Unit 7 - Week 5

Assignment 5

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

Due on 2019-09-04, 23:59 IST.

1) Under what limits can the nonlinear terms of magnetoconvection be dropped? *1 point*

- $u \ll B_0$ and $b \ll B_0$
- $u \gg B_0$ and $b \ll B_0$
- $u \ll B_0$ and $b \gg B_0$
- $u \gg B_0$ and $b \gg B_0$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$u \ll B_0$ and $b \ll B_0$

2) The ratio between Prandtl number and magnetic Prandtl number is Pr/Pm. What is this ratio in terms of kinematic viscosity, ν, thermal diffusivity, κ, and magnetic diffusivity, η? *1 point*

- $\frac{\nu^2}{\kappa\eta}$
- $\kappa\eta$
- $\frac{1}{\kappa\eta}$
- $\frac{\eta}{\kappa}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\frac{\eta}{\kappa}$

3) For linearized magnetoconvection equation in Craya-Herring basis, the evolution of the terms along $\hat{\mathbf{e}}_1$, namely $u_1(\mathbf{k})$ and $b_1(\mathbf{k})$, can be written in the form $\dot{\mathbf{x}} = \mathbf{A}\mathbf{x}$, where *1 point*

$$\mathbf{A} = \begin{pmatrix} -k^2\mathrm{Pr} & iQk_z\frac{\mathrm{Pr}^2}{\mathrm{Pm}} \\ ik_z & -k^2\frac{\mathrm{Pr}}{\mathrm{Pm}} \end{pmatrix}.$$

It can be seen that these components will decay with time because

- The trace of A is negative
- The determinant of A is positive
- Both eigenvalues of A are negative
- None of the above

No, the answer is incorrect.
Score: 0
Accepted Answers:
Both eigenvalues of A are negative

4) For a temperature field $\theta(\mathbf{k})$ in Fourier space, (where $*$ indicates complex conjugation), what is the reality condition? *1 point*

- $\theta(-\mathbf{k}) = \theta(\mathbf{k})$
- $\theta(-\mathbf{k}) = -\theta(\mathbf{k})$
- $\theta(-\mathbf{k}) = \theta^*(\mathbf{k})$
- $\theta(-\mathbf{k}) = -\theta^*(\mathbf{k})$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\theta(-\mathbf{k}) = \theta^*(\mathbf{k})$

5) Which of the following modes are used to derive the Lorenz equations? *1 point*

- U_{11}, U_{01}, and θ_{11}
- U_{01}, θ_{11}, and θ_{01}
- U_{11}, θ_{11}, and θ_{02}
- U_{01}, θ_{11}, and θ_{02}

No, the answer is incorrect.
Score: 0
Accepted Answers:
U_{11}, θ_{11}, and θ_{02}

6) Which of the following is the first bifurcation observed in the dynamics of Lorenz equations as the parameter r is increased? *1 point*

- Hopf bifurcation
- Supercritical pitchfork
- Subcritical pitchfork
- Saddle-node

No, the answer is incorrect.
Score: 0
Accepted Answers:
Supercritical pitchfork

7) Identify the triad used to derive the seven-mode model in the video lecture. *1 point*

- $(1,1,2) = (1,0,1) \oplus (0,1,1)$
- $(1,2,1) = (1,1,1) \oplus (0,1,0)$
- $(1,1,2) = (0,0,1) \oplus (1,1,1)$
- $(1,2,1) = (0,1,1) \oplus (1,1,0)$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$(1,1,2) = (1,0,1) \oplus (0,1,1)$

8) For the Lorenz equations, which value of r gives rise to chaotic behaviour? *1 point*

- $r < 0$
- $r \ll 1$
- $r \approx 1$
- $r \gg 1$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$r \gg 1$

9) In a chaotic system, if we choose two points which are close to each other in the phase space as initial condition, the trajectories starting from these two points will *1 point*

- Converge into a single path
- Stay close to each other
- Diverge, but the gap between them remains finite
- Diverge away to infinity

No, the answer is incorrect.
Score: 0
Accepted Answers:
Diverge, but the gap between them remains finite

10) For a box of size $\sqrt{2} \times \sqrt{2} \times 1$ satisfying free-slip boundary conditions on all walls, the wavenumber $\mathbf{k}_1 = (1,0,1)$ can be written as *1 point*

- $\sqrt{2}\,\hat{x} + \hat{z}$
- $\frac{\sqrt{2}}{\pi}\,\hat{x} + \frac{\hat{z}}{\pi}$
- $\frac{\pi}{\sqrt{2}}\,\hat{x} + \frac{\pi}{2}\hat{z}$
- $\frac{\pi}{\sqrt{2}}\,\hat{x} + \pi\hat{z}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\frac{\pi}{\sqrt{2}}\,\hat{x} + \pi\hat{z}$