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Courses » **Computational Fluid Dynamics**

Announcements **Course** Ask a Question Progress FAQ

Unit 10 - Week 9

Course outline

Week 9 Assignment 9

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

Due on 2018-10-03, 23:59 IST.

1) *1 point*

Consider the following statement regarding the gradient search based method.

(i) r_0 and r_1 are orthogonal to each other.

(ii) r_0 is "A" orthogonal to r_1

(iii) p_0 and p_1 are orthogonal to each other.

(iv) p_0 is "A" orthogonal to p_1

Choose the correct statement(s)

(a) only (i) is correct
(b) only (iii) is correct
(c) (i) and (iv) are correct
(d) (ii) and (iii) are correct.

- a
- b
- c
- d

No, the answer is incorrect.
Score: 0

Accepted Answers:
c

2) *1 point*

One has applied conjugate gradient method for solving Ax=b. The iteration equation is written as

$$x^n = x^{n-1} + \alpha_{n-1} p_{n-1}$$

where r_{n-1} is the residual at (n-1) th iteration and is given by $r_{n-1} = b - Ax^{n-1}$. Choose the correct expression for α_{n-1} and p_{n-1}

(a) $\alpha_{n-1} = \dfrac{r_{n-1}^T r_{n-1}}{r_{n-1}^T A r_{n-1}}$, $p_{n-1} = r_{n-1} - \dfrac{p_{n-2}^T A r_{n-1}}{p_{n-2}^T A p_{n-2}} p_{n-2}$

(b) $\alpha_{n-1} = \dfrac{p_{n-1}^T r_{n-1}}{p_{n-1}^T A p_{n-1}}$, $p_{n-1} = r_{n-1} - \dfrac{p_{n-2}^T A r_{n-1}}{p_{n-2}^T A p_{n-2}} p_{n-2}$

(c) $\alpha_{n-1} = \dfrac{p_{n-1}^T r_{n-1}}{p_{n-1}^T A p_{n-1}}$, $p_{n-1} = r_{n-1} - \dfrac{p_{n-2}^T r_{n-1}}{r_{n-2}^T A r_{n-2}} p_{n-2}$

(d) $\alpha_{n-1} = \dfrac{p_{n-1}^T p_{n-1}}{r_{n-1}^T A r_{n-1}}$, $p_{n-1} = r_{n-1} - \dfrac{r_{n-2}^T r_{n-1}}{p_{n-2}^T A p_{n-2}} p_{n-2}$

- a
- b
- c
- d

No, the answer is incorrect.
Score: 0

Accepted Answers:
b

3) *1 point*

Consider the solution of $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 2 \\ 2 \end{bmatrix}$ by using gradient search method.

Which of the following is correct?

(a) Steepest descent method can be applied for the problem, while conjugate gradient method can not be applied.
(b) Conjugate gradient method can be applied for the problem, while steepest descent method can not be applied.
(c) Both the methods can be applied although steepest descent method requires more number of steps than conjugate gradient method.
(d) Both the methods can be applied and the solution can be obtained by identical steps in both steepest descent and conjugate gradient method.

- a
- b
- c
- d

No, the answer is incorrect.
Score: 0

Accepted Answers:
d

4) *1 point*

In general, the Peclet number corresponding to energy transfer, momentum transfer and mass transfer are respectively given by

(a) Pr, Re and Sc

(b) Pr, Re and Re × Sc

(c) Re/Pr, Re and Re/Sc

(d) Re × Pr, Re and Re × Sc

where Pr is Prandtl number, Re is Reynolds number and Sc is Schmidt number.

- a
- b
- c
- d

No, the answer is incorrect.
Score: 0

Accepted Answers:
d

5) *1 point*

The central difference scheme will not work accurately

(a) if the cell based Peclet number is less than or equal to 2

(b) if the coefficients of the discretized equation satisfy the Scarborough criterion

(c) in the limit of very weak diffusion

(d) in the limit of very weak advection

- a

- b
- c
- d

No, the answer is incorrect.
Score: 0

Accepted Answers:
c

6) **1 p**

A property φ is transported by means of convection and diffusion through the one dimensional domain sketched in Figure 1a which is divided into 5 equal control volumes as shown in Figure 1b. The governing differential equation is $\frac{d}{dx}(\rho u\phi)=\frac{d}{dx}\left(\Gamma\frac{d\phi}{dx}\right)$.

The boundary conditions are ϕ_A=1 at x=0 and ϕ_B=0 at x=L. Other parameter include u= m/s, L=2m, $\rho = 1\text{kg/m}^3$ and $\Gamma = 0.5\text{kg/ms}$. If the finite volume based discretized equation with the central difference scheme for convective and diffusive terms is of the form $a_P\phi_P = a_W\phi_W + a_E\phi_E + S_u$ and the domain is discretized into five equal control volumes then the solution obtained will

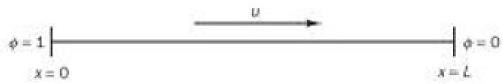

Figure 1a

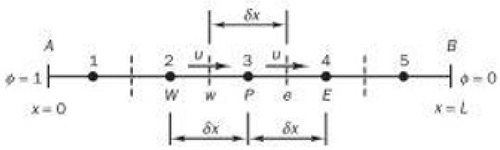

Figure 1b

(a) Satisfy conservativeness and boundedness

(b) Satisfy conservativeness, boundedness and Transportiveness

(c) Satisfy conservativeness, but will be unbounded and non-transportive

(d) Satisfy boundedness but will not be conservative

- a
- b
- c
- d

No, the answer is incorrect.
Score: 0

Accepted Answers:
c

7) **1 point**

Consider the governing differential equation $\frac{d}{dx}(\rho u\phi) = \frac{d}{dx}\left(\Gamma \frac{d\phi}{dx}\right)$ which is discretized us

the central difference scheme into the form $a_P\phi_P = a_W\phi_W + a_E\phi_E$ w

$a_E = D_e - \frac{F_e}{2}, a_W = D_w - \frac{F_w}{2}$ and $a_P = a_E + a_W$. Given that $F_e = F_w = 100, \phi_E = 100$ and $\phi_W =$

If $\Gamma = 10\text{kg/ms}$ then the minimum number of control volumes into which the doma

length 1m should be divided in order to achieve a bounded solution is

(a) 4

(b) 5

(c) 10

(d) 20

- a
- b
- c
- d

No, the answer is incorrect.
Score: 0

Accepted Answers:
b

8) ***1 point***

A property φ is transported by means of convection and diffusion through the one-dimensional domain sketched in the figure 2a which is divided into 5 equal control volumes as shown in Figure 2b. The governing differential equation is $\frac{d}{dx}(\rho u\phi)=\frac{d}{dx}\left(\Gamma\frac{d\phi}{dx}\right)$. The boundary conditions are $\phi_A=1$ at x=0 and $\phi_B=0$ at x=L. Other parameter include u=5 m/s, L=2m, $\rho=1\text{kg/m}^3$ and $\Gamma=0.5\text{kg/ms}$. If the finite volume based discretized equation with the upwind difference scheme for convective and diffusive terms is of the form $a_P\phi_P=a_W\phi_W+a_E\phi_E+S_u$ then the relation between ϕ_4 and ϕ_5 is

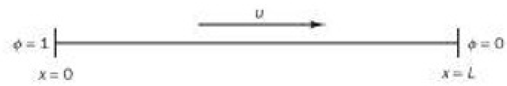

Figure 2a

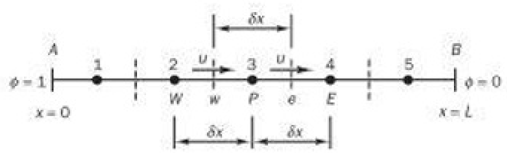

Figure 2b

(a) $\phi_5=6.25\phi_4$

(b) $\phi_5=8.75\phi_4$

(c) $\phi_5=0.7143\phi_4$

(d) $\phi_5=\phi_4/0.7143$

- a
- b
- c
- d

No, the answer is incorrect.
Score: 0

Accepted Answers:
c

9) *1 point*

The temperature variation in condenser tube is given by $\dot{m}C\frac{dT}{dx}=\frac{UA}{L}(T_0-T)$, where $\dot{m}$ is mass flow rate, C is the specific heat, T is the temperature of cooling water, T_0 is the con temperature of the condensing steam, U is the overall heat transfer coefficient, A ar the total heat transfer area. It is given that $\frac{AU}{\dot{m}C}=2$. Define a non- dimensional temperature $\theta=\frac{T-T_{in}}{T_0-T_{in}}$, $y=\frac{x}{L}$ with $y=0$ at $\theta=0$. The exact profile of temperature con expressed as

(a) $\theta=1-e^{-2y}$

(b) $\theta=1-e^{-y}$

(c) $\theta=1+e^{-2y}$

(d) $\theta=1+e^{-y}$

- a
- b
- c
- d

No, the answer is incorrect.
Score: 0

Accepted Answers:
a

10) *1 point*

The temperature variation in condenser tube is given by $\dot{m}C\frac{dT}{dx}=\frac{UA}{L}(T_0-T)$, where $\dot{m}$ is the mass flow rate, C is the specific heat, T is the temperature of cooling water, T_0 is the constant temperature of the condensing steam, U is the overall heat transfer coefficient, L is the length of the condenser tube and A is the total heat transfer area. It is given that $\frac{AU}{\dot{m}C}=2$. Define a non-dimensional temperature $\theta=\frac{T-T_{in}}{T_0-T_{in}}$, $y=\frac{x}{L}$. The boundary conditions are at x=0, T=T_{in}. If the domain is divided into 5 grid points with Δx = 0.25 L, then what is the value of θ at the 5th grid point using upwind scheme?

(a) 0.8025

(b) 0.9265

(c) 0.9864

(d) 0.62

- a
- b
- c
- d

No, the answer is incorrect.
Score: 0

Accepted Answers:
a

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