Unit 12 - Week 10

Assignment 10

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

Due on 2019-10-09, 23:59 IST.

1) Total kinetic helicity is given by *1 point*

- $\frac{1}{2}\int d\mathbf{r} u^2$
- $\frac{1}{2}\int d\mathbf{r}(\mathbf{u}\cdot\boldsymbol{\omega})$
- $\frac{1}{2}\int d\mathbf{r}\omega^2$
- None of the above

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\frac{1}{2}\int d\mathbf{r}(\mathbf{u}\cdot\boldsymbol{\omega})$

2) For very large wavenumbers (dissipation range) in passive scalar turbulence, $\partial\Pi_\theta/\partial k$ is *1 point*

- Zero
- Positive
- Negative
- Cannot be said

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

3) The helicity injection rate in Fourier space is given by ($\mathbf{F}_u$ is the external force field) *1 point*

- $\sum \Re[\boldsymbol{\omega}^*(\mathbf{k})\cdot\mathbf{F}_u(\mathbf{k})]$
- $\sum \Im[\boldsymbol{\omega}^*(\mathbf{k})\cdot\mathbf{F}_u(\mathbf{k})]$
- $\sum \Re[\mathbf{u}^*(\mathbf{k})\cdot\mathbf{F}_u(\mathbf{k})]$
- $\sum \Im[\mathbf{u}^*(\mathbf{k})\cdot\mathbf{F}_u(\mathbf{k})]$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\sum \Re[\boldsymbol{\omega}^*(\mathbf{k})\cdot\mathbf{F}_u(\mathbf{k})]$

4) In a periodic box $[2\pi, 2\pi]$, consider the following flow with a scalar θ: *1 point*

$\mathbf{u} = A\hat{x}\cos y + B\hat{y}\cos x + C(\hat{x}-\hat{y})\sin(x+y)$
$\theta = A_\theta\cos y + B_\theta\cos x + C_\theta\sin(x+y)$.
The modal kinetic helicity at wavenumber (0,1) is

- $\frac{A^2}{4}$
- $\frac{AB}{4}$
- 0
- None of the above

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

5) For the flow described in Q.4, the total scalar energy for the flow is: *1 point*

- $A_\theta^2 + B_\theta^2 + C_\theta^2$
- $\frac{A_\theta^2}{2} + \frac{B_\theta^2}{4} + \frac{C_\theta^2}{8}$
- $\frac{A_\theta^2}{8} + \frac{B_\theta^2}{2} + C_\theta^2$
- $\frac{1}{4}(A_\theta^2 + B_\theta^2 + C_\theta^2)$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\frac{1}{4}(A_\theta^2 + B_\theta^2 + C_\theta^2)$

6) For the flow described in Q.4, the total scalar energy transferred to the mode $\theta(0,1)$ is *1 point*

- $\frac{1}{8}(A_\theta B_\theta C - A_\theta B C_\theta)$
- $\frac{1}{2}(A B_\theta C + A_\theta B C)$
- $2(A B_\theta C_\theta - A_\theta B C_\theta)$
- $4(A B C_\theta + A_\theta B C)$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\frac{1}{8}(A_\theta B_\theta C - A_\theta B C_\theta)$

7) Consider a triad $\mathbf{k} = \mathbf{p} + \mathbf{q}$. The kinetic helicity transfer from wavenumber $\mathbf{p}$ to wavenumber $\mathbf{k}$ with $\mathbf{q}$ as the mediator is *1 point*

- $\Re[\mathbf{u}(\mathbf{q})\cdot\{\boldsymbol{\omega}(\mathbf{p})\times\boldsymbol{\omega}(\mathbf{k})\}]$
- $\Re[\mathbf{u}(\mathbf{q})\cdot\{\boldsymbol{\omega}(\mathbf{p})\times\boldsymbol{\omega}^*(\mathbf{k})\}]$
- $\Im[\mathbf{u}(\mathbf{q})\cdot\{\boldsymbol{\omega}(\mathbf{p})\times\boldsymbol{\omega}(\mathbf{k})\}]$
- $-\Im[\mathbf{u}(\mathbf{q})\cdot\{\boldsymbol{\omega}(\mathbf{p})\times\boldsymbol{\omega}^*(\mathbf{k})\}]$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\Re[\mathbf{u}(\mathbf{q})\cdot\{\boldsymbol{\omega}(\mathbf{p})\times\boldsymbol{\omega}^*(\mathbf{k})\}]$

8) Which of the following sentences are true? Select ALL that apply. *1 point*

- Kinetic helicity is zero in two-dimensional flows.
- Kinetic helicity does not affect the kinetic energy spectrum in the inertial range of helical turbulence.
- The helicity flux decreases with wavenumber in the inertial range.
- Kinetic helicity spectrum and kinetic energy spectrum both follow $k^{-5/3}$ scaling in the inertial range.

No, the answer is incorrect.
Score: 0
Accepted Answers:
Kinetic helicity is zero in two-dimensional flows.

Kinetic helicity does not affect the kinetic energy spectrum in the inertial range of helical turbulence.
Kinetic helicity spectrum and kinetic energy spectrum both follow $k^{-5/3}$
scaling in the inertial range.

9) In the dissipation range, the ratio of the helicity flux to kinetic helicity in helical turbulence is (the symbols have their usual meanings) *1 point*

- $\frac{\epsilon_u^{1/3}k^{5/3}}{K_H}\exp\left(-\frac{3}{2}K_H(k/k_d)^{4/3}\right)^{1/2}$
- $\frac{\epsilon_u^{1/3}k^{5/3}}{K_H}\exp\left(-\frac{3}{2}K_H(k/k_d)^{4/3}\right)$
- $\frac{\epsilon_u^{1/3}k^{5/3}}{K_H}$
- None of the above

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\frac{\epsilon_u^{1/3}k^{5/3}}{K_H}$

10) Choose the correct statement for passive scalar turbulence. *1 point*

- In the inertial range, while kinetic energy flux is constant, scalar energy flux is not.
- The scalar energy spectrum follows $k^{-11/5}$ in the inertial range.
- The third order scalar structure function is given by $S_3^\theta(l) = -\frac{4}{5}\epsilon_\theta l$.
- None of the above are correct.

No, the answer is incorrect.
Score: 0
Accepted Answers:
None of the above are correct.