X

Unit 11 - Week 10

Course outline

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- Module 16 - Lecture 64 : Interfacial energy in CH
- Module 16 - Lecture 65 : CH: analytical solution
- Module 16 - Lecture 66 : Interfacial energy in CH:

Assignment 10

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2018-10-10, 23:59 IST.

1) The analytical solution for Cahn-Hilliard equation, where the free energy profile is given by $f_0 = Ac^2(1-c)^2$ in 1-D (where c is the composition) is : ***1 point***

- $c = \frac{1}{2}\left(1 + tanh\left(\frac{\beta x^2}{2}\right)\right)$
- $c = \frac{1}{2}\left(1 + tanh\left(\frac{\beta x^3}{2}\right)\right)$
- $c = \frac{1}{2}\left(1 + tanh\left(\frac{\beta x}{2}\right)\right)$
- $c = \frac{1}{2}\left(1 + tanh\left(\frac{\beta^2 x}{2}\right)\right)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$c = \frac{1}{2}\left(1 + tanh\left(\frac{\beta x}{2}\right)\right)$

2) Consider the following step during the solution of the Euler-Lagrange equation for the Cahn-Hilliard formulation. ($F(x, y, y\prime)$ is the free energy functional): ***1 point***

$$\frac{d}{dx}\left(y\prime \frac{\partial F}{\partial y\prime}\right) = y\prime \frac{\partial F}{\partial y} + y\prime\prime \frac{\partial F}{\partial y\prime}$$

In the next step, we simplify this expression as :

$$\frac{d}{dx}\left(y\prime \frac{\partial F}{\partial y\prime}\right) = \frac{dF}{dx}$$

where, the following identity is used for simplification.

analytical values
Module 17 - Lecture 68 : Order-disorder transition and Allen-Cahn equation
Module 17 - Lecture 69 : AC: numerical solution
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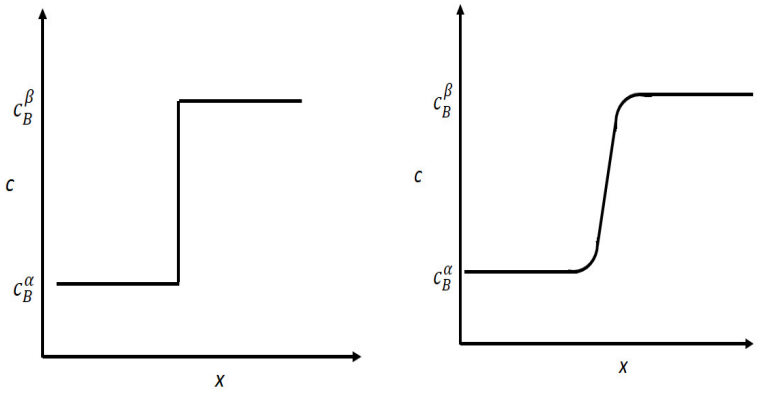
- F is not an explicit function of x.
- The above simplification is incorrect.

No, the answer is incorrect.
Score: 0

Accepted Answers:
F is not an explicit function of x.

3) Which of the following two systems will have a higher gradient energy contribution? ***1 point***



- System 1 (First image from left)
- System 2 (Second image from left)

No, the answer is incorrect.
Score: 0

Accepted Answers:
System 1 (First image from left)

4) We know that the values of both κ and A affect the interfacial and bulk free energy contributions. These may be calculated by slightly modifying the GNU Octave script which was used to solve Cahn-Hilliard equation (spectral technique). Using the values of $\kappa = 3,\ dx = 1,\ dt = 0.5\ and\ A = 1$, calculate the contribution of interfacial energy (for one interface) in a 1-D system of size N = 128 by running the simulation for 4000 steps. (Note: We are solving a non-dimensionalized equation) ***1 point***

- 0.57735
- 0.28868
- -0.28868
- -0.57735

No, the answer is incorrect.
Score: 0

Accepted Answers:
0.28868

5) For the same conditions as in Q.4 ($\kappa,\ A,\ dx,\ dt$ etc.), find the interfacial energy contribution (again for one interface) using finite difference method. What is the value? (**Hint**: Use *diff* command in GNU Octave to find out finite difference. However, there is a catch !) ***1 point***

- -0.28108
- 0.28708
- 0.28208
- -0.29808

No, the answer is incorrect.
Score: 0

Accepted Answers:
0.28708

6) Which of the following options is/are represented by a non-conserved order parameter? ***1 point***

- grain orientation in a grain growth model.
- % fraction of ordered phase during an order-disorder transformation.
- composition in a diffusion problem.
- both (a) and (b)

No, the answer is incorrect.
Score: 0

Accepted Answers:
both (a) and (b)

7) Consider a system in which the contribution of bulk free energy is given by $Ac^2(1-c)^2$ and interfacial free energy is given by $\kappa(\frac{dc}{dx})^2$. Equilibrium in a system of the above type is achieved in such a way that: ***1 point***

- bulk free energy and interfacial energy is minimized to zero.
- changes in bulk free energy and interfacial energy balance each other.
- change in bulk free energy is greater than the change in interfacial free energy
- change in bulk free energy is less than the change in interfacial free energy

No, the answer is incorrect.
Score: 0

Accepted Answers:
changes in bulk free energy and interfacial energy balance each other.

8) State whether true or false : "Grain growth phenomena is modelled using Allen-Cahn equation because the order parameter in such a model is not conserved"

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: String) true

1 point

9) The semi-implicit form of Allen-Cahn equation in Fourier space is given by : ***1 point***

- $\tilde{\phi}^{t+\Delta t} = \frac{\tilde{\phi}^t - L\Delta t\tilde{g}}{1+2\kappa Lk^2}$
- $\tilde{\phi}^{t+\Delta t} = \frac{\tilde{\phi}^t + L\Delta t\tilde{g}}{1+2\kappa Lk^2}$
- $\tilde{\phi}^{t+\Delta t} = \frac{\tilde{\phi}^t - L\Delta t\tilde{g}}{1-2\kappa Lk^2}$
- $\tilde{\phi}^{t+\Delta t} = \frac{\tilde{\phi}^t + L\Delta t\tilde{g}}{1-2\kappa Lk^2}$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$\tilde{\phi}^{t+\Delta t} = \frac{\tilde{\phi}^{t} - L\Delta t\tilde{g}}{1+2\kappa Lk^2}$

10)Which among the following is the correct expression for concentration profile according to the analytical solution of the Cahn-Hilliard equation? (Note: All symbols have usual meaning) ***1 point***

- $c = \frac{1}{1+e^{\sqrt{\frac{A}{\kappa}}x}}$
- $c = \frac{1}{1+e^{-\sqrt{\frac{A}{\kappa}}x}}$
- $c = \frac{1}{1-e^{\sqrt{\frac{A}{\kappa}}x}}$
- $c = \frac{1}{1-e^{-\sqrt{\frac{A}{\kappa}}x}}$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$c = \frac{1}{1+e^{-\sqrt{\frac{A}{\kappa}}x}}$

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