ROYAUME DU MAROC

MINISTÈRE DE L'ÉDUCATION NATIONALE, DU PRÉSCOLAIRE ET DES SPORTS

1075.J

EXAMEN DU BACCALAUREAT

Série / Option : ....

65229

COMPOSITION DE : P.C

RESERVE ACADEMIE

Nom du correcteur et signature : ....

Note Globale	
En chiffres	En lettres
17,00	
Appréciation de la note chiffrée	

Chemistry:

Exercise 1:

1.1) The equation of reaction:

$$CH_3COOH_{(aq)} + H_2O_{(l)} \rightleftharpoons CH_3COO^-_{(aq)} + H_3O^+_{(aq)}$$

0,5

1.2) The progress table:

The equation of reaction		$CH_3COOH_{(aq)}$ +	$H_2O_{(l)}$ ⇄	$CH_3COO^-_{(aq)}$ +	$H_3O^+_{(aq)}$
State of reaction	The progress x	The amount of substances			
Initial state	0	$n_i(CH_3COOH)$	excess	0	0
Intermediate state	x	$n_i(CH_3COOH)-x$	excess	x	x
Final state	x_f	$n_i(CH_3COOH)-x_f$		x_f	x_f
Max state	x_{max}	$n_i(CH_3COOH)-x_{max}$		x_{max}	x_{max}

CH_3COOH is the limiting reactant because H_2O is in excess

so $n_m(CH_3COOH)=0 \iff n_i(CH_3COOH)-x_{max}=0$

$\iff n_i(CH_3COOH)=x_{max}$

Therefore $x_{max}=C_A.V_A$

we have $\alpha(CH_3COOH)=\dfrac{[CH_3COOH]_{eq}}{[CH_3COOH]_{eq}+[CH_3COO^-]_{eq}}$

According to the progress table:

$[CH_3COOH]_{eq}=\dfrac{n_f(CH_3COOH)}{V_A}=\dfrac{n_i(CH_3COOH)-x_f}{V_A}$

$=\dfrac{C_A.V_A-x_f}{V_A}$

$=C_A-\dfrac{x_f}{V_A}$

$[CH_3COO^-]_{eq}=\dfrac{n_f(CH_3COO^-)}{V_A}=\dfrac{x_f}{V_A}$

Thus $\alpha(CH_3COOH)=\dfrac{[CH_3COOH]_{eq}}{[CH_3COOH]_{eq}+[CH_3COO^-]_{eq}}=\dfrac{C_A-\frac{x_f}{V_A}}{C_A-\frac{x_f}{V_A}+\frac{x_f}{V_A}}$

-N.B: IL' est interdit au candidat de signer sa composition ou d'y mettre un signe quelconque pouvant indiquer son identité.

so $\alpha(CH_3COOH) = \frac{C_A - \frac{x_f}{V_A}}{C_A} = 1 - \frac{x_f}{C_A \cdot V_A}$

Since $x_{max} = C_A \cdot V_A$

so $\alpha(CH_3COOH) = 1 - \frac{x_f}{x_{max}}$

we know that $\tau = \frac{x_f}{x_{max}}$

0,5

therefore $\alpha(CH_3COOH) = 1 - \tau$

we have $[H_3O^+] = \frac{x_f}{V_A}$ according to the progress table

so $x_f = [H_3O^+] \cdot V_A$ (where $[H_3O^+] = 10^{-pH}$)

and we have $x_{max} = C_A \cdot V_A$

so $\tau = \frac{[H_3O^+] \cdot V_A}{C_A \cdot V_A} = \frac{10^{-pH}}{C_A}$

0,25

therefore $\alpha(CH_3COOH) = 1 - \frac{10^{-pH}}{C_A} = 0{,}9821$

3.) we know that

$$K_A = \frac{[CH_3COO^-][H_3O^+]}{[CH_3COOH]}$$

According to the progress table

$[H_3O^+] = [CH_3COO^-] = \frac{x_f}{V_A} = 10^{-pH}$

$[CH_3COOH] = C_A - \frac{x_f}{V_A}$

0,5

so $K_A = \frac{[H_3O^+]^2}{[CH_3COOH]} = \frac{\frac{x_f}{V_A}}{C_A - \frac{x_f}{V_A}} = \frac{10^{-2pH}}{C_A - 10^{-pH}}$

so $pK_A = -\log\left(\frac{10^{-2pH}}{C_A - 10^{-pH}}\right) = 4{,}79$

0,5

2.1) The equation of reaction:

$CH_3COOH_{(aq)} + HCOO^-_{(aq)} \rightleftharpoons CH_3COO^-_{(aq)} + HCOOH_{(aq)}$

2.2) we know that

$$Q_{r,eq} = \frac{[HCOOH]_{eq} \cdot [CH_3COO^-]_{eq}}{[CH_3COOH] \times [HCOO^-]}$$

$$Q_{r,eq} = \frac{[HCOOH]_{eq} \cdot [CH_3COO^-] \cdot [H_3O^+]}{[CH_3COOH] \cdot [HCOO^-] \cdot [H_3O^+]}$$

$Q_{r,eq} = \dfrac{K_{A1}}{K_{A2}} = \dfrac{10^{-pK_{A1}}}{10^{-pK_{A2}}} = 10^{pK_{A2} - pK_{A1}}$ 0.75

2.3) $pH = \dfrac{1}{1 + 10^{pK_{A2} - pK_{A1}}}$

$Q_{r,eq} = 0.0912$

3.1) The equation of reaction

$CH_3-\overset{\overset{O}{\|}}{C}-OH_{(aq)} + CH_3-OH_{(aq)} \rightleftharpoons CH_3-\overset{\overset{O}{\|}}{C}-O-CH_{3(aq)} + H_2O_{(l)}$ 0.5

3.2) The curve where the catalyst is used is the curve C.

we have $t_{f_1} > t_{f_2}$ t_f (the instant when x reaches x_f) 0.5

3.3) The progress table

The equation of reaction		$CH_3-\overset{\overset{O}{\|}}{C}-OH + CH_3-OH \rightleftharpoons CH_3-\overset{\overset{O}{\|}}{C}-O-CH_3 + H_2O$			
state of reaction	progress x	Amount of substances			
Initial state	0	$n_i(CH_3COOH)$	$n_i(CH_3OH)$	0	0
Intermediate state	x	$n_i(CH_3COOH)-x$	$n_i(CH_3OH)-x$	x	0
final state	x_f	$n_i(CH_3COOH)-x_f$	$n_i(CH_3OH)-x_f$	x_f	x_f
Max state	x_{max}	$n_i(CH_3COOH)-x_{max}$	$n_i(CH_3-OH)-x_{max}$	x_{max}	x_{max}

at the equilibrium

$n_{eq}(CH_3COOH) = n_i(CH_3COOH) - x_f$

we have $n_{af} = 0.3$ mol

so $n_{af} = n_i\ CH_3COOH - x_f$ $(n_0(CH_3COOH) = n_0(CH_3OH))$

so $x_f = n_0(CH_3COOH) - n_{af}$

$x_f = 0.6$ mol

Therefore the composition of the reactional mixture at the equilibrium is:

$n_{eq}(CH_3COOH) = 0.3$ mol

$n_{eq}(CH_3OH) = 0.3$ mol

$n_{eq}(CH_3COOCH_3) = 0.6$ mol 0.5

$n_{eq}(H_2O) = 0.6$ mol

3.4) at $t = t_{1/2}$ we have $x_{1/2} = \dfrac{x_{max}}{2}$

$n_0(CH_3COOH) = n_0(CH_3OH) = 0.9$

therefore according to the progress table both are limiting reactant $(CH_3COOH$ and $CH_3OH)$

therefore $x_{max} = 0.9$

~~so $n_{a t_{1/2}}$~~

$n_a = n_i - x$ 0

so $n_{a\,t_{1/2}} = n_0 - \dfrac{x_{max}}{2}$

$n_{a\,t_{1/2}} = 0.9 - \dfrac{0.9}{2} = 0.45$ mol

$t_{1/2}$ is the antecedent of $n_{a\,t_{1/2}}$

so $t_{1/2}$ of the curve C_2 is $t_{1/2} = 7$ h

- <u>تنبيه</u>: يمنع على المترشح(ة) أن يوقع أو يضع أية علامة في ورقته(ها) تبين هويته(ها).

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مادة : ....

خاص بالأكاديمية

....

اسم المصحح وتوقيعه (ها) : ....

3.5) $\tau = \frac{x_f}{x_{max}}$

0,75

According to the progress table $x_{max} = 0,5$ mol and $x_f = 0,6$ mol

so $\tau = \frac{0,6}{0,5} = 0,67 = ~~66,67\%~~$

3.6)

eq of reacti		$CH_3COOH + CH_3COH \rightleftharpoons CH_3-\overset{O}{C}-O-CH_3 + H_2O$			
state	progr	Amount of substance			
Init st	0	0,43	0,33	0,6	0,6
Inter eq st	x_{eq}	$0,43 - x_{eq}$	$0,33 - x_{eq}$	$0,6 + x_{eq}$	$0,6 + x_{eq}$

we know that

$$K = \frac{[CH_3COOCH_3][H_2O]}{[CH_3COOH][CH_3COH]}$$

0,25

$$K = \frac{(0,6 + x_{eq})^2}{(0,43 - x_{eq})(0,33 - x_{eq})}$$ Then $4 = \frac{0,36 + 1,2x_{eq} + x_{eq}^2}{0,1419 - 0,43x_{eq} - 0,33x_{eq} + x_{eq}^2}$

so $x_{eq} =$

Exercise 2:

1.1) The correct statement is : C

1.2) The equation of the disintegration of the tritium nucleus

$^3_1H \longrightarrow ^A_Z X + ^0_{-1}e$

According to SODDY's law

$\begin{cases} 3 = A - 0 \\ 1 = Z - 1 \end{cases}$ $\begin{cases} A = 3 \\ Z = 2 \end{cases}$

0,25

therefore $^A_Z X = ^3_2He$

therefore

$^3_1H \longrightarrow ^3_2He + ^0_{-1}e$

1.3) we know that

$N_t = N_0 \cdot e^{-\lambda \cdot t}$

- تنبيه: يمنع على المترشح(ة) أن يوقع أو يضع أية علامة في ورقته(ها) تبين هويته(ها).

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at $t = t_{1/2}$ $N = \frac{N_0}{2}$

so $\frac{N_0}{2} = N_0 \, e^{-\lambda . t_{1/2}}$

$\ln\left(\frac{1}{2}\right) = -\lambda . t_{1/2}$

0,25

therefore $\ln(2) = \lambda . t_{1/2}$

so $t_{1/2} = \frac{\ln 2}{\lambda}$

1.1.1) let's find N_0

at $t = 0$

$\frac{m_0 ({}^3H)}{M ({}^3H)} = \frac{N_0}{N_A}$

so $N_0 = \frac{m_0 ({}^3_1H) . N_A}{M ({}^3_1H)}$

N.A $N_0 = 4{,}013 . 10^{17}$

we know that $a_0 = \lambda . N_0$

so $a_0 = 3{,}16 . 10^{-18}$ Bq

at an instant t_1 90% of the tritium nuclei are disintegrated

we have $N = N_0 \, e^{-\lambda t_1}$

at t_1 $10\% \, N_0 = N_0 \, e^{-\lambda . t_1}$

0,5

$\ln(10\%) = -\lambda . t_1$

so $t_1 = 1293266470$ s

at t_1

$a_x = a_0 \, e^{-\lambda . t_1}$

$a_x = 71455046$ Bq

2.1) ~~a.~~ False

~~the binding energy is~~

~~$E_\ell ({}^4_2He) - E_\ell {}^2H - E_\ell {}^3H = 17{,}455$ MeV~~

-N.B: IL' est interdit au candidat de signer sa composition ou d'y mettre un signe quelconque pouvant indiquer son identité.

b) True

the $\mathcal{E}(^2_1H) = \dfrac{E_b(^2_1H)}{2} = 1.113$ MeV

$\mathcal{E}(^3_1H) = \dfrac{E_b(^3_1H)}{3} = 2.835$ MeV 0,25

so $\mathcal{E}(^3_1H) > \mathcal{E}(^2_1H)$

therefore the tritium is more stable than the deuterium

2.1) a) True

we have the binding energy of the tritium is the energy required to seperate the nucleons from nucleus

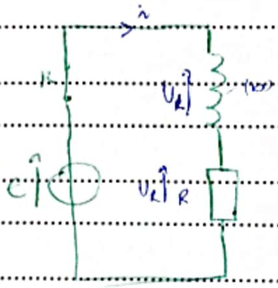
we have $E_b(^3_1H) = 8.475$ MeV 0,25

2.2) $|\Delta E| = |E_b(^2_1H) + E_b(^3_1H) - E_b(^4_2He)|$

$= |-17.455\text{ MeV}|$ 0,5

$\mathcal{E}_{pro} = |\Delta E| = 17.455$ MeV

Exercise 3



1.1) According to the second law of Kirchhoff:

$u_R + u_L = E$ 0,25

$Ri + L\dfrac{di}{dt} = E$

$\dfrac{di}{dt} + \dfrac{R}{L}i = \dfrac{E}{L}$ (1)

1.2) we have $i(t) = A + Be^{-\frac{t}{\tau}}$

so $\dfrac{di(t)}{dt} = -B\dfrac{1}{\tau}e^{-\frac{t}{\tau}}$

we substitute in (1)

$-B\dfrac{1}{\tau}e^{-\frac{t}{\tau}} + \dfrac{R}{L}(A + Be^{-\frac{t}{\tau}}) = \dfrac{E}{L}$

$-B\dfrac{1}{\tau}e^{-\frac{t}{\tau}} + \dfrac{R}{L}A + \dfrac{R}{L}Be^{-\frac{t}{\tau}} = \dfrac{E}{L}$

at $t=0$ $i(0) = A + B$

so $A = -B$

$Be^{-\frac{t}{\tau}}\left(-\dfrac{1}{\tau} + \dfrac{R}{L}\right) = \dfrac{E}{L} - \dfrac{R}{L}A$

$Be^{-\frac{t}{\tau}} \neq 0$

For the equation to be verified

$\begin{cases} -\dfrac{1}{\tau} + \dfrac{R}{L} = 0 \\ \dfrac{E}{L} - \dfrac{R}{L}A = 0 \end{cases} \Rightarrow \begin{cases} \dfrac{R}{L} = \dfrac{1}{\tau} \\ \dfrac{E}{L} = \dfrac{R}{L}A \end{cases} \Rightarrow \begin{cases} \tau = \dfrac{L}{R} \\ A = \dfrac{E}{R} \end{cases}$

-**N.B:** IL' est interdit au candidat de signer sa composition ou d'y mettre un signe quelconque pouvant indiquer son identité.

so $B = -\frac{E}{R}$

therefore

the expression is written as: 0,5

$i(t) = \frac{E}{R} - \frac{E}{R} e^{-\frac{t}{\tau}}$

so $i(t) = \frac{E}{R}\left(1 - e^{-\frac{t}{\tau}}\right)$

1.2.2) According to the graph: $\tau = 2\,ms$

and we know that

$\tau = \frac{L}{R}$ so $L = \tau . R$ 0,5

at the steady state

$i = \frac{E}{R}$ so $R = \frac{E}{i}$ where $i = 48\,mA$

therefore $L = \tau \frac{E}{i} = 2.10^{-3} \frac{24}{48.10^{-3}} = 1\,H$

1.3) we have

$i(t) = \frac{E}{R}\left(1 - e^{-\frac{t}{\tau}}\right)$

and $\frac{di}{dt} = -\frac{E}{R} . -\frac{1}{\tau} e^{-\frac{t}{\tau}}$

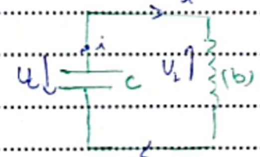
$\frac{di}{dt} = -\frac{E}{R} \frac{R}{L} e^{-\frac{t}{\tau}}$ 0,5

$L \frac{di}{dt} = \frac{-E}{L} . L e^{-\frac{t}{\tau}}$

$U_L(t) = + E e^{-\frac{t}{\tau}}$

$U_L(t) = 24\, e^{-\frac{t}{2.10^{-3}}}$

2.1) According to the second law of Kirchhoff:



$U_C + U_L = 0$

$U_C + L \frac{di}{dt} = 0$

$U_C + LC \frac{d^2U_C}{dt^2} = 0$ 0,25

$\frac{d^2U_C}{dt^2} + \frac{1}{LC} U_C = 0$

2.2.1) we know that

$T_0 = 2\pi \sqrt{L.C}$

so $C = \left(\frac{T_0}{2\pi}\right)^2 \frac{1}{L} = 1.10^{-7}\,F$ 0,5

2.2.2) $E_m = \frac{1}{2} L i^2$ 0,5

- **تنبيه:** يمنع على المترشح(ة) أن يوقع أو يضع أية علامة في ورقته(ها) تبين هويته(ها).

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....

الشعبة/المسلك : ....

مادة : ....

اسم المصحح وتوقيعه (ها) : ....

3.1) the correct is B 0,5

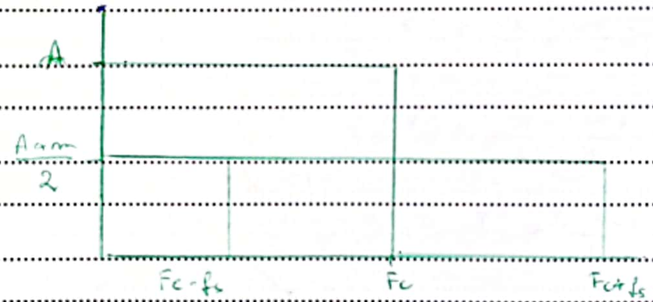
3.2) a- False

$m = \dfrac{U_{max} - U_{min}}{U_{max} + U_{min}} = \dfrac{6-2}{6+2} = 0,5$ ✗ 0,5

b) True A cordig to the graph $U_0 = 2V$ 0,25 0

$U_0 = \dfrac{6-2}{2} = 2V$

3.3)



0,5

- تنبيه: يمنع على المترشح(ة) أن يوقع أو يضع أية علامة في ورقته(ها) تبين هويته(ها).

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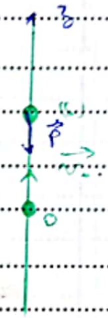
Exercise 4:



1.1) According to the second law of Newton

$\sum \vec{F}_{ext} = m.\vec{a}_G$

$m = $ ~~propose~~

$\vec{P} = m.\vec{a}_G$

we project on z axis

$P_z = m.a_z$

$-m.g = m.a_z$

so $a_z + g = 0$

by primitive

$v_z = -g.t + v_0$

$v_z(t) = -10.t + 12$

by primitive

$z(t) = -\frac{1}{2}10t^2 + 12t + z_0$

$z(t) = -5t^2 + 12t$ ✓ 1

0,75

1.2.1) when G reaches the max height h $v_z = 0$

so $v_z(t) = -10.t_a + 12$

so $t_a = \frac{12}{10} = 1.2s$

so $z(t_a) = h_{max} = -5t_a^2 + 12t_a$

$= -5 \times 1,2^2 + 12 \times 1,2$

$h_{max} = 7,2m$

0,5

1.2.2) when G moves through the point O $z(t) = 0$

so $0 = -5t^2 + 12t$

$+5t_{o_2}^2 = 12t$

$5t_{o_2} = 12$

$t_{o_2} = \frac{12}{5} = 2,4s$

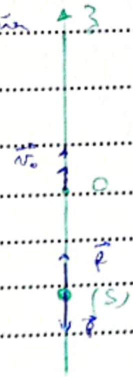
0,5

so $|v_{o_2}| = |-10t_{o_2} + 12|$

$|v_{o_2}| = |-12| m.s = 12 ms$ $(v_{o_2} = -v_0)$

-N.B: IL' est interdit au candidat de signer sa composition ou d'y mettre un signe quelconque pouvant indiquer son identité.

2.1) According to the second law of Newton



$\sum \vec{F}_{ext} = m \cdot \vec{a}_G$

$\vec{P} + \vec{f} = m \cdot \vec{a}_G$

we project on z-axis

$P_z + f_z = m \cdot a_z$

0,75

$-m \cdot g - \lambda v_z = m \cdot a_z \quad (\vec{v} = v_z \vec{k})$

so $m\, a_z + m g + \lambda\, v_z = 0$

$\frac{dv_z}{dt} + g + \frac{\lambda}{m} v_z = 0$ we denote $\frac{\lambda}{m} = \frac{1}{\tau}$

so $\frac{dv_z}{dt} + \frac{1}{\tau} v_z + g = 0$

2.2) at the steady state $\frac{dv_z}{dt} = 0$

so $\frac{1}{\tau} v_{z_\ell} + g = 0$

0,75

so $v_{z_\ell} = -g \cdot \tau$ $\quad (v_{z_\ell} = -v_\ell)$ (opposite sense)

$v_\ell = g \cdot \frac{m}{\lambda} = 6,67\ m \cdot s^{-1}$

2.3) $v_z(t_1)$

$a_{t=1} + \frac{1}{\tau} v_z + g = 0$

$v_z = (-g - a_{t=1})\, \tau$ 0,25

$v_z = -10,33\ m \cdot s^{-1}$

since $v_z = -v$ $\quad (\vec{v} = v_z \vec{k})$

so $v = 10,33\ m \cdot s^{-1}$

Part II:

1) we know that

$E_{pp} = m \cdot g \cdot z + C$

At the equilibrium state

$E_{pp} = 0$ so $C = 0$

then $E_{pp} = m \cdot g \cdot z$

we have

$OG_0 = OH + HG_0$

so $HG_0 = OG_0 - OH$

$HG_0 = z = OG_0 - OH$

-N.B: IL' est interdit au candidat de signer sa composition ou d'y mettre un signe quelconque pouvant indiquer son identité.

In the triangle OHG

$\cos\theta = \frac{OH}{OG}$

so $OH = \cos\theta \cdot OG$

thus $z = OG - OG\cos\theta$

$z = l(1-\cos\theta)$

we have $\cos\theta \approx 1 - \frac{\theta^2}{2}$ so $1-\cos\theta \approx \frac{\theta^2}{2}$

thus $z = l \cdot \frac{\theta^2}{2}$

so $E_{pp} = m \cdot g \cdot z = \frac{1}{2} m \cdot g \cdot l \cdot \theta^2$

0,5

2.1) we have $\theta_m = \theta_{max} = 9°$

At the maximum state

$E_{pp_{max}} = \frac{1}{2} m \cdot g \cdot l \cdot \theta_m^2$

so $E_{pp_{max}} = E_m \quad (E_k = 0)$

therefore $E_k = \frac{1}{2} J_\Delta \dot{\theta}^2$

so $E_{k_{max}} = \frac{1}{2} J_\Delta \cdot \dot{\theta}^2_{max} = E_m$

0,25

so $E_{pp_{max}} = E_{k_{max}}$

$\frac{1}{2} m g l \theta_m^2 = \frac{1}{2} m l^2 \dot{\theta}^2_{max}$

$\dot{\theta}_{max} = \sqrt{\frac{g}{l}}$

$\dot{\theta}_{max} = 3{,}041$ rad

2.2) According to the fundamental relationship of dynamics

$\sum M(\vec{F}_{ext}) = J_\Delta \ddot{\theta}$

$M(\vec{P}) + M(\vec{R}) = J_\Delta \ddot{\theta}$

$-P l \sin\theta = J_\Delta \ddot{\theta}$

so $J_\Delta \ddot{\theta} + m g l \sin\theta = 0 \quad (\sin\theta \approx \theta)$

so $m l^2 \ddot{\theta} + m g l \sin\theta = 0$

$\ddot{\theta} + \frac{g}{l}\theta = 0$

0,5

0,25

3) we know that T of the simple pendulum is

$T = 2\pi\sqrt{\frac{l}{g}}$

- تنبيه: يمنع على المترشح(ة) أن يوقع أو يضع أية علامة في ورقته(ها) تبين هويته(ها).

ⵜⴰⴳⵍⴷⵉⵜ ⵏ ⵍⵎⵖⵔⵉⴱ
ⵜⴰⵎⴰⵡⴰⵙⵜ ⵏ ⵜⵔⴱⵉⵜ ⵜⴰⵏⴰⵎⵓⵔⵜ
ⴷ ⵓⵙⵍⵎⴷ ⴰⵎⵣⵡⴰⵔⵓ ⴷ ⵜⵏⴰⴹⵓⵜ

المملكة المغربية
وزارة التربية الوطنية
والتعليم الأولي والرياضة

امتحان شهادة البكالوريا

النقطة الإجمالية	
بالأرقام	بالحروف
التقدير المفسر للنقطة	

خاص بالأكاديمية
....

الشعبة /المسلك : ....

مادة : ....

اسم المصحح وتوقيعه (ها) : ....

a?? Tout
so T = 3,07 s

0,7

ـ **تنبيه**: يمنع على المترشح(ة) أن يوقع أو يضع أية علامة في ورقته(ها) تبين هويته(ها).