# Unit 10 - Week 8



## Assignment 8

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

**Due on 2019-09-25, 23:59 IST.**

1) Third-order structure function $S_3(l) = \langle (\Delta \mathbf{u})_{\parallel}^3 \rangle$ for a three-dimensional homogeneous isotropic turbulent flow is related to the energy dissipation rate $\epsilon$
and the separation $l$ as: *1 point*

- $S_3(l) = \frac{2}{3}\epsilon l$
- $S_3(l) = -\frac{4}{5}\epsilon^{2/3} l^{2/3}$
- $S_3(l) = -\frac{4}{5}\epsilon l$
- No relation exists

No, the answer is incorrect.
Score: 0
Accepted Answers:
$S_3(l) = -\frac{4}{5}\epsilon l$

2) Choose the correct statement. *1 point*

- Homogeneous flows are always isotropic.
- Isotropic flows are always homogeneous.
- Wall bounded flows (for example channel flow) are homogeneous and isotropic.
- Rapidly rotating flows are anisotropic.

No, the answer is incorrect.
Score: 0
Accepted Answers:
*Rapidly rotating flows are anisotropic.*

3) An isotropic vector which is a function of $l$ can be represented as [$\hat{l}$, $\hat{x}$, $\hat{z}$ are unit vectors in respective directions.]: *1 point*

- $(1/l)\hat{x}$
- $(1/l)\hat{z}$
- $(1/l)\hat{x} + (1/l)\hat{z}$
- $(1/l)\hat{l}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$(1/l)\hat{l}$

4) Choose the correct relation. *1 point*

- $\langle |\partial u_1/\partial x_3| \rangle = \bar{u}/\lambda$
- $\langle (\partial u_1/\partial x_1)^2 \rangle = \bar{u}^2/\lambda^2$
- $\langle (\partial u_1/\partial x_2)^3 \rangle = \bar{u}^3/\lambda^3$
- None of these

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\langle (\partial u_1/\partial x_1)^2 \rangle = \bar{u}^2/\lambda^2$

5) Which one of following is the correct expression for the energy dissipation rate ($\epsilon$) in terms of Taylor microscale ($\lambda$) for isotropic turbulence? *1 point*

- $\epsilon = 2\nu(\bar{u}^2/\lambda^2)$
- $\epsilon = \bar{u}^3/\lambda$
- $\epsilon = 15\nu(\bar{u}^2/\lambda^2)$
- None of these

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\epsilon = 15\nu(\bar{u}^2/\lambda^2)$

6) The three important length scales in turbulent flows are --- Kolmogorov length scale ($\eta$), Taylor microscale ($\lambda$), and integral length scale ($\ell$). Which one of the following condition is true at $\mathrm{Re} \to \infty$? *1 point*

- $\lambda << \ell << \eta$
- $\eta \sim \lambda < \ell$
- $\eta << \lambda << \ell$
- Depends on flow conditions

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\eta << \lambda << \ell$

7) Consider the following statements for integral length scale ($\ell$). Which one is **incorrect**? *1 point*

- It represents the size of the eddies in the inertial range.
- It represents the size of large eddies in a turbulent flow.
- $\ell = \int_0^\infty f(l)dl$, where $f(l)$ is the longitudinal velocity correlation function.
- None of these

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

*It represents the size of the eddies in the inertial range.*

8) The equations needed to derive the third-order structure function $S_3(l) = -\frac{4}{5}\epsilon l$ for a turbulent flow are: *1 point*

- Momentum equation and $\nabla \cdot \mathbf{u} = 0$ (incompressibility condition)
- Only momentum equation
- Only $\nabla \cdot \mathbf{u} = 0$ (incompressibility condition)
- It does not require any equations

No, the answer is incorrect.
Score: 0
Accepted Answers:
*Momentum equation and $\nabla \cdot \mathbf{u} = 0$ (incompressibility condition)*

9) An isotropic second-order tensor ($T_{ij}$), which is a function of $\mathbf{r}$ (vector), can be represented as: *1 point*

- $T_{ij}(\mathbf{r}) = B(\mathbf{r})\delta_{ij}$
- $T_{ij}(\mathbf{r}) = A(\mathbf{r})(r_i r_j/r^2)$
- $T_{ij}(\mathbf{r}) = A(\mathbf{r})(r_i r_j/r^2) + B(\mathbf{r})$
- $T_{ij}(\mathbf{r}) = A(\mathbf{r})(r_i r_j/r^2) + B(\mathbf{r})\delta_{ij}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$T_{ij}(\mathbf{r}) = A(\mathbf{r})(r_i r_j/r^2) + B(\mathbf{r})\delta_{ij}$

10) For a fully-developed 3D homogeneous isotropic turbulent flow, $q^{th}$-order structure function is customarily modelled as $S_q(l) \sim (\langle \epsilon \rangle l)^{\zeta_q}$. Among all the available models, which expression for $\zeta_q$ fits best with the experimental and numerical data? *1 point*

- $\zeta_q = (q/3) - (0.2/18)q(q-1)$
- $\zeta_q = (q/9) + 2(1 - (2/3)^{q/3})$
- $\zeta_q = 3q/5$
- No such model exists

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\zeta_q = (q/9) + 2(1 - (2/3)^{q/3})$