EOES
2023

Task 1
ANSWER SHEETS

Song and Dance through eyes of science

EOES2023, 01.05.2023

Team ____________________

Students________________________________

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Problem 1

1.1. *Match the letter corresponding to the correct term, so the sentence below would be correct. (2 p)*

While [1] is not a striated muscle, metabolically it is very close to [2] muscle fibers, that can be also deduced from its high myoglobin content

Box No	Letter (a, b, c)	*Marks*
[1]		
[2]		
Total marks		

1.2.1. Write which scheme corresponds to the white muscle fibres (W) and which to the red ones (R). (2p)

Scheme	Letter R or W	*Marks*
Scheme 1		
Scheme 2		
Total marks		

1.2.2. Calculate how many ATP molecules can be produced from 1 glucose molecule in each type of muscle fibre and how many oxygen molecules would be used (4 p)

Scheme	Number	*Marks*
Amount of ATP molecules produced from one glucose molecule in scheme 1		
Amount of ATP molecules produced from one glucose molecule in scheme 2		
Amount of O_2 molecules used to produced ATP from one glucose molecule in scheme 1		
Amount of O_2 molecules used to produced ATP from one glucose molecule in scheme 2		
Total marks		

1.3.1.Pick the right cause for bubble formation (1 p)

Letter (a, b, c, d)	*Marks*

1.3.2. Arrange your samples according to their catalase activity, starting from the most active one.(3 p)

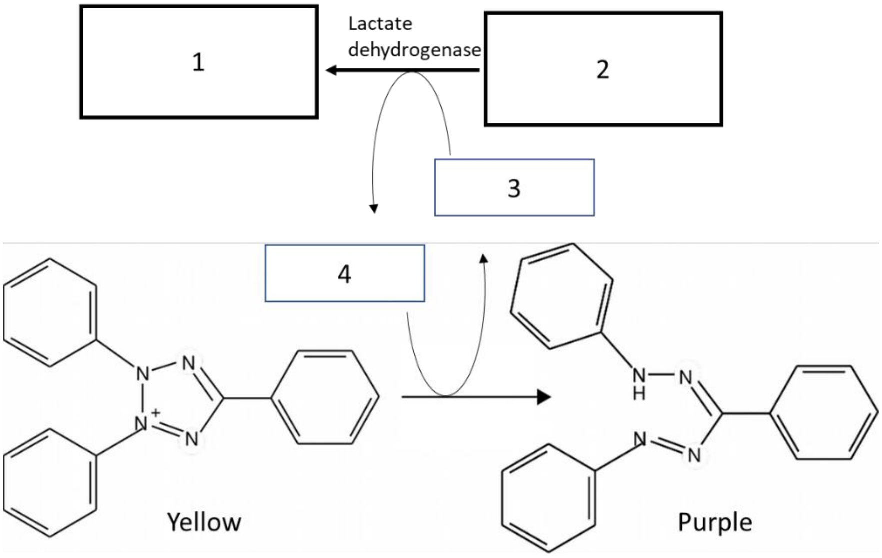
	Letter of the sample (A, B or C)	*Marks*
The most active catalase		
Catalase with average activity		
The least active catalase		
Total marks		

1.3.3. Which of the statements explains the observed catalase activity differences? (1 p)

Letter (a, b, c, d, e)	*Marks*

1.4.1. Complete the reaction scheme by writing the correct reactants in the correct boxes (2 p)

Choices: A - lactate; B - pyruvate; C- NAD^+; D - $NADH+H^+$; E - ATP; F - ADP



Number	*Letter*	*Marks*
1		
2		
3		
4		
Total marks		

1.4.2. Sample correctly prepared (3 p)

Letter of the sample	*Mark*	*Signature of lab assistant*
A		
B		
C		
Total marks		

1.4.3. Fill in the table with your recorded results, use provided numbers to code the colours (6 p)

Yellow	*Orange*	*Red*	*Brown*	*Purple*
1	*2*	*3*	*4*	*5*

	A	*B*	*C*	*A1*	*B1*	*C1*
0.5 minutes						
1 minute						
1.5 minutes						
2 minutes						
2.5 minutes						

Marks for this task

Total marks	

Confirmation of the results. Signature of lab assistant ____________________

1.4.4. Arrange samples A1-C1 according to their lactate dehydrogenase activity, starting from the most active one.(3 p)

	Letter of the sample (A1, B1 or C1)	*Marks*
The most active lactate dehydrogenase		
Lactate dehydrogenase with average activity		
The least active lactate dehydrogenase		
Total		

1.4.5. Compare the protein concentration in samples A and A1 based on your enzyme activity by using >, =, < symbols (1 p)

	Compare *>, =, <*		*Marks*
Protein concentration of A1 is		*than in A*	

Problem 2

2.1.1. Indicate the best wavelength to use for measuring haemoglobin concentrations (1 p)

Letter (A, B, C, D)	*Marks*

2.1.2. Write concentrations of haemoglobin solutions you have prepared, considering that the STANDARD haemoglobin solution's concentration is 1,0 g/L (3p)

Show calculation of concentration for tube 1

Calculation	*Marks*

Tube No	*Concentration, g/L*	*Marks*
Standard solution		
1		
2		
3		
4		
5		
6		

2.1.3. Write measurements that you obtained (4.5 p)

Tube No	*Absorbance*	*Marks*
Standard solution		
1		
2		
3		
4		
5		
6		
Total		

2.1.4. See millimetre paper (6 p)

Total marks	

2.1.5. Preparation of diluted samples. Write how much water you should add and what will the dilution coefficient be in this cuvette (2 p)

Tube No	*Answer*	*Marks*
Water, microliters		
Dilution coefficient, k		
Total marks		

2.1.6. Write measurements that you obtained (3 p)

Sample	*Absorbance*	*Marks*
A		
B		
C		
A1		
B1		
C1		
Total marks		

2.1.7. Fill out the table if additional measurements are needed and state why (3 p)

Sample	*Additional measurement needed (Y/N)*	*Reason for additional measurement - 1 - out of calibration curve 2 - out of apparatus measuring abilities*	*Marks*
A			
B			
C			
A1			
B1			
C1			
Total			

2.1.8. Fill out the table for samples that needed additional dilutions (2 p)

Sample	*Amount of sample, microliters*	*Amount of water, microliters*	*k*	*A, AU*	*Marks*

2.1.9. Calculate initial concentration of myoglobin in each sample. (7 p)
Show calculation of concentration for sample A

Calculation	*Marks*

Sample	*Myoglobin, g/L*	*Marks*
A		
B		
C		
A1		
B1		
C1		
Total		

2.1.10. *Indicate which muscle (A1, B1, C1) will have the largest oxygen reserves. (1 p)*

Letter	*Marks*

Problem 3

3.1. *Write the results of your measurements (8 p)*

Specimen	*Initial weight, g*	*Weight after burning*	*Water temperature before burning, ^oC*	*Highest temperature reached during measurement ^oC*

Total marks	

3.2. *Calculate the energetic value of all food items from your data in kcal/100g, write your answers in the answer sheet. Show your calculation for potato crisp. (6 p)*

Calculation	*Marks*

	Potato crisp	*Rice galette*	*Corn puff*	*Marks*
kcal/100g				

3.3. *Mark to which forms of energy chemical energy contained in glucose is converted in each case. (2 p)*

Condition	Letter (A, B, C)	*Marks*
Metabolic activity		
Burning		

3.4. *Mark if aerobic (A) or anaerobic (N) metabolism is closer to burning (1 p)*

Letter	*Marks*

3.5. *Evaluate sentences in the task sheet and propose which is the correct one (1 p)*

Letter (a, b, c, d)	*Marks*

3.6. *Estimate, which nutrient has the highest caloric value per mass: (1 p)*
A: Fats, B: Carbohydrates, C: Proteins, D: Salt

Letter (A, B, C, D)	*Marks*

3.7. *Write letters corresponding to the processes why your measurements would give you less calories than on packaging (2 p)*

Letter (a, b, c, d, e, f)	*Marks*

Problem 4

4.1. *Deduce if vocal cords are open (A) or closed (B), when breathing (1p)*

Letter (A or B)	*Marks*

4.2. *Deduce which muscles will open and close the vocal cords if contracted. Which muscle will change the length of the vocal cords? (3 p)*

State after muscle contraction	*Letter of the muscle (A, B, C)*	*Marks*
Opens vocal cords		
Closes vocal cords		
Shortens vocal cords		
Total		

4.3. *Describe your observations in the answer sheet. (4 p)*

Sound	*Vibration of larynx (+ present, - absent)*	*Vocal cords open (A) or closed (B)*	*Marks*
[f]			
[v]			
Total			

Problem 5

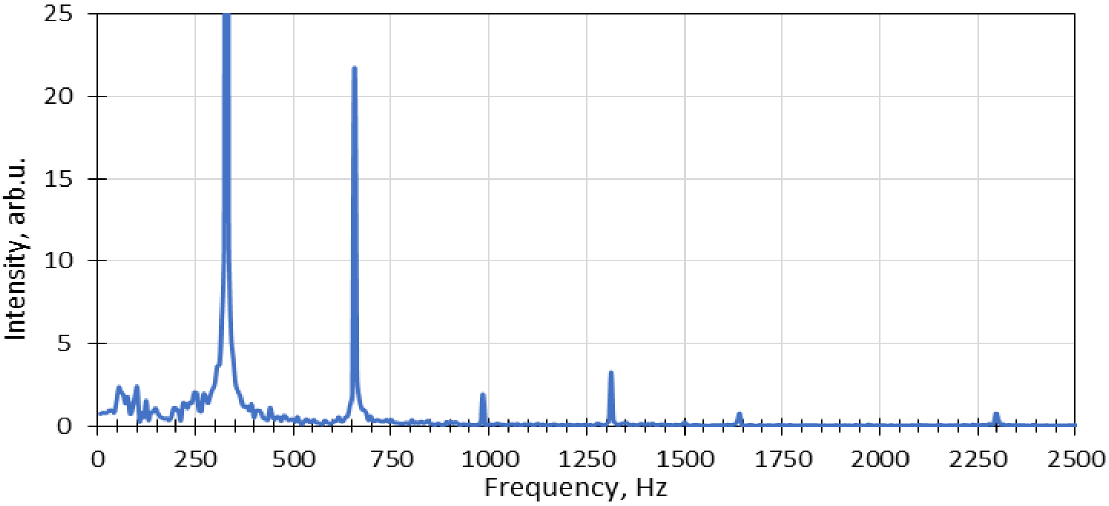
5.1.1. *Write the fundamental frequency (the first harmonic) of this particular string on a guitar. (1 p)*

Frequency, Hz	*Marks*

5.1.2. *Write how many harmonics including the fundamental one can you see in the spectra and what their frequencies are? (3.5 p)*

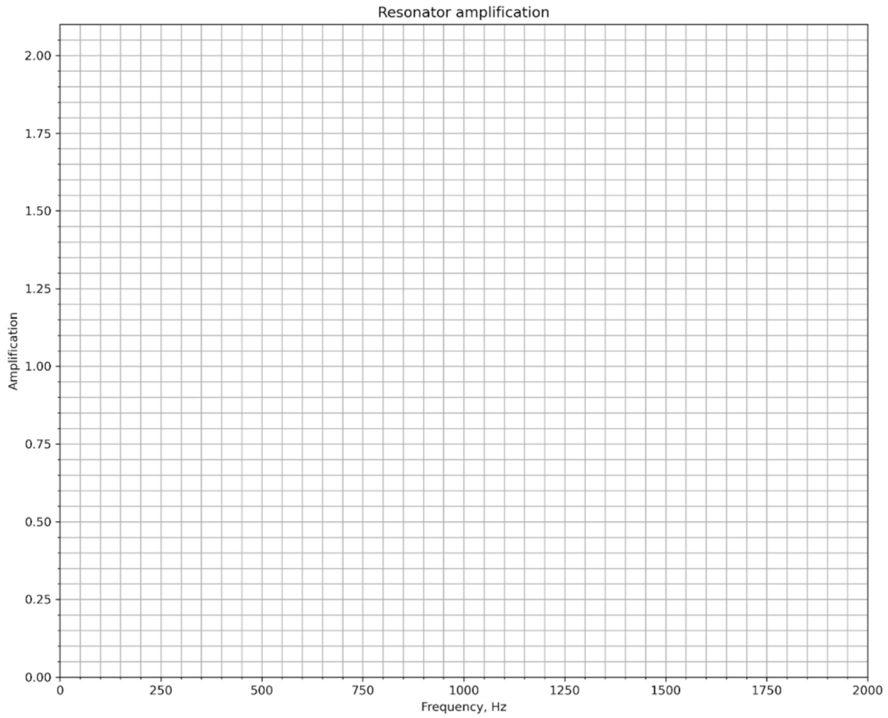
	Answer	*Marks*
Number of harmonics		
Frequencies of harmonics		
Total		

5.1.3. *Write in the answer sheet are all the possible harmonics within the frequency range 0-2500 Hz present. If not - sketch in the graph where the missing harmonics would be. (1.5 p)*

<table>
<tr><td></td><td>Answer</td><td>Marks</td></tr>
<tr><td>Are all the harmonics present (Y- yes, N - no)</td><td></td><td></td></tr>
<tr><td colspan="2">


</td><td></td></tr>
<tr><td colspan="2">Total</td><td></td></tr>
</table>

5.1.4. *Determine and plot the resonator amplification as a function of frequency for the these source and resulting sound spectra. (4 p)*

	Answer	*Marks*
		

5.1.5. *What are the frequencies of the first two formants for this resonator? (1 p)*

	Answer	*Marks*
f_1		
f_2		
Total		

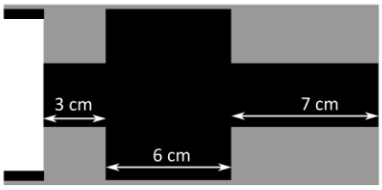
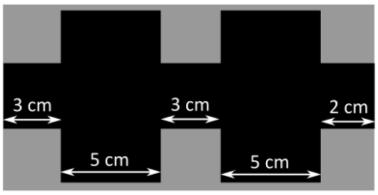
5.2.1. *If you increase the length of the reed that is poking out of the stopper, the frequency of the duck call increases, decreases or stays the same? (1 p)*

	Answer	*Marks*
Check the correct box	☐ Increases ☐ Decreases ☐ Stays the same	

5.2.2 *Adjust the reed position so that the duck call produces a sound with the fundamental frequency of 150 Hz. Measure the spectrum of the duck call sound, making sure that the frequency peaks are well-defined and not "fuzzy". Rename the spectrum as "duck_call_YOURCOUNTRY.bmp". (4 p)*

Total marks	

5.3.1 *Look at the models for the three vowels below and match each of the models to the corresponding vowel based on what you can identify in the MRI scans. (3 p)*

<table>
<tr><td></td><td>Answer ([ɑ], [i], [u])</td><td>Marks</td></tr>
<tr><td>
</td><td></td><td></td></tr>
<tr><td>
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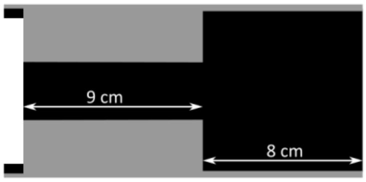
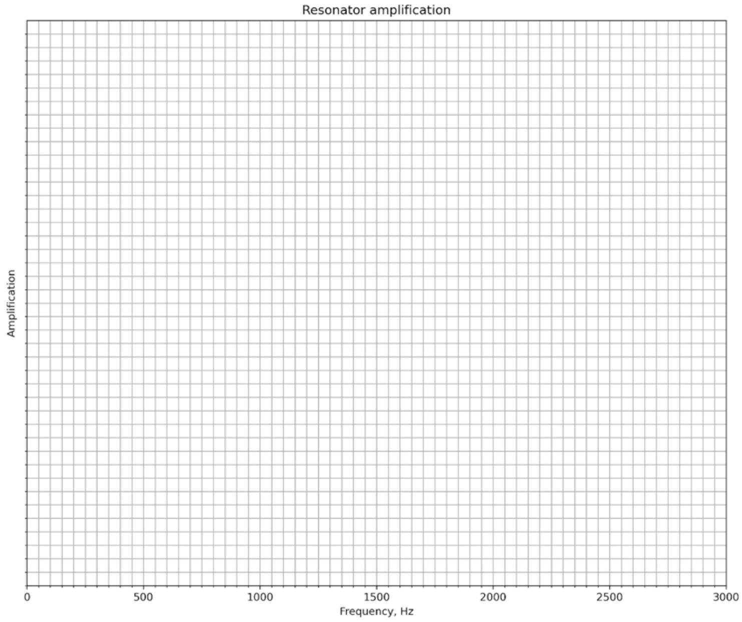
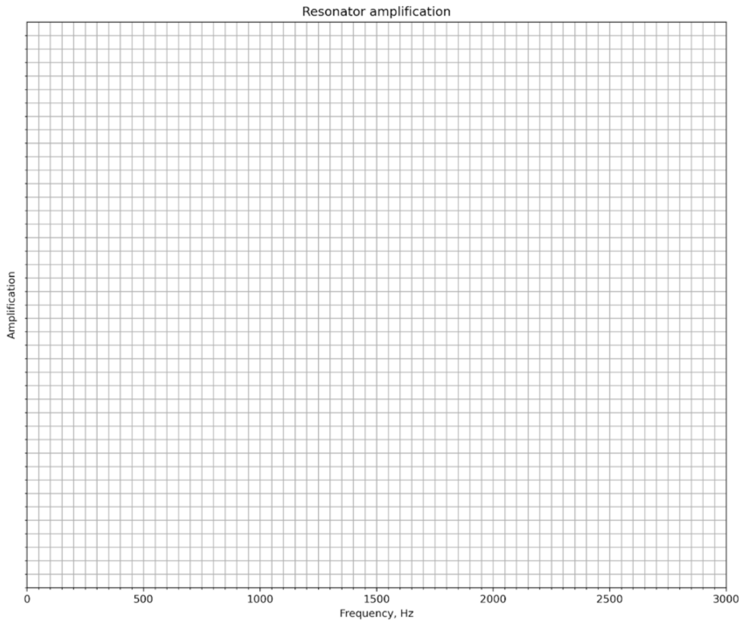
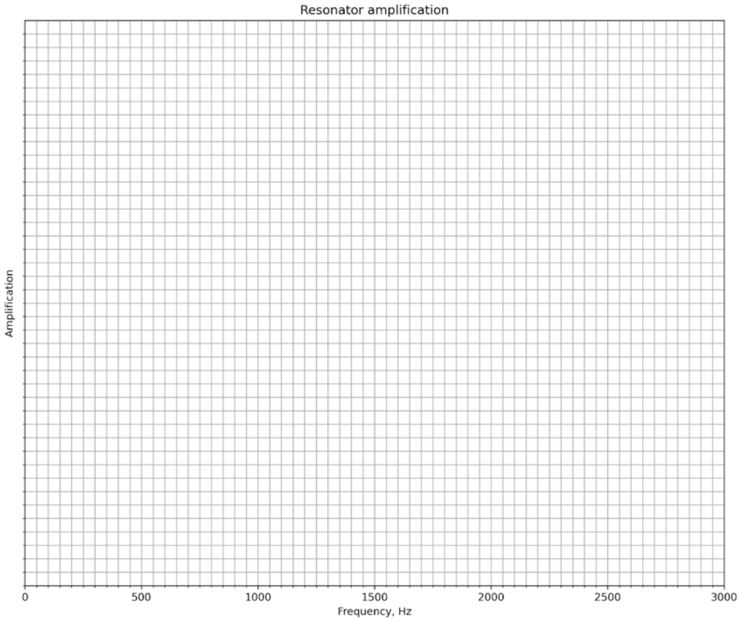
<tr><td>
</td><td></td><td></td></tr>
<tr><td colspan="2">Total</td><td></td></tr>
</table>

5.4.1. *Measure the spectra of the sound produced by the duck call and filtered through the ɑ, i, u vowel resonators. Make sure that the frequency peaks are well-defined and not “fuzzy”. Rename the spectra as “resonator_a_YOURCOUNTRY.bmp”, “resonator_i_YOURCOUNTRY.bmp”, “resonator_u_YOURCOUNTRY.bmp” for each of the corresponding ɑ, i, u vowel resonators. (6 p)*

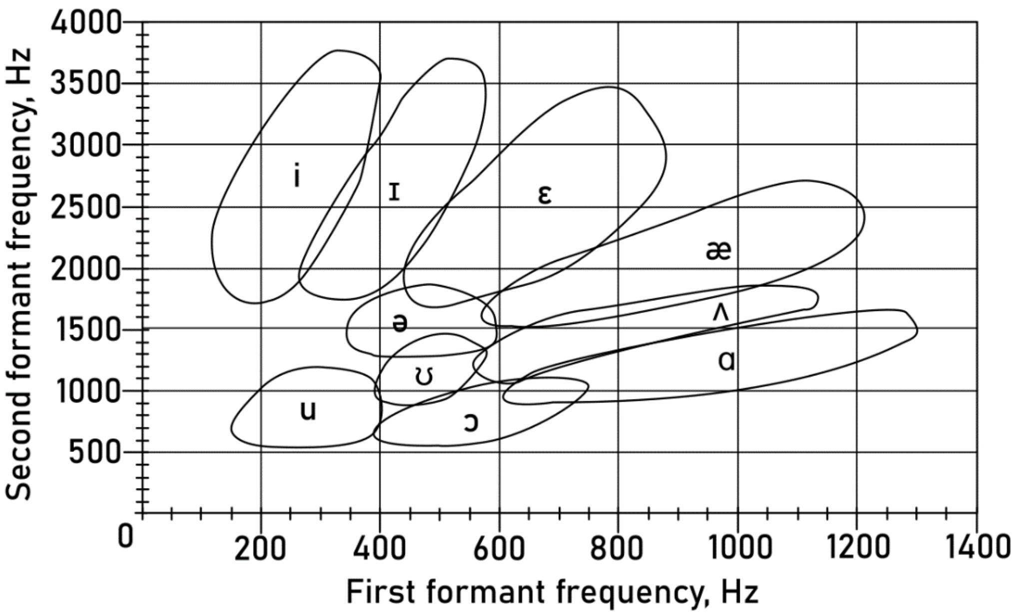
Wovel	*Points awarded by evaluator*	*Marks*
[a]		
[i]		
[u]		
Total		

5.4.2. *Compare the spectrum of the pure sound from the duck call with the spectra of the sound filtered through the [ɑ], [i], [u] vowel resonators. Make three sketches of the amplification v.s. frequency of the resonators - one for of each vowel ɑ, i, u. The scale of the amplification axis is arbitrary. For each sketch, below the first and second formant write down their approximate frequencies. (6 p)*

Vowel	*Your sketch*	*Marks*
[a]		
[i]		

[u]	Resonator amplification Amplification 0 500 1000 1500 2000 2500 3000 Frequency, Hz	
Total		

5.4.3. *Using your sketch of the amplification of each resonator, determine the first two formant frequencies for each ɑ, i, u vowel resonator. Mark them down as points in the vowel chart (Figure 5.4.1.). (3 p)*

<table>
<tr>
<td>
</td>
<td>Marks</td>
</tr>
</table>

5.5.1 *What is the vowel that produced this spectrum? (1 p)*

Answer	*Marks*

5.5.2 *What is the vowel that produced this spectrum? (1 p)*

Answer	*Marks*

5.5.3 *What is the vowel that produced this spectrum? (1 p)*

Answer	*Marks*