EXAMEN DE P311

COURS, TD et DOCUMENTS INTERDITS
CALCULATRICES AUTORISEES
PORTABLES STRICTEMMENT ETEINTS
DUREE 1h00

QUESTIONS DE COURS. (5 points)

1) On considère une charge ponctuelle q<0 et un fil de longueur totale L, portant la densité linéique de charge constante \( \lambda > 0 \).
   a) Donner l'expression vectorielle de la force de Coulomb exercée par q sur un élément de longueur dl du fil en précisant la signification de chacun des termes utilisés. Faire un schéma illustratif.
   b) La charge q subit-elle une force de la part du fil? Donner alors l'expression qui servirait de base à son calcul.
2) Que permet de calculer la loi de Biot et Savart? Donner son expression, schéma à l'appui, en précisant la signification de chacun de ses termes. Quelle est l'unité de la grandeur obtenue?

EXERCICE 1. (8 points)

Une charge \( q_A = +3 \mu C \) est placée au point A, d'abscisse \( x_A = -10 \) cm, d'un axe x'Ox de vecteur unitaire \( \vec{i} \).
1) Déterminer la valeur de la charge \( q_B \) qu'il faut placer au point B d'abscisse \( x_B = +15 \) cm, pour que le potentiel électrique résultant que les deux charges créent au point O soit nul.
2) Calculer le vecteur champ électrique que ces deux charges créent au point O.
3) Déterminer qualitativement la position probable, par rapport aux points A et B, du point C de l'axe où le champ électrique résultant de l'action des deux charges est nul, puis calculer précisément l'abscisse de C.

EXERCICE 2. (7 points)

Une sphère de rayon R, de centre O, est uniformément chargée en surface avec une densité surfacique \( \sigma = \text{Cte} > 0 \).
1) En utilisant le théorème de Gauss (détaillez la démarche SVP), déterminer le champ électrique qu'elle crée en tout point de l'espace à la distance \( r \) de O.
2) Tracer le graphe \( E(r) \).
3) En déduire le potentiel créé par la sphère en tout point \( r > R \) (on considérera que le potentiel est nul à l'infini).
4) Montrer que le potentiel est constant pour \( r < R \) et déterminer sa valeur en utilisant la propriété de continuité du potentiel au passage par \( r = R \).
5) Tracer le graphe de \( V(r) \).
Every year about two million people visit Mount Rushmore, where the faces of four U.S. presidents were carved in granite by the sculptor Gutzon Borglum and his son. The creation of the Mount Rushmore monument took 14 years — from 1927 to 1941 — and nearly a million dollars. These were times when money was difficult to come by, and many people were jobless. To help him with this sculpture, Borglum hired laid-off workers from the closed-down mines in the Black Hills area of South Dakota. He taught these men to dynamite, drill, carve, and finish the granite as they were hanging in midair in his specially devised chairs, which had many safety features.

Borglum used dynamite to remove 90 percent of the 450,000 tons of rock from the mountain quickly and relatively inexpensively. His workmen became so skilled that without causing damage, they could blast within four inches of the finished surface and grade the contours of the facial features. Borglum was proud of the fact that no workers were killed or seriously injured during the years of blasting and carving the granite. Considering the workers regularly used dynamite and heavy equipment, this was a remarkable feat.

During the carving, many changes in the original design had to be made to keep the carved heads free of large fissures that were uncovered. However, not all the cracks could be avoided, so Borglum concocted a mixture of granite dust, white lead, and linseed oil to fill them.

Every winter, water from melting snow gets into the fissures and expands as it freezes, making the fissures bigger. Consequently, every autumn maintenance work is done to refill the cracks. To preserve this national monument for future generations, the repairers swing out in space over a 500-foot drop and fix the monument with the same mixture that Borglum used.

1. The author of the passage indicates that the men Borglum hired were
   A. trained sculptors
   B. laid-off stone carvers
   C. Black Hills volunteers
   D. unemployed miners

2. According to the passage, what achievement did Borglum pride himself on?
   A. The four presidential faces in granite that he had sculpted
   B. The removal of 90 percent of the 450,000 tons of rock quickly and at a relatively low cost
   C. His safety record of no deaths or serious injuries during the years of work with heavy equipment and dynamite
   D. His skillful training of the labor force that enabled blasts of dynamite to be within inches of the contour lines of the faces
3. Which of the sentences below best expresses the essential information in the highlighted sentence in the passage? Incorrect choices change the meaning in important ways or leave out essential information.

A) Since cracks could not be avoided, Borglum tried various materials to cover them.
B) In order to fill the unavoidable cracks, Borglum invented a mixture for filling them.
C) A mixture was uncovered by Borglum during the changes in design needed to avoid cracks.
D) Because cracks could not be avoided, Borglum bought a mixture of granite dust, white lead, and linseed oil.

4. According to the passage, today Mount Rushmore needs to be

A) protected from air pollution
B) polished for tourists
C) restored during the winter
D) repaired periodically

5. The passage discusses all of the following aspects of the creation of the Mount Rushmore carvings EXCEPT

A) where the people who worked on Mount Rushmore came from
B) why Borglum carved the heads of four U.S. presidents
C) how Borglum dealt with fissures that could not be avoided
D) when repairs to this national monument are made
Exercice 2. Vocabulary. For 1-10 choose the correct alternative in *italics* by circling it.

We reached the airport quite early, and went straight to the (1) **platform/check-in** to show our tickets and leave our (2) **hand luggage/suitcases** at the desk. The woman told us we would be (3) **boarding/picking up** the plane to New York in about two hours, so we went through (4) **passport control/ticket office** and then into the (5) **departure/customs** lounge. We had heard there was extremely bad weather in the eastern USA, and someone said the flight might be (6) **ended/taken away**, but we (7) **got into/got onto** the plane exactly on time. I put my bag into the overhead (8) **cabin/locker**, sat down and looked through the window. I was a little worried when I noticed there was ice on the (9) **wings/masts**, but the (10) **ticket inspector/flight attendant** explained that they would do something about that before we took off. I was very relieved!

Complete each sentences a-g with one one of the conjunctions in the box.

<table>
<thead>
<tr>
<th>after</th>
<th>as</th>
<th>even though</th>
<th>in case</th>
<th>unless</th>
<th>whereas</th>
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a. My brother is an experienced driver, .........................he's only 19.

b. Jacke i gazed out of the window of the train ....................he ate his sandwich.

c. We're going to travel by plane .........................you like it or not.

d. I'll be home by lunchtime .........................the flight is delayed.

e. You should carry your phone with you ....................your car breaks down.

f. The ferry is slower: it takes five hours .....................it only takes two hours by plane.

g. They're planning to backpack around Europe .....................they finish their exams.
Exercice 4.
For 1-6 choose the correct words in italics (by circling them) to complete the dialogue.

**Man:** Excuse me. (1) Could/would you mind telling me where the Museum of Modern Art is?

**Woman:** Not at all. It’s in West Avenue, opposite the bus.

**Man:** (2) Could/May I walk there, do you think?

**Woman:** Yes, but it’s about three kilometres.

**Man:** Maybe I (3) must/ought to get a taxi?

**Woman:** Or you (4) could/should get a bus. The stop is right here.

**Man:** Great! (5) May/Would I ask if you’ve been to the museum yourself?

**Woman:** Yes, I have. It’s definitely worth a visit. You (6) may/must make sure you see the sculptures in the museum garden, too. They’re beautiful.

Exercice 5. Writing.
You have received an email from your English-speaking friend, Chris, who is planning to visit you. Read Chris’s email and the notes you have made. Then write an email to Chris, using all your notes.

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**email**

From: Chris McFadden
Sent: 16th July
Subject: Visit

Better, actually, because...

I know we agreed that I would visit you during the first week in August, but would you mind if I came the week after instead?

I’m really looking forward to seeing your country for the first time. What do you think I’ll particularly like about it? **Tell Chris**

Suggest...

August there is quite different from summer in my country, so what clothes do you think I should bring with me?

I’ll fly to the main airport, of course, but from there what’s the best way to get to where you live? **Give directions**

Speak to you again soon,

Chris
Write your email here in 120-150 words. You must use grammatically correct sentences with accurate spelling and punctuation in a style appropriate for the situation.
Exercice 6.
What country would you most like to visit? Why? Do you think you will ever go there? (Write your answer in 120-150 words).
Electromagnétisme (P411), examen de deuxième session, 24 juin 2013
Durée 2h. Documents et calculatrices interdits. Le troisième exercice (Onde électromagnétiques) concerne uniquement la filière PC.

1 Electrostatique


2. En déduire la capacité de la sphère.

3. Mêmes questions pour une sphère conductrice pleine.

2 Définition de l’Ampère

1. (Question préliminaire). Quel est le champ magnétostatique produit en tout point de l'espace par un fil rectiligne infini, de section circulaire négligeable, parcouru par un courant continu d'intensité $I$ ? On détaillera les étapes de ce calcul classique et on introduira les coordonnées, les axes et les vecteurs nécessaires, en illustrant le tout par un schéma.

2. On considère maintenant deux conducteurs rectilignes, de longueur infinies et de section circulaire négligeable, placés dans le vide. Ces deux conducteurs sont parallèles et situés à une distance $d$ l'un de l'autre. Ils sont parcourus par des courants algébriques d'intensité $I_1$ et $I_2$, respectivement.

   (a) Calculer la force de Laplace $F_{1\rightarrow 2}$ exercée par le premier fil sur un élément de longueur $L$ du deuxième fil. Que peut-on dire de $F_{2\rightarrow 1}$ ?

   (b) Discuter le résultat suivant les signes de $I_1$ et $I_2$ (4 possibilités).

   (c) La définition de l'Ampère dans le Système International est la suivante: "1 Ampère est l'intensité d'un courant électrostatique constant qui, maintenu dans deux conducteurs parallèles, rectilignes, de longueur infinie, de section circulaire négligeable et situés à une distance de 1 mètre l'un de l'autre dans le vide, produirait entre ces conducteurs une force égale à $2 \times 10^{-7}$ Newton par unité de longueur."

   Montrer que cette définition fixe la valeur de la constante $\mu_0$.

3 Ondes électromagnétiques

1. Rappeler les équations de Maxwell temporelles dans le vide pour les champs $E$ et $B$, en l'absence de charges et de courants.

2. En déduire que le champ électromagnétique vérifie l'équation d'onde. Quelle est la conséquence fondamentale de cette équation ?

3. Définir l'onde plane monochromatique. Montrer, avec un minimum de développements, qu'une telle onde électromagnétique est transverse.