Report and results regarding Midterm exam L2 Electromagnetism

A mistake was present in the statement of the second exercise. The quantity $a\tan\theta = z$ should be obviously $z\tan\theta = a$. It has been taken into account during the correction. However it has to be mentioned that this data was NOT needed to solve the exercise since the quantity $a = R\sin\theta$ was explicitly given to drive the calculation.

I General comments about the exam papers and the common mistakes

1) Do not make the confusion between σ which is sigma and δ which is delta. FYI (usual sense, not the second ☺).

2) A Flux through a closed surface is written $\oiint \vec{E}\cdot\overrightarrow{dS}$. All the following hybrid things like: $\oiint EdS$ or $\oiint E\overrightarrow{dS}$, or $\int E\overrightarrow{dS}$ are incorrect.

3) The statement was mentioning a cylinder having a surface charge density σ (in C/m2) so it was obviously an empty cylinder **without any charge inside** and without volumic charge density ρ.
When applying Gauss theorem it was mentioned to precise the Gauss volume (or the closed surface) . Many students confused this point. **A volume IS a closed surface** and it is related here with the flux $\oiint \vec{E}\cdot\overrightarrow{dS}$ only. It has no relation with Q_{int} that will depend on the charge distribution (surface or volume; here surface). Consequently it was:

- Irrelevant to think that we can chose between surface density σ or volume density ρ.
- A **mistake** to make the development with the volume density ρ.
- **Irrelevant to write the 2 cases** without any comment or discussion.
- Meaningless to present calculations into two parts with density σ and volume density ρ by explaining one is Gauss surface and the second one is Gauss volume.
- Not a good idea to develop the calculation of a potential having no relation with the electric field before. It is not a lottery where maybe statistically a good answer can appear.

Too often the details about the split of the flux onto the three different surfaces was not precised neither a picture of the Gauss volume.
As general remark, the question 3), 4) 5), 7) and 8) were correct ONLY IF calculations were done (correctly) with surface density σ.

4) A vector is written with an arrow like $\vec{E}$ and NOT $\bar{E}$ with a bar which represents a norm in complex notation, or an algebric distance. A vector has a direction.

5) The relations $\vec{E} = -\overrightarrow{grad}\,V$ and $[V] = -\int \vec{E}\cdot\overrightarrow{dr}$ have to be written WITH vector**S** AND scalar product for the second.

6) For some students, the level of mathematics was surprisingly frightening. As example:

- The Integration of an inverse function $\frac{1}{r}$ is: $\int \frac{dr}{r} = \ln r + cte$ and NOT r or $\frac{1}{r^2}$ or a constant.

- When you integrate between radii R_1 and R_2 and calculate the difference, the constant cancels as follows

$$\int_{R_1}^{R_2} \frac{\sigma R_1 dr}{\varepsilon_0 r} = \left[\frac{\sigma R_1}{\varepsilon_0}\ln r + cte\right]_{R_1}^{R_2} = \frac{\sigma R_1}{\varepsilon_0}\ln R_2 - \frac{\sigma R_1}{\varepsilon_0}\ln R_1 = \frac{\sigma R_1}{\varepsilon_0}\ln\frac{R_2}{R_1}$$

- Additional comments:
  - here R_1 inside the integral is a constant, it is not the parameter of integration and we can not replace it by R_2 after
  - $\ln a - \ln b = \ln\frac{a}{b}$ and not $\ln(a-b)$

7) Too often, the integration of the last question with the magnetic field was catastrophic and many students have invented new mathematical rules to make appear the final result or even have changed the notation of some parameters. We remember that :

- $\int \sin^4\theta\, d\theta$ is NOT EQUAL to $\sin\theta \times \int \sin^3\theta\, d\theta$

- $\int \sin^4\theta\, d\theta$ is NOT EQUAL to $\int \sin^3\theta\, d\theta \times \int \sin\theta$ (it was not the worst, I have seen one with 3 integrals and one with double integral)

- $\sin^3\theta\, d\theta$ is NOT EQUAL to 4/3 . One has to integrate and maybe to specify initial and final value of range of integration

II Results

Chemical	
21621773	15,5
21621820	9,5
21621916	16,5
21621932	8
21621934	10,5
21621935	17
21621939	14,5
21621943	7
21621953	14
21621963	20
21622136	9
21622139	13
21622102	17
21622123	9
21622120	16
21725124	6
21622133	16
21622140	9
21622131	15,5
21622138	10
21622118	6
21622105	12,5
21622132	14
21622081	3
21622113	20
21622129	6,5
21622099	19
21622107	19
21622100	3,5
21622116	8,5
21622195	5,5
21622137	10
21622135	12,5
21622192	8

Computer	
21621791	19
21621948	4
21621801	19
21621821	6,5
21621913	8
21621950	2,5
21621957	6
21621961	15
21621962	DISP
21622154	4
21622144	2
21622177	10
21622161	12,5
21622150	14,5
21622146	6,5
21622141	20
21622160	10
21622158	10
21622187	7,5
21622126	19
21621965	11
21622147	10
21622201	10,5
21622051	2
21622215	6,5
21622142	15,5
21622152	13
21622156	8
21622184	20
21622221	10
21622164	11
21622155	2
21622153	18
21622183	5
21622148	16,5
21622149	8

GeoPhys	
21621758	5
21621925	15
21621928	10
21621942	7,5
21621945	12,5
21621951	4
21621952	5
21621958	6
21622046	8
21622043	15
21622034	4
21622059	15
21622054	7
21622076	6,5
21622066	14,5
21622072	9
21622079	10,5
21622047	10
21622064	8,5
21622039	18,5
21622070	7
21622049	7,5
21622048	10,5
21622036	14,5
21622001	5,5
21622065	18
21622080	18
21622074	5,5
21622063	6

Petrole	
21621753	6,5
21621755	8
21621920	13,5
21621924	10,5
21621921	10
21621930	8
21621946	ABS
21621960	10
21622205	7
21622210	10
21622203	16
21622209	16
21622218	17
21622206	7,5
21621980	10
21622197	7
21622204	7
21622219	12
21622216	11
21622189	5,5
21622211	14,5
21622208	13
21622191	8,5
21622214	11,5
21622190	20
21622194	14,5
21622200	9
21622212	10
21622199	10
21622198	13
21622196	12