Correction and marks for Exam 2 – Physics, SCAN 1st.

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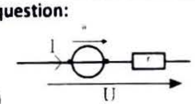
15,75 / 20

General comment : - 0.5 for a non homogeneous result without any comment;
Possibly + 0.25 for homogeneity verification.

Lecture question: 1	**2 POINTS**
	
1)	2*~~0.5~~ (U & I) 0,5
2) e=3V r=3/0.06 = 50Ω	2*0.5 0,5

Exercise 1 : 5.75	**8.75 POINTS**
Question 1 : 2 points	
- Measuring tape standardisation, systematic (negligible) measure : 2 times half a graduation : 1 cm Multiple use of the 2m measuring tape : 1cm for each use *Wall straightness... no information but probably important!*	3 * 0.25 + *0.25 bonus (straightness)* 1
- $\Delta L=1+4*1=5cm$ $\Delta h=1+2*1=3cm$	0.25
- *Smin= 2,85*7,08=20.178 m² Smax=2,89*7,16=20.6924 m²*	~~0.5~~
(Smax-Smin)/2=0.2572 m² We get *ΔS=0.36 m²*	~~0.5~~ 0
Question 2 : 5.25 points	0.5 ✓
a) $[R]=[P]^{-1}\Theta=M^{-1}L^{-2}T^{3}\Theta$	0.25
b) e_{max}=0.41m e_{min}=0.39m	0.5
- λ_{min}= 0.9 W.m⁻¹.K⁻¹ λ_{max}= 1.1 W.m⁻¹.K⁻¹ ____	0.5
- $R_{max}=e_{max}/(\lambda_{min}*S_{min})$ $R_{min}=e_{min}/(\lambda_{max}*S_{max})$	3*0.25 1,75
- Rmax=0,02257684 K.W⁻¹; Rmin=0,01713409 K.W⁻¹; R=0,01957483 K.W⁻¹ ___ - $R=(0.0196\pm0.0028)\,K.W^{-1}$ using (max –min)/2 ; - (if R = (Rmin+Rmax)/2 = 0.0199 *Other method (differential) OK)*	1 (significant digits and unit) 1
c) $R_{ft-lbf}=\left(\frac{M_{ft-lbf}}{M_{SI}}\right)^{-1}\left(\frac{L_{ft-lbf}}{L_{SI}}\right)^{-2}\left(\frac{T_{ft-lbf}}{T_{SI}}\right)^{3}\left(\frac{\Theta_{ft-lbf}}{\Theta_{SI}}\right)^{1}R_{SI}$	0.5
$R_{ft-lbf}=\left(\frac{1}{0.4536}\right)^{-1}\left(\frac{1}{0.3048}\right)^{-2}\left(\frac{1}{60}\right)^{3}\left(\frac{1}{1}\right)^{1}R_{SI}$	0.5
$R_{ft-lbf}=3.82\,.\,10^{-9}\,K.lb^{-1}.ft^{-2}.min^{3}$	~~0.5~~ 0,25 (value) + 0.25 (unit) 1,5
Question 3 : 1.5 points	
- $Cost=24\,x\frac{\Delta\theta}{R}$	~~0.5~~ 0,25
[x]= M⁻¹L⁻²T³ (or € M⁻¹L⁻²T³), 24 is a time, Δθ a temperature, R determined in previous question : we get a dimensionless number (or dimension €)	~~0.5~~
Numerical application : Cost = 2,21 €	~~0.5~~ 0,25

Exercice 2 : 8.5	**9.25 points**
Question 1 :	**3.25 points**
a) The intermediate image should be located on the first focal plane of the ocular lens L_2 so that the observer can see a sharp image without any accomodation.	0.5
b) The intermediate image $A'_1B'_1$ is formed at distance $\overline{O_1A'_1}$ given by the conjugate equation: $$\frac{1}{\overline{O_1A'_1}} - \frac{1}{\overline{O_1A}} = \frac{1}{f'_1} \Leftrightarrow \overline{O_1A'_1} = \frac{f'_1.\overline{O_1A}}{f'_1 + \overline{O_1A}}$$	0.25
From a) we have $\overline{A'_1O_2} = f'_2$, thus $$H = \overline{O_1O_2} = \overline{O_1A'_1} + \overline{A'_1O_2} = \frac{f'_1.\overline{O_1A}}{f'_1 + \overline{O_1A}} + f'_2$$	0.25
Numerical application : H = 45 cm	0.25
c) 3 rays (0,5 each)	1,5 1,25
d) Answer : reversed Justification: without the optical system, the rays from B get to the eye above the optical axis. With the doublet, these rays get to the eye below the optical axis. The eye sees the object reversed.	~~0.25 + 0.25~~
Question 2 :	**4.25 points + 1 bonus point**
a) Scheme correction with correct size of the lenses and the tube.	0.25
According to scheme 1, the intermediate image B'_1 is located out of the tube. As a consequence, the rays that come from B and should converge to B'_1 are intercepted by the tube and do not go through the second lens and reach the observer's eye. No light coming from B reaches the eye, so point B is not visible through the eyepiece.	1
b) A necessary condition for the image of one point of the object to exist through the doublet is that the intermediate image is in the tube. The limit case corresponds to an intermediate image located at the intersection of the tube and the first focal plane of L_2. This is point C_1. By drawing the ray going through O_1, we find the object point C on AB.	0.5 ~~0.5~~ 0.5
C and C_1 well positioned on the scheme (see diagram)	~~0.5~~ 0,25
Bonus: By drawing different rays going through O_1, we see that the points located above C will not be visible. C is the farthest point from the optical axis that can be seen. *One needs then to show that at least one ray reaches the observer's eye. It is the case of the ray going through the first focal point F_1, which is parallel to the optical axis between the two lenses. Since it is parallel to the tube, this ray reaches the ocular lens and is therefore transmitted to the eye.*	*Bonus for the justification (not required) : 1* 0,5
c) From the scheme, we get : $\frac{A'_1C_1}{AC} = \frac{O_1A'_1}{O_1A}$ Since $A'_1 = F_2$ and $A'_1C_1 = \frac{d}{2}$, we get (in absolute values) $$AC = \frac{d}{2} \cdot \frac{O_1A}{O_1A'_1}$$	~~1~~ 0,5

Question 3 :	**Sur 1.75 points + 2 bonus points**
a) See correction	0.5
b) This second ray enters the objective lens by its lower edge. The image of this ray can be constructed (for instance) by considering that the intermediate image D'_1 of D through L_1 is on the first focal plane of L_2, so the two rays should intersect there. Then the ray actually goes through O_2 and is not deviated by the ocular lens.	Construction rays or justification (D'_1): 0.25 Correct ray between L_1 and L_2 : 0.5 Correct ray after L_2 : 0.5
Bonus : *From scheme 2, we see that point D is the farthest point from the optical axis for which all the rays entering through L_1 reach the observer's eye. The part AD of the object will be the brightest.* *From D to C, a smaller and smaller fraction of rays reach the eye, as an increasing fraction of rays will be intercepted by the tube. The brightness will decrease from D to C.* *Point C is actually almost invisible as it corresponds to the limit where only one ray of light reaches the eye.*	*Bonus : 2 points* 0,75
TOTAL	**20 + 3 bonus points**

NAME and GROUP : MAGNIER Zoé G2

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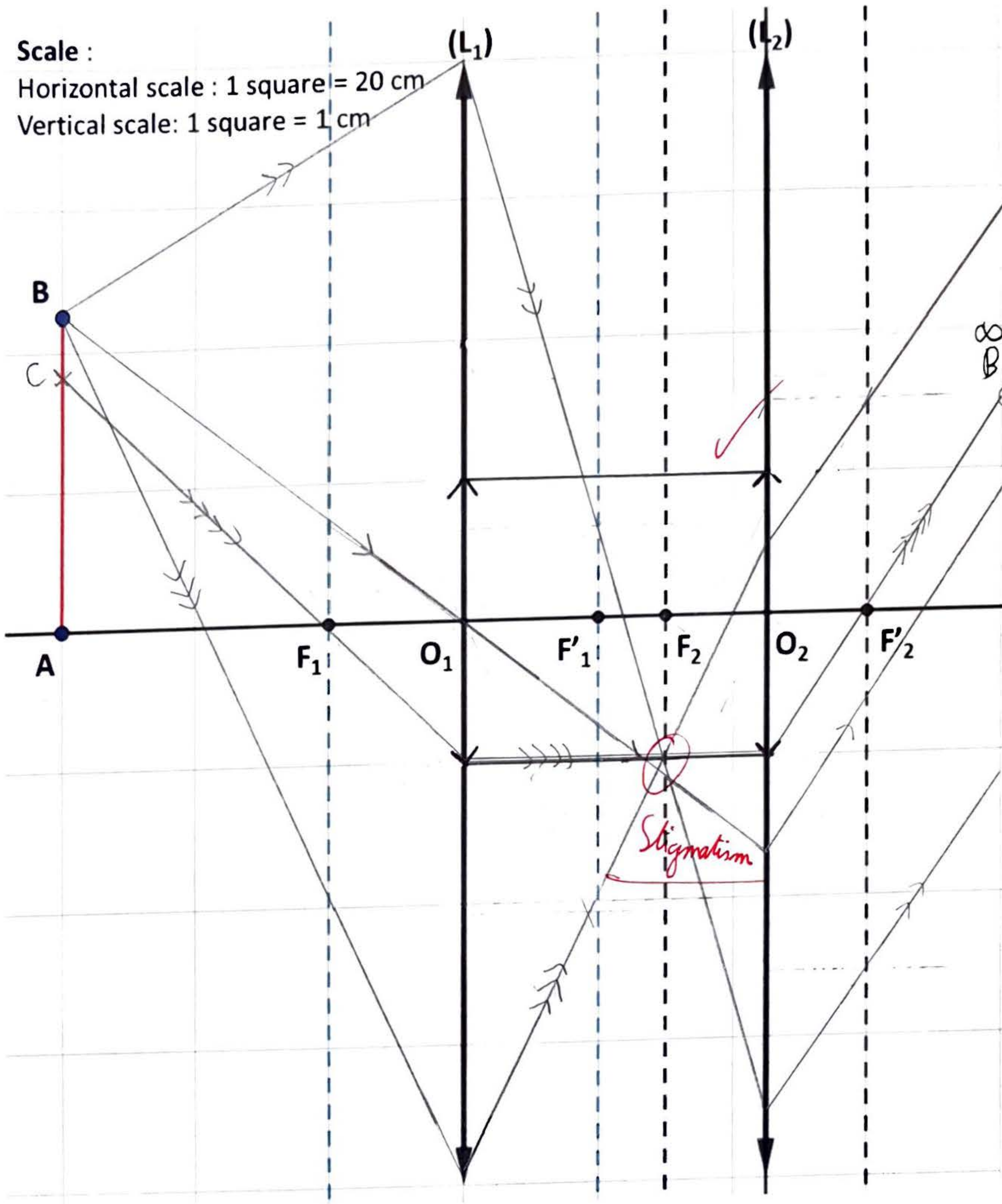

Scheme 1