

Country code and team

TASK 1

ANSWER SHEET

COUNTRY AND TEAM CODE.:

TEAM.:

NAME:

SIGNATURE:

NAME:

SIGNATURE:

NAME:

SIGNATURE:

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For the multiple choice Questions, select the correct option with a circle.

Task 1 - 1.1

60 marks

Spare materials

Assistant and student should sign in in this table, if spare additional material is requested (maximum materials reposition allowed as number of rows):

Calling for assistance	Marks	Assistant	Student
Additional Biological samples	-10		
Additional Biological samples	-10		
Additional material	-5		
Additional material	-5		
Additional material	-5		
Additional material	-5		
Swap of biological samples	-20		

DATASET ID number

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Question 1.1.a

40 marks

Fill the Table 1.1.a using the provided biological samples in the plate, the photos and the Appendix 1. Indicate with a cross (X) the characteristic that best fits your observations and/or experimental results. There may be more than one option correct for each specimen. Be sure to clearly indicate all that apply.

Task 1 – Answer sheet

Table 1.1.a	A	B	C	D	E
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Section 1 - leaf arrangement on the stem

Alternate					
Opposite					
Whorled					

Section 2 - leaf shape

Ovate					
Oblong					
Lanceolate					
Palmately lobed					
Oblanceolate					

Section 3 - leaf margin

Lobed					
Dentate					
Entire					
Serrate					

Section 4 - leaf arrangement

Simple					
Palmately compound					
Pinnately compound					
Bipinnately compound					

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Table 1.1.a	A	B	C	D	E
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Section 5 - leaf venation

Pinnate					
Parallel					
Palmate					

Section 6 - size and structure of the adult specimen

Typically a shrub					
Tree (typically > 12m)					

Task 1 – Answer sheet

Table 1.1.a - this section requires the use	A	B	C	D	E
---	---	---	---	---	---

Section 7 - Leaf Trichomes

Leaf upper surface (section 7.1)

Glabrous (no hairs present) to glabrescent					
Pubescent to very pubescent (hairs are					

If hairs are present in the upper surface

With star-shaped hairs					
With postulate or glandular hairs					

Leaf lower surface (section 7.3)

Glabrous (no hairs present) to glabrescent					
Pubescent to very pubescent (hairs are					

If hairs are present in the lower surface

With star-shaped hairs					
With postulate or glandular trichomes					
Individual hairs detected, but they are					

Table 1.1.a - this section requires the use of the stereomicroscope	A	B	C	D	E
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Section 8 - water droplet test

Adhesion to the upper surface of the leaf (section 8.1)

Water droplet does not adhere or adheres with difficulty					
Water droplet adheres well and forms a sphere or a half sphere					

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Adhesion to the lower surface of the leaf (section 8.2)

Water droplet does not adhere or adheres with difficulty					
Water droplet adheres well and forms a sphere or a half sphere					

Shape of the water droplet on leaves inclined at 90° (lower surface) (section 8.3)

Majority of the droplets slide or change shape (from spherical to teardrop shape)					
Majority of the droplets do not slide either change shape					

Task 1 – Answer sheet

Table 1.1.a - this section requires the use of the microscope

A

B

C

D

E

Section 9 - Sudan Red test using young stems

Positive stain (at least one of the layers is similar to the positive control)					
Negative stain (none of the layers shows similar staining to the positive control)					

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Table 1.1.a - section 12 requires the use	A	B	C	D	E
---	---	---	---	---	---

Section 10 - fruit type

Acorn					
Berry					
One seed per fruit					
Multiple seeds per fruit					

Section 11 - fruit shape

Oval					
Spherical or globose					
Elongated and fusiform (torpedo like)					

Section 12 - fruit cupule

Fruit with no cupule					
Cupule with completely fused and/or					
With protruding, sharp, scales and raised					
With protruding, triangular scales					

Section 13 - fruit footstalk

Present					
Absent					

Task 1 – Answer sheet

Question 1.1.b

10 marks

Use the dichotomous key to identify the species present in each box. Make a correspondence between the box letter and the name of the tree in Table 1.1.b.

- | | | |
|---|---|---------------------------|
| 1 | Fruit is a berry | <i>Arbutus unedo</i> |
| | Fruit is an acorn | 2 |
| 2 | Lobed shape leaf | <i>Quercus robur</i> |
| | Leaf shape different from lobed | 3 |
| 3 | Fruit with a cupule with fused scales | 4 |
| | Fruit with a cupule with protruding scales | 5 |
| 4 | Glabrous (no hair present) to glabrescent (occasional hair) | <i>Quercus faginea</i> |
| | Pubescent leaf upper surface (trichomes are present) | 6 |
| 5 | Stem cut does not stain for Sudan Red similar to the | <i>Quercus coccifera</i> |
| | Stem cut stains for Sudan Red similar to the positive | <i>Quercus suber</i> |
| 6 | Stem cut does not stain for Sudan Red similar to the | <i>Quercus latifolia</i> |
| | Stem cut stains for Sudan Red similar to the positive | <i>Quercus lusitanica</i> |

Table 1.1.b. Specimen´s Letter	Tree species
#A	
#B	
#C	
#D	
#E	

Task 1 – Answer sheet

Question 1.1.c

2.5 marks

In which region of the leaf would you expect to find stomata?

- a) Upper surface
- b) Lower surface
- c) Both upper and lower surface
- d) Petiole
- e) Vein

Question 1.1.d

2.5 marks

A highly pubescent leaf is expected to:

- a) Loose a lot of water through transpiration;
- b) Limit water loss while keeping stomata open;
- c) Limit water loss due to more efficient stomata closing;
- d) Be able to retain more water from the atmosphere;
- e) Maximise gas-exchange with the atmosphere.

Question 1.1.e

2.5 marks

If you are asked to determine if these trees are monocotyledonous or dicotyledonous, which plant organ would you use?

- a) Root
- b) Stem
- c) Leaf
- d) Seeds
- e) Flower

Question 1.1.f

2.5 marks

You were asked to perform the Sudan red staining in young stems of the several specimens. You most probably notice a dark layer in the most external part of the sections. Can you provide the most probable function of this layer?

- a) Avoid transpiration;
- b) Water transport;
- c) Allow transpiration;
- d) Growth indicator;
- e) Pollution indicator.

Task 1 – Answer sheet

Task 1 - 2.1

60 marks

Question 2.1.a

5 marks

Observe the different images you have prepared in step 5. Which channel(s) allows you the best observation of the growth rings?

- a) Green channel
- b) Blue channel
- c) Red channel
- d) All three channels
- e) None of the channels

Question 2.1.b

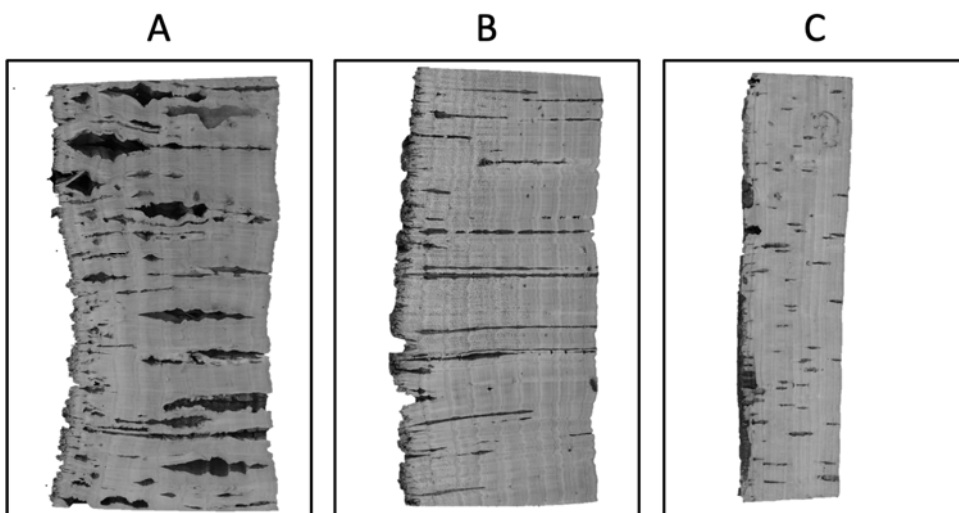
10 marks

How many files have you produced with the protocol you followed to determine the percentage of area with imperfections in the cork samples A to C?

Question 2.1.c

12.5 marks

Which area of the cork samples A to C have you considered in the determination of the percentage of are with imperfections? Draw **with waterproof marker** the area in the answer sheet.



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Task 1 – Answer sheet

Question 2.1.d

10 marks

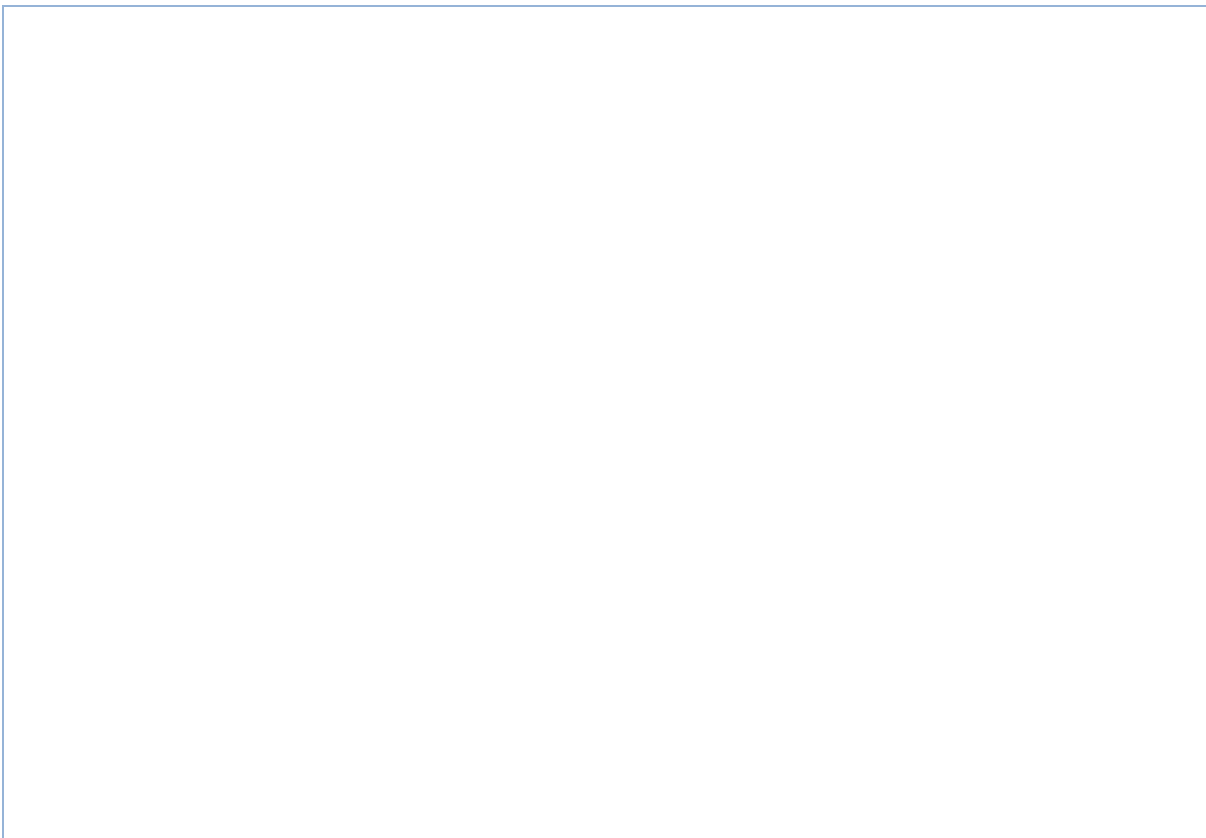
Determine the percentage of area with imperfections in the different cork samples A to C. Which sample has the lowest percentage of area with imperfections?

- a) A
- b) B
- c) C
- d) A and B
- e) B and C

Question 2.1.e

10 marks

Take into consideration the area with imperfections, draw a bar plot with the sum of the dark regions, which include the imperfections, present in the 3 cork planks. You should use the values measured in the previous question. Draw a bar plot with the sum of the dark regions present in the 3 cork planks in the following page.



Task 1 – Answer sheet

Question 2.1.f

2.5 marks

How many growth rings can you easily observe in the plank A (Figure 1 - 2.1)?

- a) 7
- b) 8
- c) 9
- d) 10
- e) 11

Question 2.1.g

2.5 marks

To answer this question take into consideration Figure 1 - 2.2. Why do you think there are darker and lighter areas? Choose the best hypothesis.

- a) It is associated with the resources available for growth.
- b) It is exclusively defined genetically.
- c) It is not related to the amount of water available.
- d) It is some dirt that got trapped inside the plant.
- e) It is the reaction to prolonged exposure to light.

Question 2.1.h

2.5 marks

To answer this question take into consideration Figure 1 - 2.2. Which year do you think it rained more?

- a) Year 3
- b) Year 5
- c) Year 6
- d) Year 7
- e) Year 8

Question 2.1.i

2.5 marks

Taking into consideration Figure 1 - 2.2, indicate which regions do you think correspond to Spring and Summer growth.

- a) Lighter regions – Spring; Darker regions – Summer
- b) No growth observed in Spring; Lighter regions - Summer
- c) Darker regions -Spring; Lighter regions – Summer
- d) Darker regions –Spring; No growth observed in Summer
- e) We can not answer due to insufficient information.

Question 2.1.j

2.5 marks

Considering Figure 1 - 2.2, which layer/growth ring has been exposed to the atmosphere?

- a) Only the layer observed in Year 10.
- b) Only the layer observed Year 1.
- c) All the dark regions.
- d) It depends on how the plant responded to the variations of the climate.
- e) It is not present in this image.

Task 1 – Answer sheet

Task 1 - 3

120 marks

Molecular mass of Galic Acid; $C_7H_6O_5 \cdot H_2O$ ($188.14 \text{ g} \cdot \text{mol}^{-1}$)

Spare materials

Assistant and student should sign in in this table, if spare additional material is requested (maximum materials reposition allowed as number of rows):

Calling for Assistance	Marks	Assistant	Student
Additional Material	0		
Additional Material	-5		
Additional Material	-5		
Additional Material	-5		
Additional solution sample	-10		

Question 3.1.1

20 marks

Calculate the concentration of the standard solutions prepared by you (in $\text{mg}\cdot\text{L}^{-1}$). State the value to 2 decimal places.

Calculations

Table

Standard	Concentration ($\text{mg}\cdot\text{L}^{-1}$)
S1	
S2	
S3	
S4	
S5	

Task 1 – Answer sheet

Question 3.1.2

5 marks

Fill the table with the requested values

Table

Standard	Concentration (mg. L ⁻¹)	Absorbance
S1		
S2		
S3		
S4		
S5		

Question 3.1.3

20 marks

Plot 3.1.3

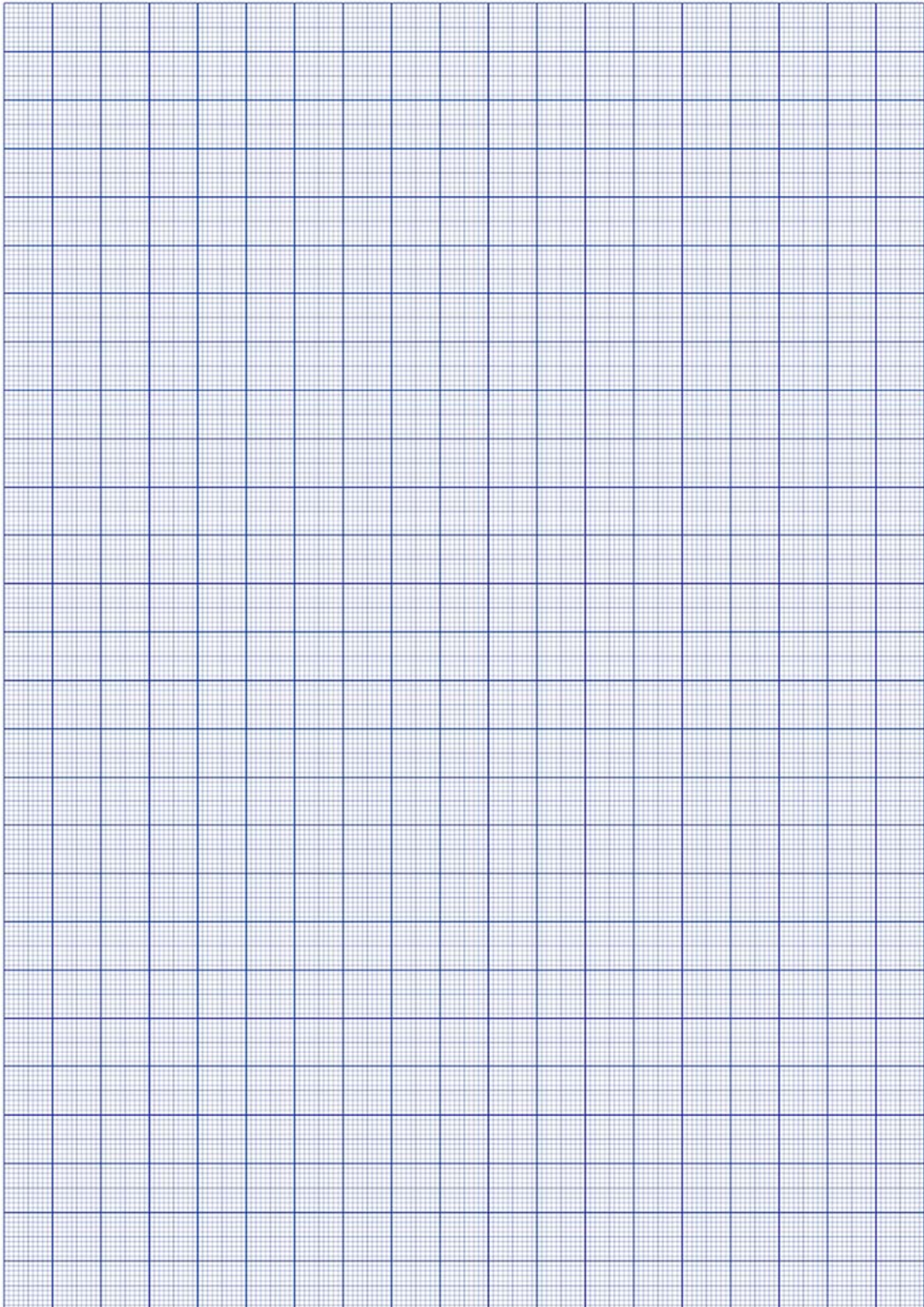
Plot the value of Absorbance versus Concentration of Total Phenol Content in the following millimeter paper

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Task 1 – Answer sheet

Question 3.1.3

Plot 3.1.



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Task 1 – Answer sheet

$m =$

absorptivity of gallic acid =

Question 3.2.1

5 marks

Fill the table with the requested values.

Table

Standard	Absorbance
S1.1	
S1.2	
S1.3	
S1.4	
S1.5	
average	

Task 1 – Answer sheet

Question 3.2.2

15 marks

Calculation of the standard variation, σ (in the calculations use 6 decimal places or scientific notation):

Calculations

 $\sigma =$

Calculation of LOD : (2 decimal places)

Calculations

LOD =

Question 3.3.1

3 marks

Table

Cork samples	Absorbance
Lot A	
Lot B	
Lot C	

Question 3.3.2

15 marks

Calculate the concentration of the cork solutions (in $\text{mg}\cdot\text{L}^{-1}$). State the value to 2 decimal places.

Calculations

Table

Cork samples	Concentration ($\text{mg}\cdot\text{L}^{-1}$)
Lot A	
Lot B	
Lot C	

Task 1 – Answer sheet

Question 3.3.3

5 marks

The detection limit of the method is adequate to ensure direct measurement of the samples (i.e., without a concentration step)

- a) None of the samples
- b) Sample A
- c) Sample B and sample C
- d) All the samples
- e) Sample A and sample B

Question 3.3.4

5 marks

Which plank would you chose as suitable for premium stoppers production?

- a) None of the planks
- b) plank B
- c) plank A and plank C
- d) All the planks
- e) plank C

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Task 1 - 4.1.

40 marks

Question 4.1.1.

2 marks

Fill the Table with the mass, m , of the Lee's disc, the height, h , of the Lee's disc, its diameter, D , and the thickness, d , of the cork sample. Indicate the SI units in the first column.

m/kg	
h/m	
D/m	
d/m	

Question 4.1.2.

20 marks

Indicate the values T_H and T_L in the steady state in the Table. Indicate the units in the first column.

$T_H/\text{_____}$	
$T_L/\text{_____}$	

Task 1 – Answer sheet

Question 4.1.3.

10 marks

Write the mathematical expression for the heat current, H_{in} , flowing into the Lee's disk at the steady state. The expression should be written as a function of k (the thermal conductivity of the cork sample) and of the appropriate symbols for other measured quantities.

 $H_{\text{in}} =$

Question 4.1.4.

8 marks

Write the mathematical expression for a in $H_{\text{in}} = k a$. This expression for a should be written as a function of the appropriate symbols for measured quantities. From the measured values of those quantities, calculate an experimental value for a (give details of your calculations and express the value in appropriate units).

 $a =$

Task 1 – Answer sheet

Task 1 - 4.2.

60 marks

Question 4.2.1.

15 marks

Select adequate values from the collected data in order to extract the cooling heat current from the disc to the environment at the temperature of the steady state found in Question 4.1.2. Indicate the units in the Table headers.

$t/$ _____	$T_{LD}/$ _____

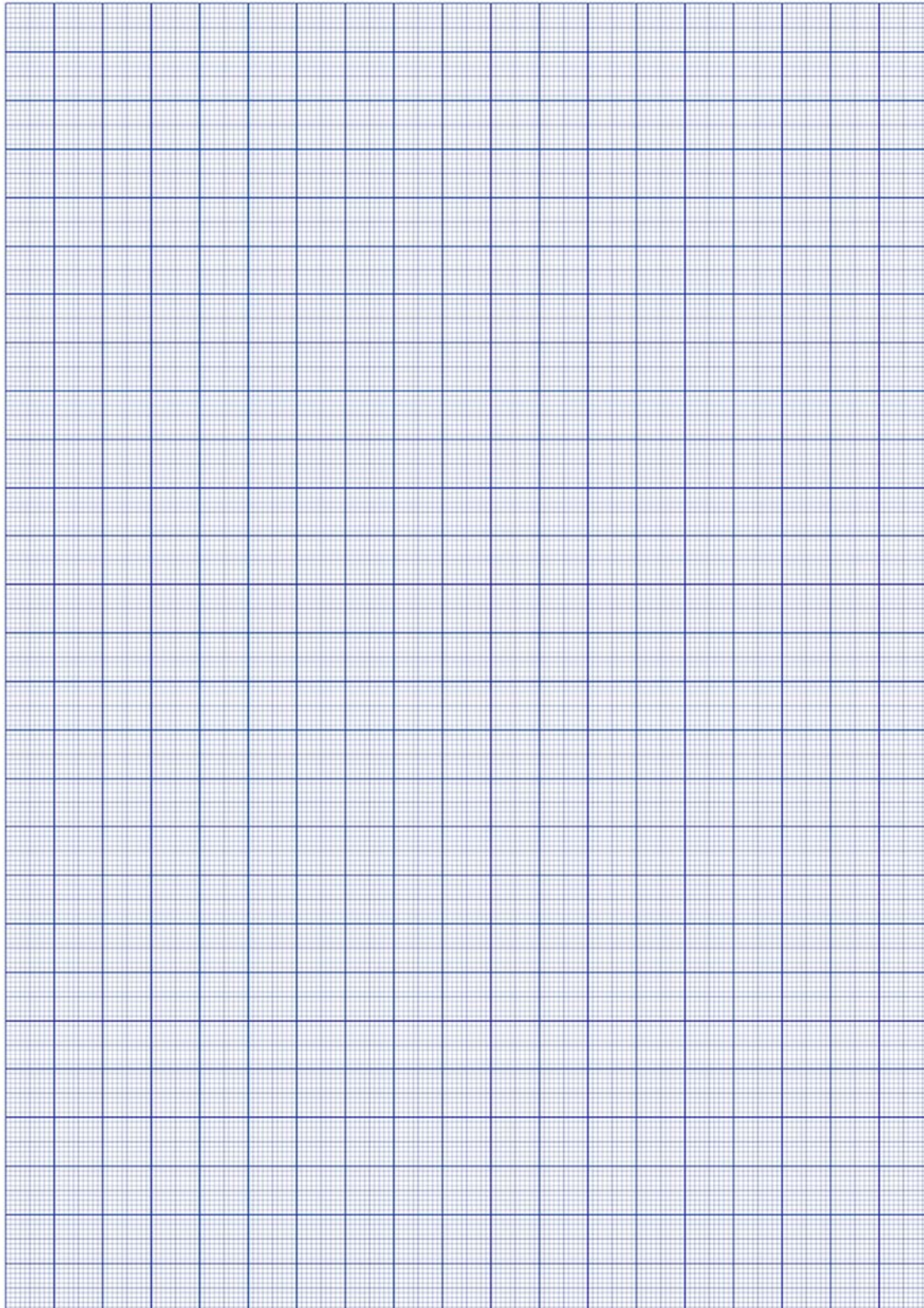
$t/$ _____	$T_{LD}/$ _____

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Question 4.2.2.

15 marks

Plot the data of the Table (Question 4.2.1.) in the following millimeter paper.



Task 1 – Answer sheet

Question 4.2.3.

15 marks

Evaluate the cooling rate, r , at the steady state found in Question 4.1.2.

Calculations

$r =$

Question 4.2.4.

15 marks

Write the mathematical expression for the thermal conductivity of the cork sample, k , as a function of m , c , and any other quantities you got from your experimental data. Using that expression, calculate the thermal conductivity of the cork sample, k .

Calculations

Country code and team

Task 1 – Answer sheet

$k =$

Using that expression, calculate an experimental value of k .

Calculations

$k_{exp} =$

Task 1 – Answer sheet

Task 1 - 4.3.

20 marks

Question 4.3.1.

10 marks

Find a mathematical expression for the total thermal resistance, R_{total} , of a wall with two layers of thickness l_1 and l_2 , from materials with different thermal conductivities, k_1 and k_2 , respectively, as a function of those quantities only. Show your calculations.

Calculations

Task 1 – Answer sheet

 $R_{total} =$

Question 4.3.2.

10 marks

To prevent losses through thermal conduction, a house with walls made of 20 cm thick concrete and a 2 cm thick plaster drywall, an insulating layer of 1 cm cork board was added. Consider that the concrete side is facing the exterior of the house at a temperature of 0 °C and that inside the house the temperature is kept at 20 °C. Calculate the energy wasted by heat conduction during 1 hour through a wall with an area of 50 m² for the two following cases:

- i) a naked (concrete+plaster, uninsulated) wall;
- ii) an insulated (concrete+plaster+cork) wall.

Consider the following thermal conductivities (given in the SI units W K m⁻¹): concrete: 1.10; plaster: 0.17; cork: use the value found in Question 4.2.4.

i)

Calculations

Task 1 – Answer sheet

$E_{\text{wast}} =$

ii)

Calculations

$E_{\text{wast}} =$