Unit 9 - Week 7

Assignment 7

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

Due on 2019-09-18, 23:59 IST.

1) In a juice making machine, a fruit-flavour is mixed in 1 kg of water ($\nu = 10^{-6}\ m^2/s$). The machine consumes 300 W power. What will be the approximate size of the smallest eddies in the flow induced by the machine? *1 point*

- 1 mm
- 0.01 mm
- 10 mm
- cannot estimate with the given information

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

2) Approximate values of Kolmogorov time (τ_η) and velocity (u_η) scales for the problem 1 are : *1 point*

- $\tau_\eta = 0.0001$ s and $u_\eta = 0.1$ m/s
- $\tau_\eta = 0.0001$ s and $u_\eta = 0.1$ mm/s
- $\tau_\eta = 0.1$ s and $u_\eta = 0.01$ m/s
- $\tau_\eta = 1$ s and $u_\eta = 1$ m/s

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\tau_\eta = 0.0001$ s and $u_\eta = 0.1$ m/s

3) How many grid points N (approximately) are required (in all three directions) to perform the Direct Numerical Simulation of a turbulent flow with Reynolds number $\mathrm{Re} = 2.2 \times 10^5$? *1 point*

- $N = 10^5$
- $N = 10^4$
- $N = 10^3$
- $N = 10^2$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$N = 10^4$

4) Choose a property of turbulence which is not due to Kolmogorov's theory of turbulence. *1 point*

- In the inertial range energy spectrum scales $E(k) \sim k^{-5/3}$
- Bottleneck effect in the energy spectrum
- Energy flux is constant in the inertial range
- Smallest length scale in the turbulence is $\eta \sim (\nu^3/\epsilon)^{1/4}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
Bottleneck effect in the energy spectrum

5) For a fully-developed turbulent flow which is forced at large scales, the energy dissipation rate (ϵ) can be estimated as: *1 point*

- $\epsilon \sim U^3/L$
- $\epsilon \sim U^2/L$
- $\epsilon \sim \nu(U^2/L^2)$
- None of these

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\epsilon \sim U^3/L$

6) In a fully-developed three-dimensional homogeneous isotropic turbulence, energy transfer is: *1 point*

- from large to small scales (forward cascade) and non-local
- from small to large scales (inverse cascde) and local
- can be both forward and inverse cascade, and local and non-local
- always forward and local

No, the answer is incorrect.
Score: 0
Accepted Answers:
always forward and local

7) Consider a fully-developed turbulent flow with $\nu = 0$ (Euler turbulence). Which one of the following statements is **incorrect** for this flow? *1 point*

- It is an equilibrium phenomenon.
- Energy of every mode are equal, that leads to energy spectrum scaling $E(k) \sim k^2$.
- Energy is transferred from large to small scales.
- No energy transfer takes place among various modes.

No, the answer is incorrect.
Score: 0
Accepted Answers:
Energy is transferred from large to small scales.

8) Pao's conjecture $E(k)/\Pi(k) = K_{Ko}\epsilon^{-1/3}k^{-5/3}$ is useful: *1 point*

- in developing a model for the energy spectrum in both inertial and the dissipation range
- in explaining the bottleneck effect in the energy spectrum
- in explaining the local nature of energy transfer in a fully developed 3D homogeneous isotropic turbulence
- None of these

No, the answer is incorrect.
Score: 0
Accepted Answers:
in developing a model for the energy spectrum in both inertial and the dissipation range

9) Consider a decaying turbulence with a constraint: $u^2\ell^3$=constant, where ℓ is the integral length scale. Also note that for a fully developed turbulence at very high Reynolds number $\epsilon \sim (u^3/\ell)$. What will be the decay law for this type of turbulence? *1 point*

- $u^2 \sim t^{-6/5}$
- $u^2 \sim t^{-10/7}$
- $u^2 \sim t^{-1}$
- decay law for turbulence depends on viscosity

No, the answer is incorrect.
Score: 0
Accepted Answers:
$u^2 \sim t^{-6/5}$

10) Which one of the following statements is correct for a laminar flow (low Reynolds number flows)? *1 point*

- Energy spectrum scaling is very close to exponential nature $E(k) \sim \exp(-bk)$, where b is a constant.
- Energy spectrum scales $E(k) \sim k^2$.
- Energy flux is constant.
- Energy flux is zero.

No, the answer is incorrect.
Score: 0
Accepted Answers:
Energy spectrum scaling is very close to exponential nature $E(k) \sim \exp(-bk)$, where b is a constant.