow CaCO_3(s)$ **or** $Mg^{2+}(aq) + CO_3^{2-}(aq) \rightarrow MgCO_3(s)$	1 mark for formulae. 1 mark for balancing. 1 mark for state symbols.	3
k		Calcium and/or magnesium ions in aqueous solution.		1
			Total	**34**