

**DEVOIR DE SYNTHESE**  
**SECTION : SCIENCES DE L'INFORMATIQUE**  
**ÉPREUVE : MATHÉMATIQUES**

DUREE : 3 h

COEFFICIENT : 3

**Exercice 1 : ( 4 points)**

- 1) Soit  $x$  un entier non nul. Si  $x \equiv 9 \pmod{10}$  alors :
- a)  $x^{402} \equiv 1 \pmod{10}$       b)  $x^{402} \equiv -1 \pmod{10}$       c)  $x^{402} \equiv 9 \pmod{10}$ .
- 2) Soit  $u$  la suite définie sur  $\mathbb{N}^*$  par  $u_n = \frac{n^2 + 2}{n}$
- a)  $\lim_{n \rightarrow +\infty} u_n = 0$       b)  $(u_n)$  est majorée par 1      c)  $u_n \geq n$  pour tout  $n \in \mathbb{N}^*$
- 3) Le quotient de la division Euclidienne de  $-20$  par  $7$  est :
- a)  $-3$       b)  $-2$       c)  $2$ .
- 4) La limite de la suite de terme général :  $u_n = \ln \left( \ln \left( 1 + \frac{1}{n^2} \right) \right)$  avec  $n \in \mathbb{N}^*$  est :
- a)  $+\infty$       b)  $-\infty$       c)  $0$

**Exercice 2 : ( 5 points)**

- 1) Déterminer le reste modulo 13 de  $5^4$ .
- 2) En déduire les restes modulo 13 de chacun des entiers  $5^{4k}, 5^{4k+1}, 5^{4k+2}, 5^{4k+3}$  avec  $k \in \mathbb{N}$ .
- 3) Déterminer les restes modulo 13 de chacun des entiers  $5^{262020202041}$  et  $5^{555555555555}$ .
- 4) Déterminer l'ensemble des entiers naturels  $n$ , tels que  $5^{2n} + 5^n \equiv 0 \pmod{13}$ .

**Exercice 3 : ( 6 points)**

A- Soit la fonction  $g$  définie sur  $]0, +\infty[$  par :  $g(x) = \frac{1}{x} - \ln(x)$

- 1) Dresser le tableau de variation de  $g$
- 2) a) Montrer que  $g$  réalise une bijection de  $]0, +\infty[$  sur  $\mathbb{R}$   
 b) En déduire que l'équation  $g(x) = 0$  admet une unique solution  $\alpha$ . Vérifier que  $1,7 < \alpha < 1,8$   
 c) En déduire suivant les valeurs de  $x$ , le signe de  $g(x)$ .
- 3) a) Montrer que  $g^{-1}$  est dérivable sur  $\mathbb{R}$ .  
 b) Calculer  $g(1)$  et déduire  $(g^{-1})'(1)$ .

B- Soit la fonction  $f$  définie sur  $]0, +\infty[$  par :  $f(x) = (x-1)(1-\ln x)$

On désigne par  $(C)$  sa courbe représentative dans un repère orthonormé  $(O, \vec{i}, \vec{j})$

- 1) a) Montrer que : pour tout  $x > 0$ ,  $f'(x) = g(x)$   
 b) Dresser le tableau de variation de  $f$ .
- 2) Déterminer les points d'intersection de la courbe  $(C)$  et de la droite  $(O, \vec{i})$ .
- 3) Ecrire une équation cartésienne de la tangente  $(T)$  à la courbe  $(C)$  au point d'abscisse 1.
- 4) Soit la fonction  $F$  définie sur  $]0, +\infty[$  par : 
$$\begin{cases} F(x) = (x^2 - 2x)(1 - \ln x) & \text{si } x > 0 \\ F(0) = 0 \end{cases}$$
- a) Etudier la continuité et la dérivabilité de  $F$  à droite en 0.  
 b) Montrer que pour tout  $x > 0$  on a :  $F'(x) = 2 - x + 2f(x)$   
 c) En déduire la primitive de  $f$  sur  $]0, +\infty[$  ; qui s'annule en 1.

# Maths SJune 2013

**Yicheng Fang**



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