Unit 8 - Week 6

Assignment 6

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

Due on 2019-09-11, 23:59 IST.

1) Choose the correct expression for mode-to-mode energy transfer $S^{uu}(\mathbf{k}'|\mathbf{p}|\mathbf{q})$. *1 point*

- $-\Im[\{\mathbf{k}' \cdot \mathbf{u}(\mathbf{p})\}\{\mathbf{u}(\mathbf{q}) \cdot \mathbf{u}(\mathbf{k}')\}]$
- $-\Im[\{\mathbf{k}' \cdot \mathbf{u}(\mathbf{q})\}\{\mathbf{u}(\mathbf{p}) \cdot \mathbf{u}(\mathbf{k}')\}]$
- $-\Im[\{\mathbf{k}' \cdot \mathbf{u}(\mathbf{k}')\}\{\mathbf{u}(\mathbf{q}) \cdot \mathbf{u}(\mathbf{p})\}]$
- $\Im[\{\mathbf{k}' \cdot \mathbf{u}(\mathbf{k}')\}\{\mathbf{u}(\mathbf{p}) \cdot \mathbf{u}(\mathbf{q})\}]$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$-\Im[\{\mathbf{k}' \cdot \mathbf{u}(\mathbf{q})\}\{\mathbf{u}(\mathbf{p}) \cdot \mathbf{u}(\mathbf{k}')\}]$

2) Which of the following assumptions on $S^{uu}(\mathbf{k}'|\mathbf{p}|\mathbf{q})$ is incorrect? *1 point*

- $S^{uu}(\mathbf{k}'|\mathbf{p}|\mathbf{q})$ is real
- $S^{uu}(\mathbf{k}'|\mathbf{p}|\mathbf{q})$ is linear w.r.t. $\mathbf{u}(\mathbf{k}'),\ \mathbf{u}(\mathbf{p})$ and $\mathbf{u}(\mathbf{q})$
- $S^{uu}(-\mathbf{k}'|\mathbf{p}|\mathbf{q}) = S^{uu}(\mathbf{k}'|\mathbf{p}|\mathbf{q})$
- $S^{uu}(-\mathbf{k}'|-\mathbf{p}|-\mathbf{q}) = S^{uu}(\mathbf{k}'|\mathbf{p}|\mathbf{q})$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$S^{uu}(-\mathbf{k}'|\mathbf{p}|\mathbf{q}) = S^{uu}(\mathbf{k}'|\mathbf{p}|\mathbf{q})$

3) Consider the nonlinear interaction among three wavenumbers $\mathbf{p} = (1,1,1)$, $\mathbf{q} = (0,1,1)$ and $\mathbf{k} = (1,2,2)$. The Fourier amplitudes of the velocity fields are $\mathbf{u}(\mathbf{k}) = (2i, -1,\ 1-i)$, $\mathbf{u}(\mathbf{p}) = (1,\ 3i, -1-3i)$, and $\mathbf{u}(\mathbf{q}) = (4i,\ 1, -1)$. What is the value of $S^{uu}(\mathbf{k}|\mathbf{p}|\mathbf{q})$? *1 point*

- 8
- -8
- 16
- -16

No, the answer is incorrect.
Score: 0
Accepted Answers:
8

4) What is the expression for kinetic energy flux $\Pi_u(k_0)$ from all modes $\mathbf{p}$ within a sphere of radius k_0 to the modes $\mathbf{k}$ outside it? *1 point*

- $\sum_{|\mathbf{k}|<k_0} \sum_{|\mathbf{p}|\le k_0} S^{uu}(\mathbf{k}|\mathbf{p}|\mathbf{q})$
- $\sum_{|\mathbf{k}|<k_0} \sum_{|\mathbf{p}|\ge k_0} S^{uu}(\mathbf{k}|\mathbf{p}|\mathbf{q})$
- $\sum_{|\mathbf{k}|>k_0} \sum_{|\mathbf{p}|\le k_0} S^{uu}(\mathbf{k}|\mathbf{p}|\mathbf{q})$
- $\sum_{|\mathbf{k}|>k_0} \sum_{|\mathbf{p}|\ge k_0} S^{uu}(\mathbf{k}|\mathbf{p}|\mathbf{q})$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\sum_{|\mathbf{k}|>k_0} \sum_{|\mathbf{p}|\le k_0} S^{uu}(\mathbf{k}|\mathbf{p}|\mathbf{q})$

5) Under statistical steady state, which of the following equations are correct? *1 point*

- $\frac{d}{dk}\Pi_u(k) = \mathcal{F}_u(k) + D_u(k)$
- $\frac{d}{dk}\Pi_u(k) = -\mathcal{F}_u(k) + D_u(k)$
- $\frac{d}{dk}\Pi_u(k) = \mathcal{F}_u(k) - D_u(k)$
- $\frac{d}{dk}\Pi_u(k) = -\mathcal{F}_u(k) - D_u(k)$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\frac{d}{dk}\Pi_u(k) = \mathcal{F}_u(k) - D_u(k)$

6) Choose the formula for dissipation in spectral space, $D_u(k)$ *1 point*

- $\nu \sum_{|\mathbf{k}|=k} k^2 E_u(\mathbf{k})$
- $2\nu \sum_{|\mathbf{k}|=k} k^2 E_u(\mathbf{k})$
- $\nu \sum_{|\mathbf{k}|=k} E_u(\mathbf{k})$
- $2\nu \sum_{|\mathbf{k}|=k} k E_u(\mathbf{k})$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$2\nu \sum_{|\mathbf{k}|=k} k^2 E_u(\mathbf{k})$

7) The energy equation for hydrodynamic turbulence in spectral space is *1 point*

$\frac{\partial}{\partial t} E_u(k,t) = -\frac{\partial}{\partial k}\Pi_u(k,t) + \mathcal{F}_u(k,t) - D_u(k,t)$.

For a flow forced at large scales, which terms are dominant in the inertial range? [Here Π_u, $\mathcal{F}_u$ and D_u denotes the flux, forcing and dissipation respectively.]

- $D_u(k,t)$
- $\mathcal{F}_u(k,t)$
- $\frac{\partial}{\partial k}\Pi_u(k,t)$
- Both $D_u(k,t)$ and $\mathcal{F}_u(k,t)$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\frac{\partial}{\partial k}\Pi_u(k,t)$

8) Consider the nonlinear interaction among three wavenumbers $\mathbf{p} = (1,1,1)$, $\mathbf{q} = (0,1,1)$, and $\mathbf{k} = (1,2,2)$. The Fourier amplitudes of the velocity fields are $\mathbf{u}(\mathbf{k}) = (2i, -1,\ 1-i)$, $\mathbf{u}(\mathbf{p}) = (1,\ 3i, -1-3i)$, and $\mathbf{u}(\mathbf{q}) = (4i,\ 1, -1)$. What is energy flux across the wavenumber sphere of radius 2? *1 point*

- -17
- -9
- 9
- 17

No, the answer is incorrect.
Score: 0
Accepted Answers:
9

9) In which of the following cases can the kinetic energy flux $\Pi_u(k)$ increase with k in the inertial range? *1 point*

- Equilibrium flows
- Decaying turbulence
- Stably-stratified flows
- Thermal convection

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

10) What is the expression for shell-to-shell kinetic energy transfer from modes in shell m to modes in shell n? *1 point*

- $T^{u,n}_{u,m} = \sum_{k\in m} \sum_{p\in n} S^{uu}(\mathbf{k}|\mathbf{p}|\mathbf{q})$
- $T^{u,m}_{u,n} = \sum_{k\in n} \sum_{p\in m} S^{uu}(\mathbf{k}|\mathbf{p}|\mathbf{q})$
- $T^{u,n}_{u,m} = \sum_{k\in n} \sum_{p\in m} S^{uu}(\mathbf{k}|\mathbf{p}|\mathbf{q})$
- $T^{u,m}_{u,n} = \sum_{k\in m} \sum_{p\in n} S^{uu}(\mathbf{k}|\mathbf{p}|\mathbf{q})$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$T^{u,m}_{u,n} = \sum_{k\in n} \sum_{p\in m} S^{uu}(\mathbf{k}|\mathbf{p}|\mathbf{q})$