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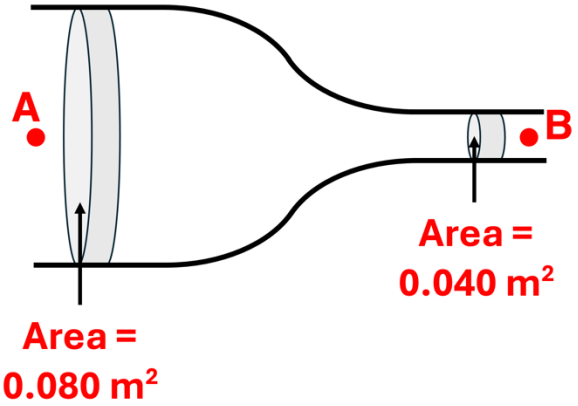
Volumetric Flow Rate and Velocity

Activity 1: Case Studies

Question Group 1

Question 1

Fluid in a pipe undergoes a sudden change from a wide cross-sectional area to a narrow cross-sectional area as it flows from location **A** to location **B**.



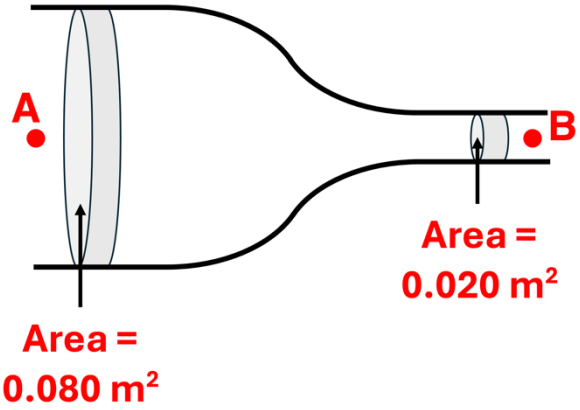
How does the volumetric flow rate (**Q** in m^3/s) and the flow velocity (**v** in m/s) at **B** compare to that at **A**?

The Q_B is _____ the Q_A.

The v_B is _____ the v_A.

Question 2

Fluid in a pipe undergoes a sudden change from a wide cross-sectional area to a narrow cross-sectional area as it flows from location **A** to location **B**.

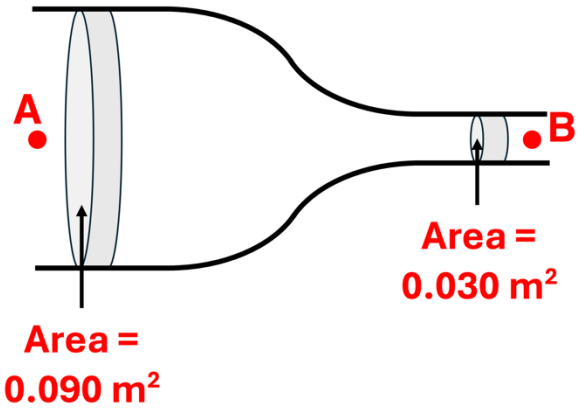


How does the volumetric flow rate (**Q** in m^3/s) and the flow velocity (**v** in m/s) at **B** compare to that at **A**?

The Q_B is _____ the Q_A.

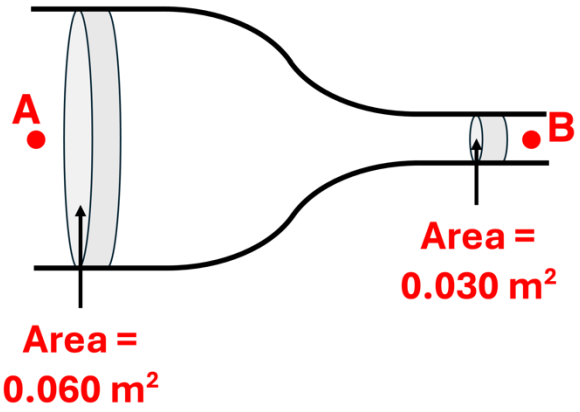
The v_B is _____ the v_A.

Question 3
Fluid in a pipe undergoes a sudden change from a wide cross-sectional area to a narrow cross-sectional area as it flows from location **A** to location **B**.



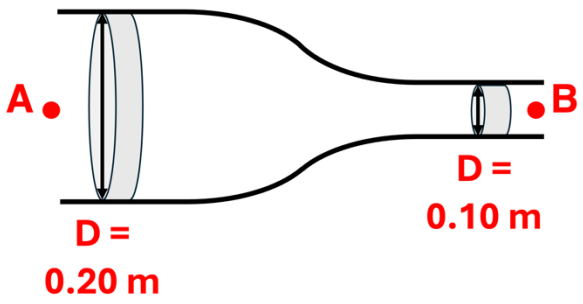
How does the volumetric flow rate (**Q** in m^3/s) and the flow velocity (**v** in m/s) at **B** compare to that at **A**?
The $\mathbf{Q_B}$ is _____ the $\mathbf{Q_A}$.
The $\mathbf{v_B}$ is _____ the $\mathbf{v_A}$.

Question 4
Fluid in a pipe undergoes a sudden change from a wide cross-sectional area to a narrow cross-sectional area as it flows from location **A** to location **B**.



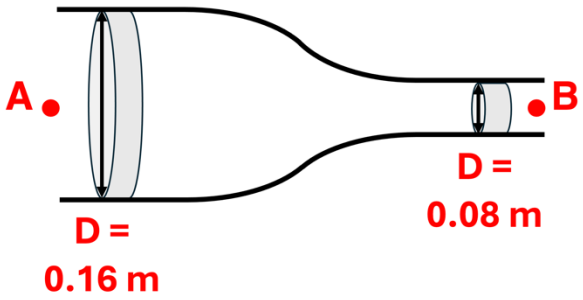
How does the volumetric flow rate (**Q** in m^3/s) and the flow velocity (**v** in m/s) at **B** compare to that at **A**?
The $\mathbf{Q_B}$ is _____ the $\mathbf{Q_A}$.
The $\mathbf{v_B}$ is _____ the $\mathbf{v_A}$.

Question Group 2
Question 5
Fluid in a pipe undergoes a sudden change from an area with a large diameter (D) to an area with a small diameter (D) as it flows from location **A** to location **B**.



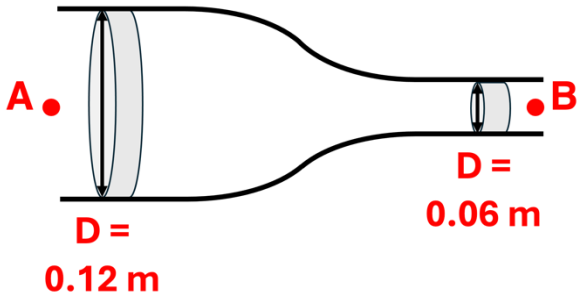
How does the volumetric flow rate (**Q** in m^3/s) and the flow velocity (**v** in m/s) at **B** compare to that at **A**?
The $\mathbf{Q_B}$ is _____ the $\mathbf{Q_A}$.
The $\mathbf{v_B}$ is _____ the $\mathbf{v_A}$.

Question 6
Fluid in a pipe undergoes a sudden change from an area with a large diameter (D) to an area with a small diameter (D) as it flows from location **A** to location **B**.



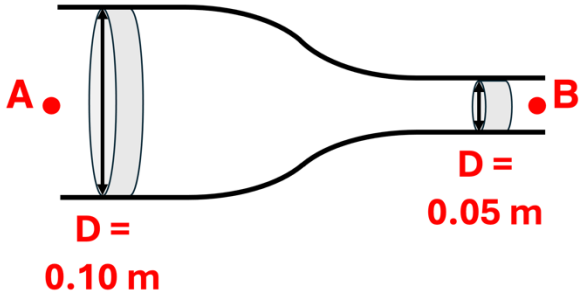
How does the volumetric flow rate (**Q** in m^3/s) and the flow velocity (**v** in m/s) at **B** compare to that at **A**?
The $\mathbf{Q_B}$ is _____ the $\mathbf{Q_A}$.
The $\mathbf{v_B}$ is _____ the $\mathbf{v_A}$.

Question 7
Fluid in a pipe undergoes a sudden change from an area with a large diameter (D) to an area with a small diameter (D) as it flows from location **A** to location **B**.



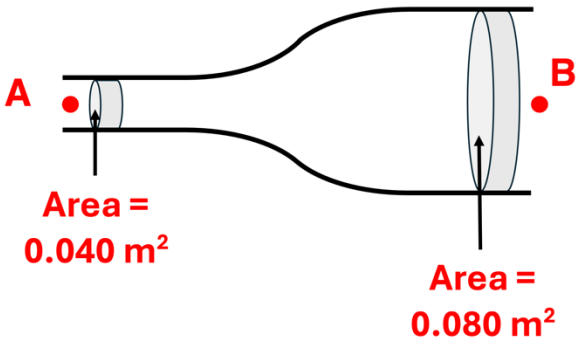
How does the volumetric flow rate (**Q** in m^3/s) and the flow velocity (**v** in m/s) at **B** compare to that at **A**?
The $\mathbf{Q_B}$ is _____ the $\mathbf{Q_A}$.
The $\mathbf{v_B}$ is _____ the $\mathbf{v_A}$.

Question 8
Fluid in a pipe undergoes a sudden change from an area with a large diameter (D) to an area with a small diameter (D) as it flows from location **A** to location **B**.



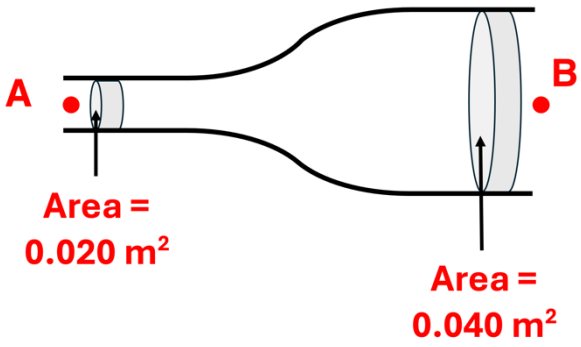
How does the volumetric flow rate (**Q** in m^3/s) and the flow velocity (**v** in m/s) at **B** compare to that at **A**?
The $\mathbf{Q_B}$ is _____ the $\mathbf{Q_A}$.
The $\mathbf{v_B}$ is _____ the $\mathbf{v_A}$.

Question Group 3
Question 9
Fluid in a pipe undergoes a sudden change from a narrow cross-sectional area to a wide cross-sectional area as it flows from location **A** to location **B**.



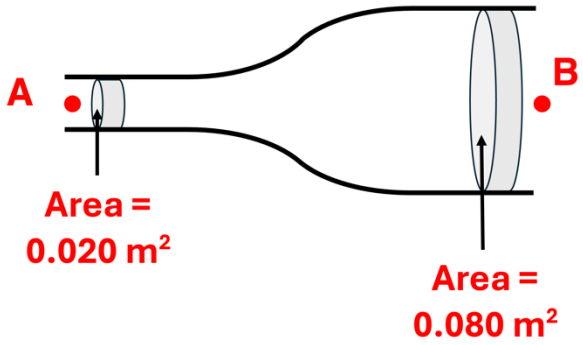
How does the volumetric flow rate (**Q** in m^3/s) and the flow velocity (**v** in m/s) at **B** compare to that at **A**?
The $\mathbf{Q_B}$ is _____ the $\mathbf{Q_A}$.
The $\mathbf{v_B}$ is _____ the $\mathbf{v_A}$.

Question 10
Fluid in a pipe undergoes a sudden change from a narrow cross-sectional area to a wide cross-sectional area as it flows from location **A** to location **B**.



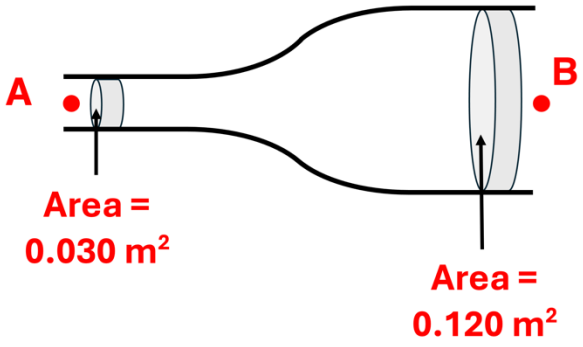
How does the volumetric flow rate (**Q** in m^3/s) and the flow velocity (**v** in m/s) at **B** compare to that at **A**?
The $\mathbf{Q_B}$ is _____ the $\mathbf{Q_A}$.
The $\mathbf{v_B}$ is _____ the $\mathbf{v_A}$.

Question 11
Fluid in a pipe undergoes a sudden change from a narrow cross-sectional area to a wide cross-sectional area as it flows from location **A** to location **B**.



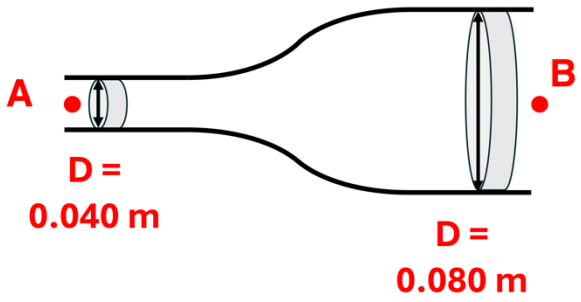
How does the volumetric flow rate (**Q** in m^3/s) and the flow velocity (**v** in m/s) at **B** compare to that at **A**?
The $\mathbf{Q_B}$ is _____ the $\mathbf{Q_A}$.
The $\mathbf{v_B}$ is _____ the $\mathbf{v_A}$.

Question 12
Fluid in a pipe undergoes a sudden change from a narrow cross-sectional area to a wide cross-sectional area as it flows from location **A** to location **B**.



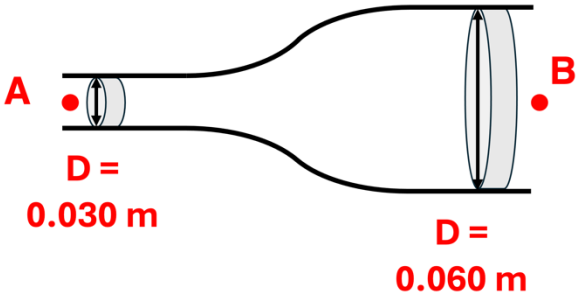
How does the volumetric flow rate (**Q** in m^3/s) and the flow velocity (**v** in m/s) at **B** compare to that at **A**?
The $\mathbf{Q_B}$ is _____ the $\mathbf{Q_A}$.
The $\mathbf{v_B}$ is _____ the $\mathbf{v_A}$.

Question Group 4
Question 13
Fluid in a pipe undergoes a sudden change from an area with a small diameter (D) to an area with a large diameter (D) as it flows from location **A** to location **B**.



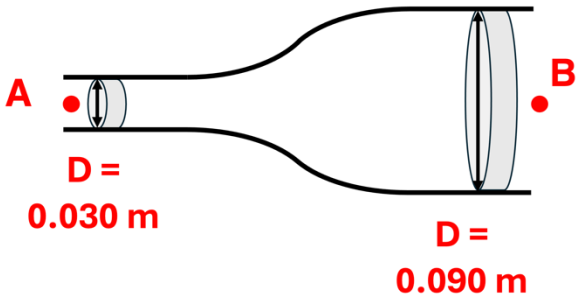
How does the volumetric flow rate (**Q** in m^3/s) and the flow velocity (**v** in m/s) at **B** compare to that at **A**?
The $\mathbf{Q_B}$ is _____ the $\mathbf{Q_A}$.
The $\mathbf{v_B}$ is _____ the $\mathbf{v_A}$.

Question 14
Fluid in a pipe undergoes a sudden change from an area with a small diameter (D) to an area with a large diameter (D) as it flows from location **A** to location **B**.



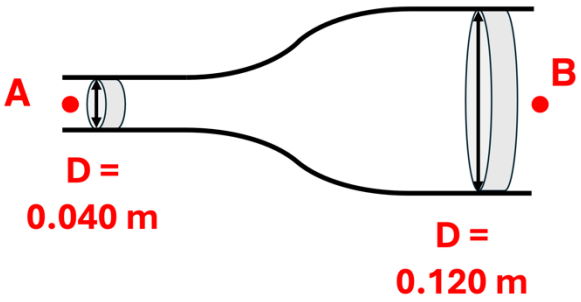
How does the volumetric flow rate (**Q** in m^3/s) and the flow velocity (**v** in m/s) at **B** compare to that at **A**?
The $\mathbf{Q_B}$ is _____ the $\mathbf{Q_A}$.

Question 15
Fluid in a pipe undergoes a sudden change from an area with a small diameter (D) to an area with a large diameter (D) as it flows from location **A** to location **B**.



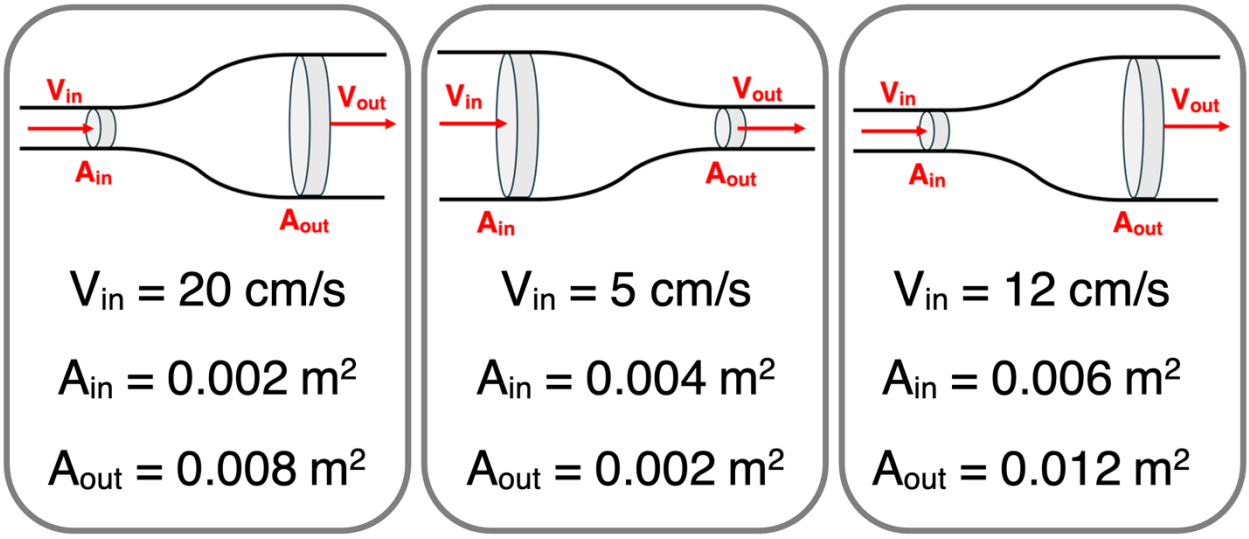
How does the volumetric flow rate (**Q** in m^3/s) and the flow velocity (**v** in m/s) at **B** compare to that at **A**?
The $\mathbf{Q_B}$ is _____ the $\mathbf{Q_A}$.

Question 16
Fluid in a pipe undergoes a sudden change from an area with a small diameter (D) to an area with a large diameter (D) as it flows from location **A** to location **B**.

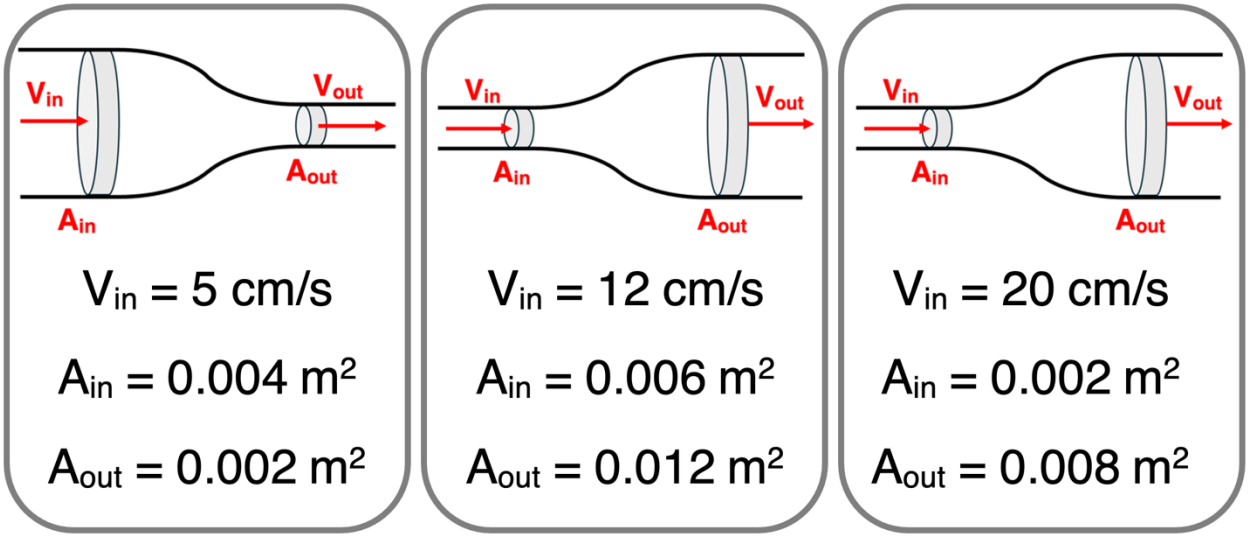


How does the volumetric flow rate (**Q** in m^3/s) and the flow velocity (**v** in m/s) at **B** compare to that at **A**?
The $\mathbf{Q_B}$ is _____ the $\mathbf{Q_A}$.

Activity 2: Ranking Tasks
Question Group 5
Question 17
Consider the three situations in which fluid in a pipe flows between regions with a different cross-sectional area (**A**). Rank the V_{out} values for the three situations.

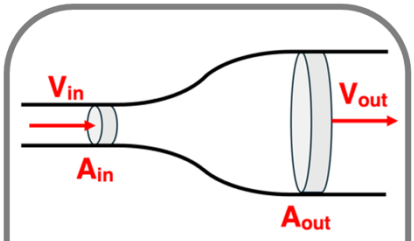


Question 18
Consider the three situations in which fluid in a pipe flows between regions with a different cross-sectional area (**A**). Rank the V_{out} values for the three situations.



Question 19

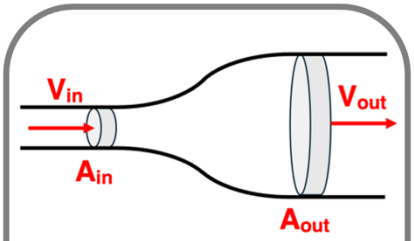
Consider the three situations in which fluid in a pipe flows between regions with a different cross-sectional area (**A**). Rank the V_{out} values for the three situations.



V_{in} = 12 cm/s

A_{in} = 0.006 m^2

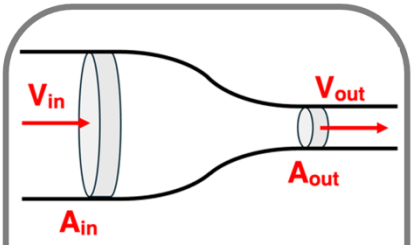
A_{out} = 0.012 m^2



V_{in} = 20 cm/s

A_{in} = 0.002 m^2

A_{out} = 0.008 m^2



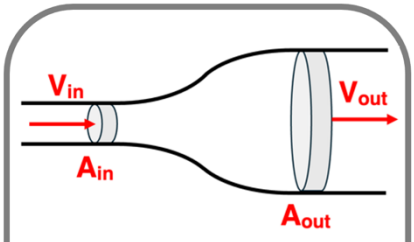
V_{in} = 5 cm/s

A_{in} = 0.004 m^2

A_{out} = 0.002 m^2

Question 20

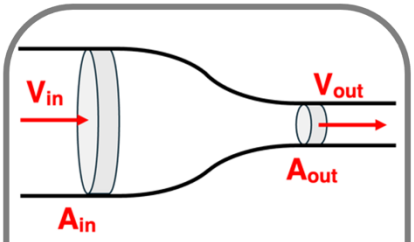
Consider the three situations in which fluid in a pipe flows between regions with a different cross-sectional area (**A**). Rank the V_{out} values for the three situations.



V_{in} = 12 cm/s

A_{in} = 0.006 m^2

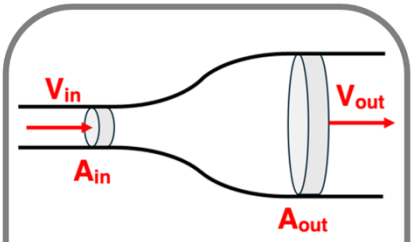
A_{out} = 0.012 m^2



V_{in} = 5 cm/s

A_{in} = 0.004 m^2

A_{out} = 0.002 m^2

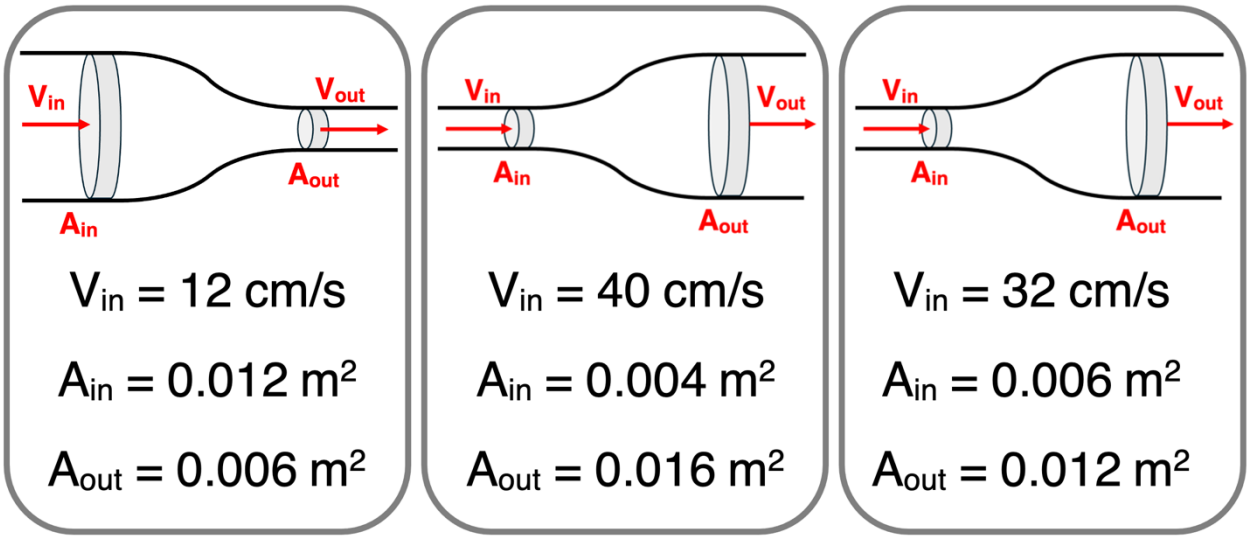


V_{in} = 20 cm/s

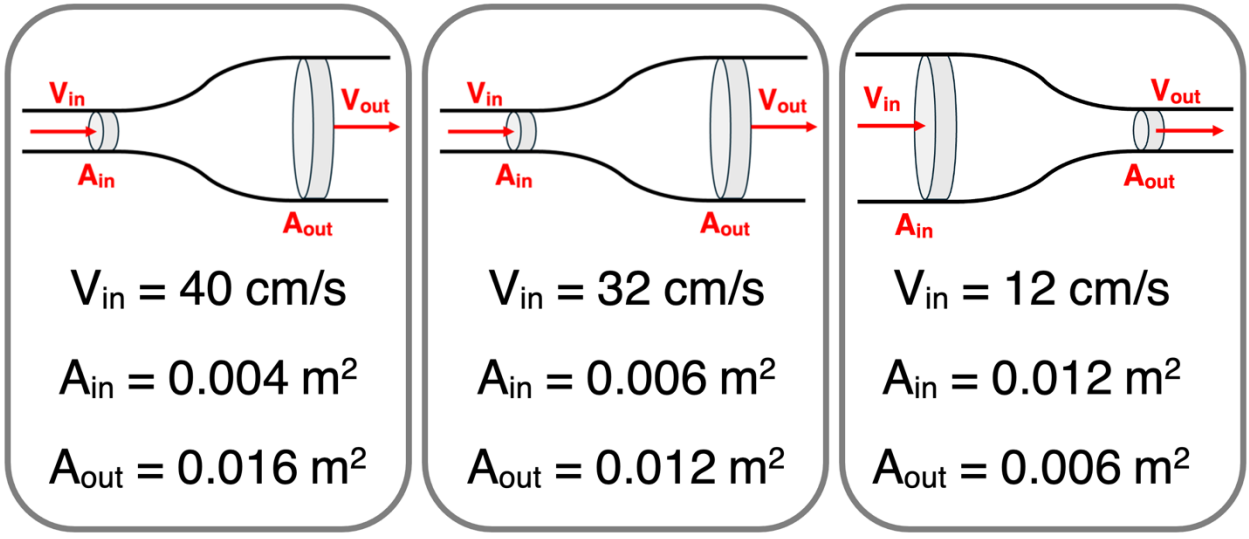
A_{in} = 0.002 m^2

A_{out} = 0.008 m^2

Question Group 6
Question 21
Consider the three situations in which fluid in a pipe flows between regions with different diameters (**D**). Rank the V_{out} values for the three situations.

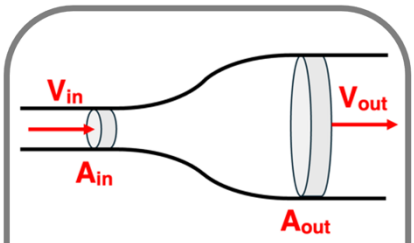


Question 22
Consider the three situations in which fluid in a pipe flows between regions with different diameters (**D**). Rank the V_{out} values for the three situations.



Question 23

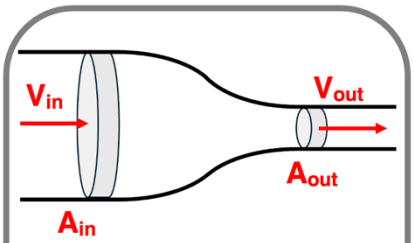
Consider the three situations in which fluid in a pipe flows between regions with different diameters (**D**). Rank the V_{out} values for the three situations.



$V_{in} = 32$ cm/s

$A_{in} = 0.006$ m^2

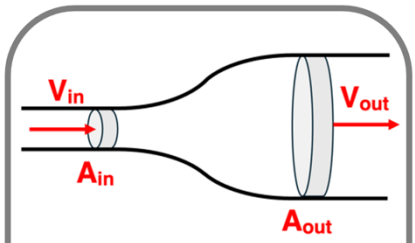
$A_{out} = 0.012$ m^2



$V_{in} = 12$ cm/s

$A_{in} = 0.012$ m^2

$A_{out} = 0.006$ m^2



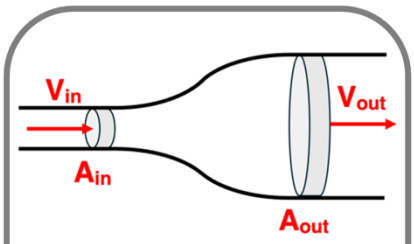
$V_{in} = 40$ cm/s

$A_{in} = 0.004$ m^2

$A_{out} = 0.016$ m^2

Question 24

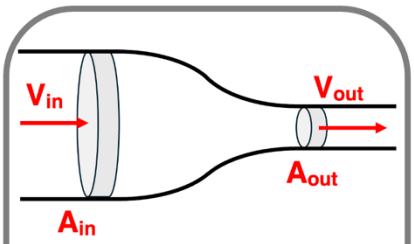
Consider the three situations in which fluid in a pipe flows between regions with different diameters (**D**). Rank the V_{out} values for the three situations.



$V_{in} = 40$ cm/s

$A_{in} = 0.004$ m^2

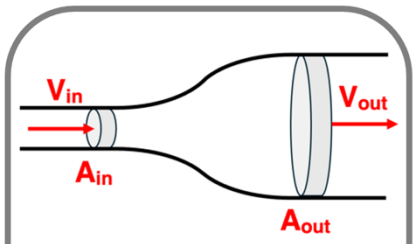
$A_{out} = 0.016$ m^2



$V_{in} = 12$ cm/s

$A_{in} = 0.012$ m^2

$A_{out} = 0.006$ m^2

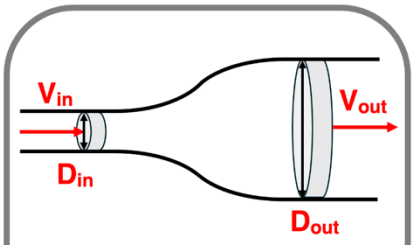


$V_{in} = 32$ cm/s

$A_{in} = 0.006$ m^2

$A_{out} = 0.012$ m^2

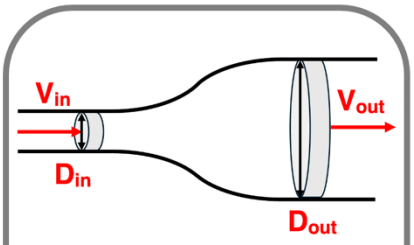
Question Group 7
Question 25
Consider the three situations in which fluid in a pipe flows between regions with a different cross-sectional area (**A**). Rank the V_{out} values for the three situations.



V_{in} = 48 cm/s

D_{in} = 0.020 m

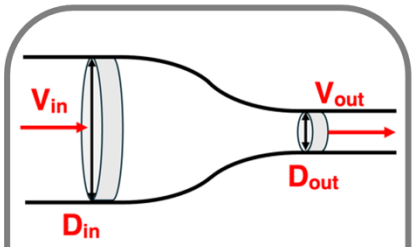
D_{out} = 0.080 m



V_{in} = 32 cm/s

D_{in} = 0.060 m

D_{out} = 0.120 m

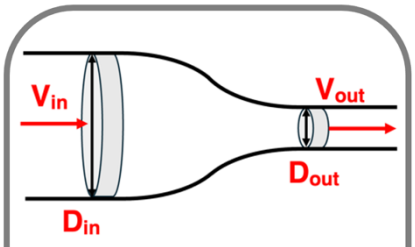


V_{in} = 6 cm/s

D_{in} = 0.100 m

D_{out} = 0.050 m

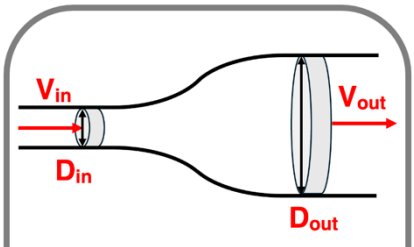
Question 26
Consider the three situations in which fluid in a pipe flows between regions with a different cross-sectional area (**A**). Rank the V_{out} values for the three situations.



V_{in} = 6 cm/s

D_{in} = 0.100 m

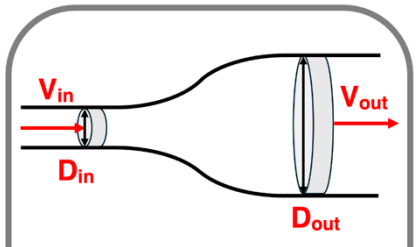
D_{out} = 0.050 m



V_{in} = 48 cm/s

D_{in} = 0.020 m

D_{out} = 0.080 m



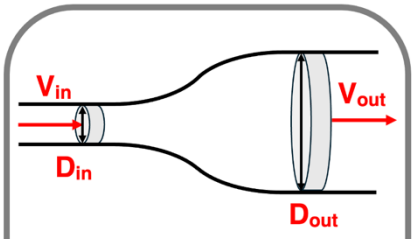
V_{in} = 32 cm/s

D_{in} = 0.060 m

D_{out} = 0.120 m

Question 27

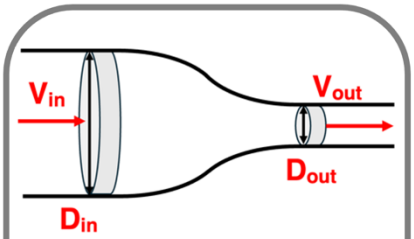
Consider the three situations in which fluid in a pipe flows between regions with a different cross-sectional area (**A**). Rank the V_{out} values for the three situations.



V_{in} = 32 cm/s

D_{in} = 0.060 m

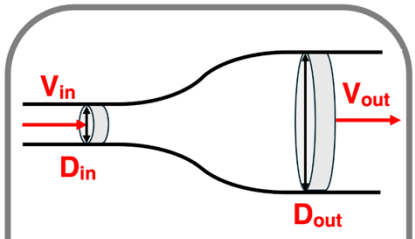
D_{out} = 0.120 m



V_{in} = 6 cm/s

D_{in} = 0.100 m

D_{out} = 0.050 m



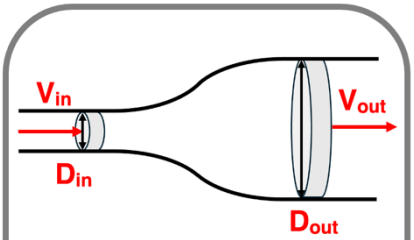
V_{in} = 48 cm/s

D_{in} = 0.020 m

D_{out} = 0.080 m

Question 28

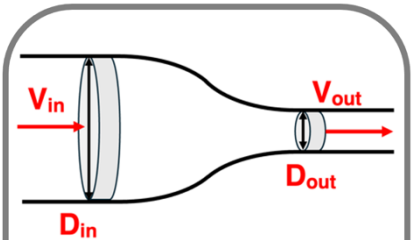
Consider the three situations in which fluid in a pipe flows between regions with a different cross-sectional area (**A**). Rank the V_{out} values for the three situations.



V_{in} = 48 cm/s

D_{in} = 0.020 m

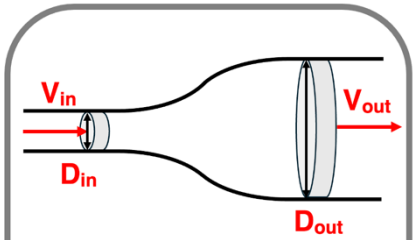
D_{out} = 0.080 m



V_{in} = 6 cm/s

D_{in} = 0.100 m

D_{out} = 0.050 m

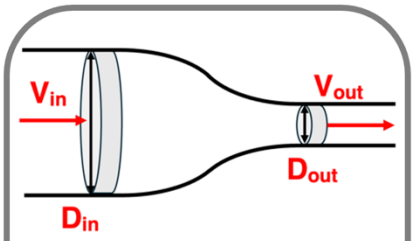


V_{in} = 32 cm/s

D_{in} = 0.060 m

D_{out} = 0.120 m

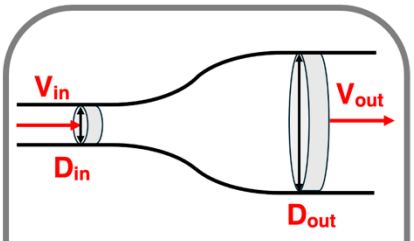
Question Group 8
Question 29
Consider the three situations in which fluid in a pipe flows between regions with different diameters (**D**). Rank the V_{out} values for the three situations.



V_{in} = 12 cm/s

D_{in} = 0.240 m

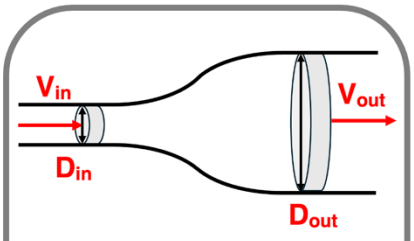
D_{out} = 0.120 m



V_{in} = 64 cm/s

D_{in} = 0.050 m

D_{out} = 0.100 m

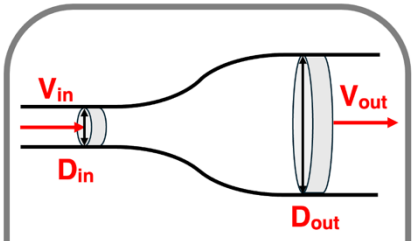


V_{in} = 80 cm/s

D_{in} = 0.060 m

D_{out} = 0.120 m

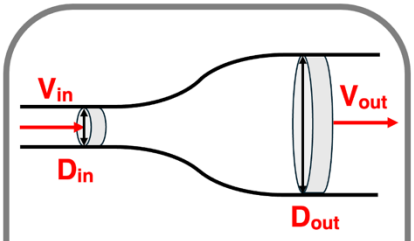
Question 30
Consider the three situations in which fluid in a pipe flows between regions with different diameters (**D**). Rank the V_{out} values for the three situations.



V_{in} = 64 cm/s

D_{in} = 0.050 m

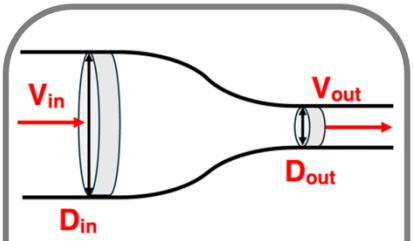
D_{out} = 0.100 m



V_{in} = 80 cm/s

D_{in} = 0.060 m

D_{out} = 0.120 m



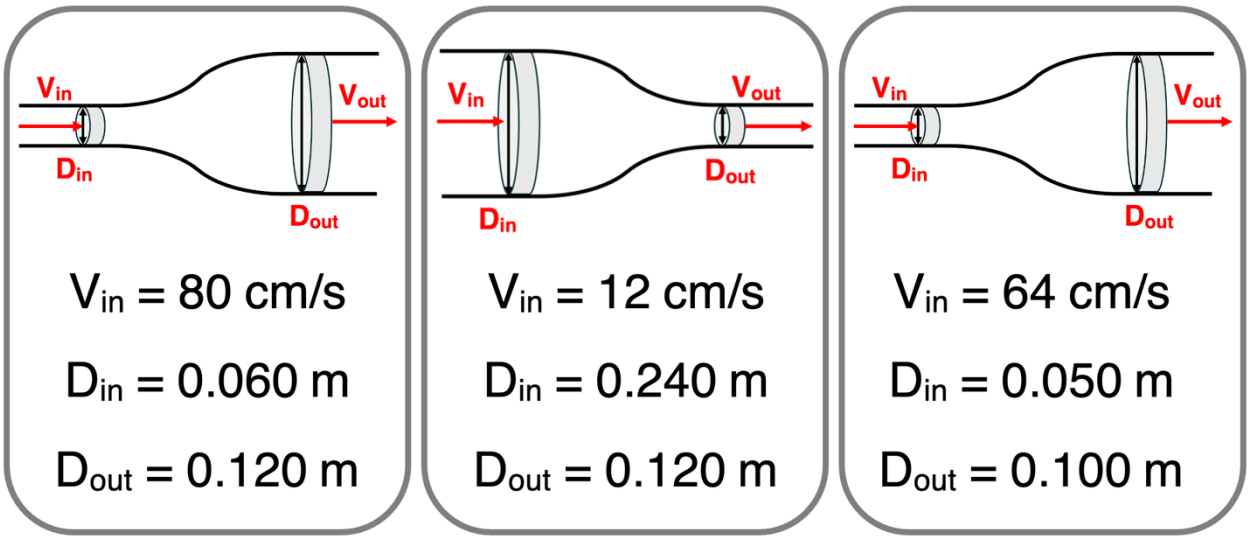
V_{in} = 12 cm/s

D_{in} = 0.240 m

D_{out} = 0.120 m

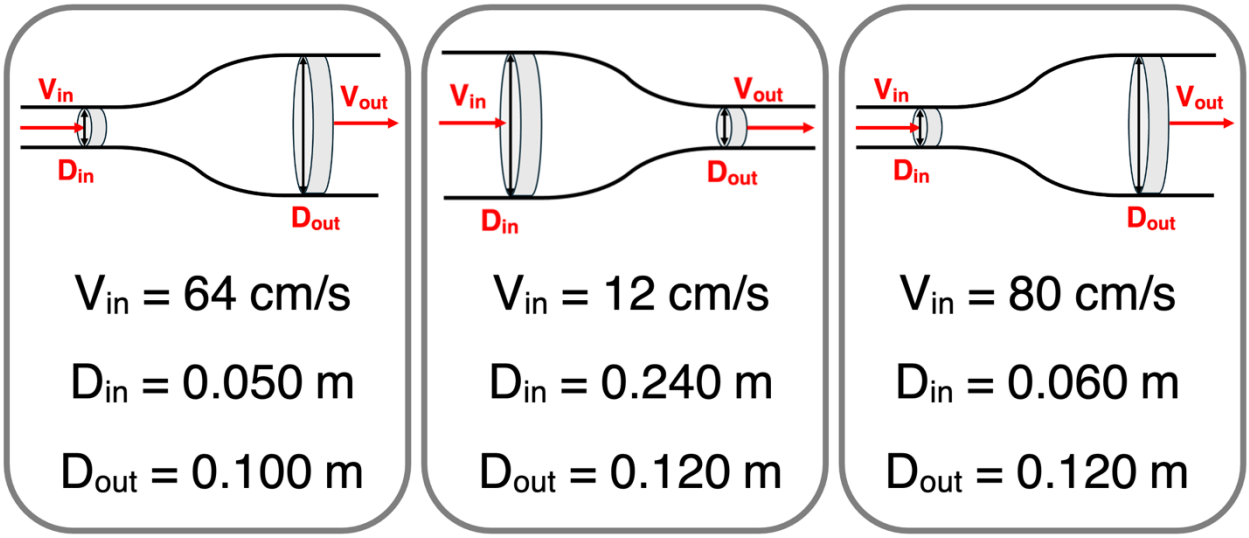
Question 31

Consider the three situations in which fluid in a pipe flows between regions with different diameters (**D**). Rank the V_{out} values for the three situations.

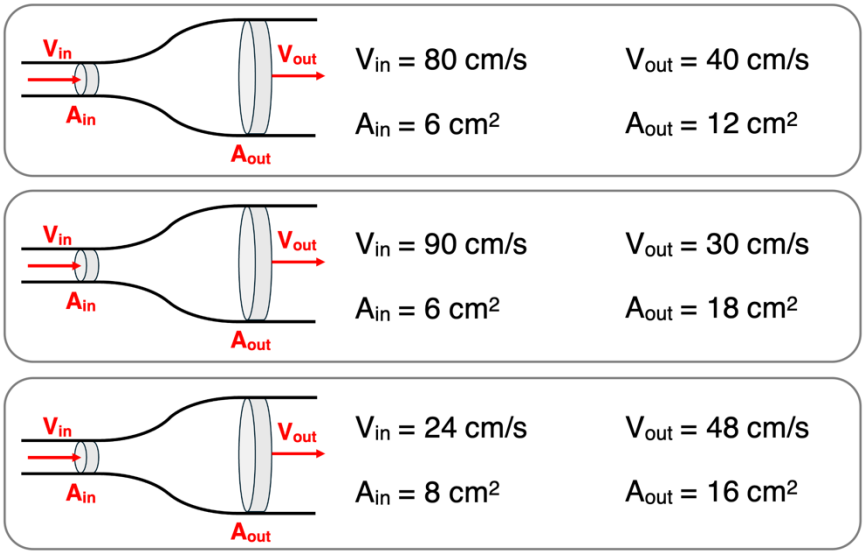


Question 32

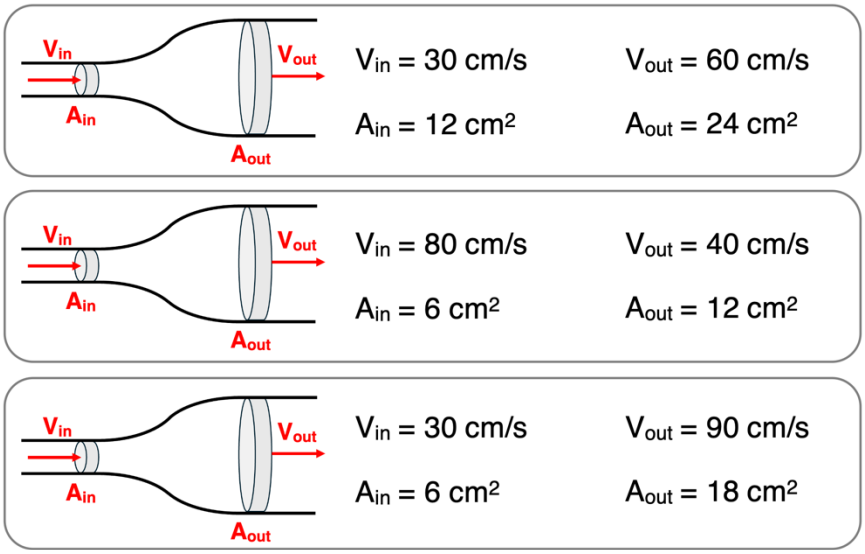
Consider the three situations in which fluid in a pipe flows between regions with different diameters (**D**). Rank the V_{out} values for the three situations.



Activity 3: Law Breakers
Question Group 9
Question 33
Fluid in a pipe flows from a narrow to a wide section. The cross-sectional areas (A) and flow velocities (V) are listed. Identify all situations that violate the law of conservation of mass.

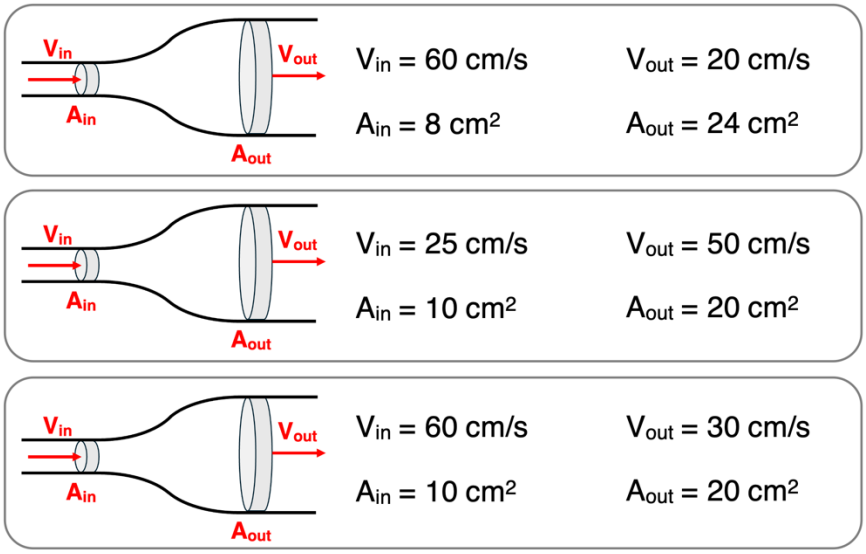


Question 34
Fluid in a pipe flows from a narrow to a wide section. The cross-sectional areas (A) and flow velocities (V) are listed. Identify all situations that violate the law of conservation of mass.



Question 35

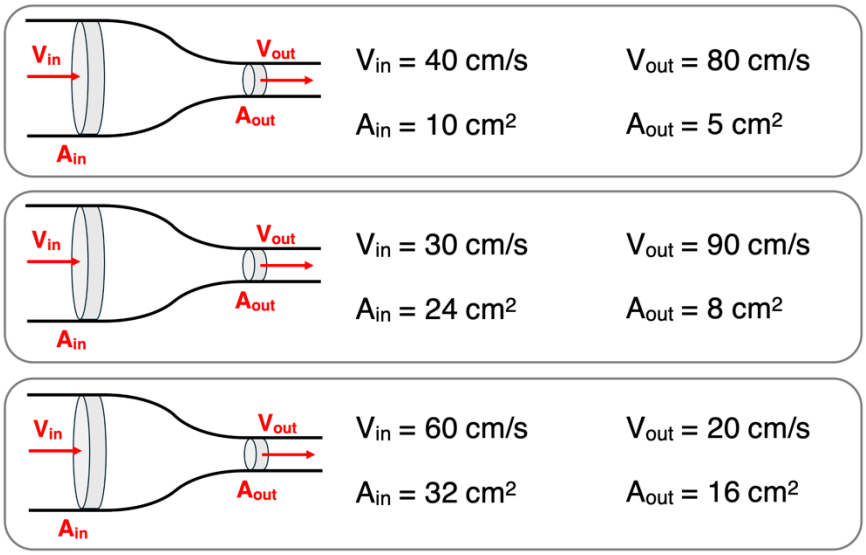
Fluid in a pipe flows from a narrow to a wide section. The cross-sectional areas (A) and flow velocities (V) are listed. Identify all situations that violate the law of conservation of mass.



Question Group 10

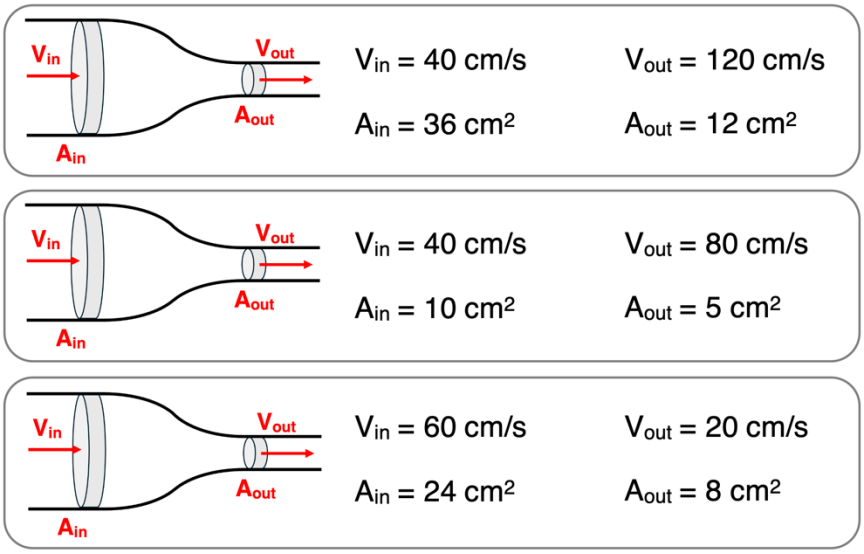
Question 36

Fluid in a pipe flows from a wide to a narrow section. The cross-sectional areas (A) and flow velocities (V) are listed. Identify all situations that violate the law of conservation of mass.



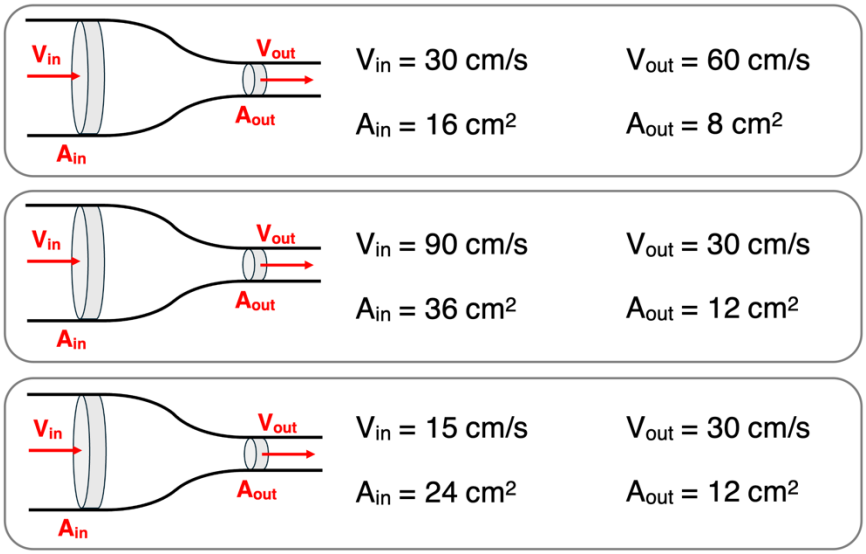
Question 37

Fluid in a pipe flows from a wide to a narrow section. The cross-sectional areas (A) and flow velocities (V) are listed. Identify all situations that violate the law of conservation of mass.

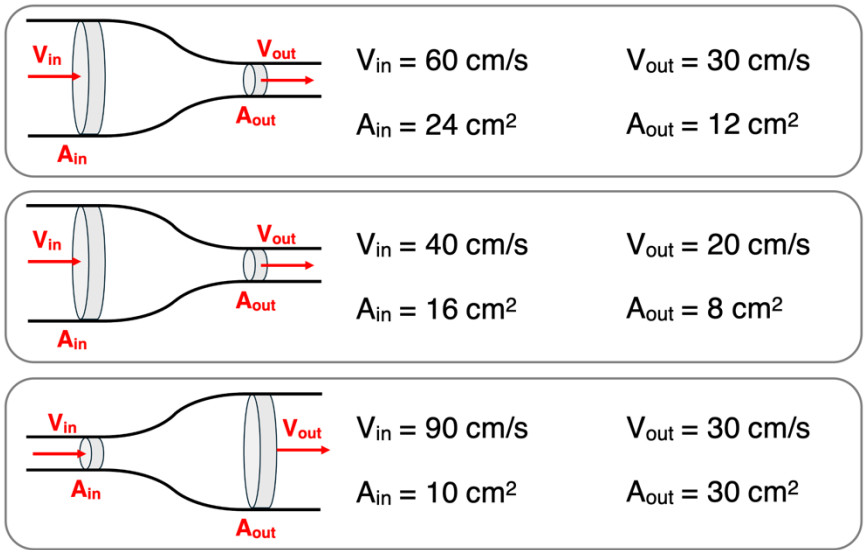


Question 38

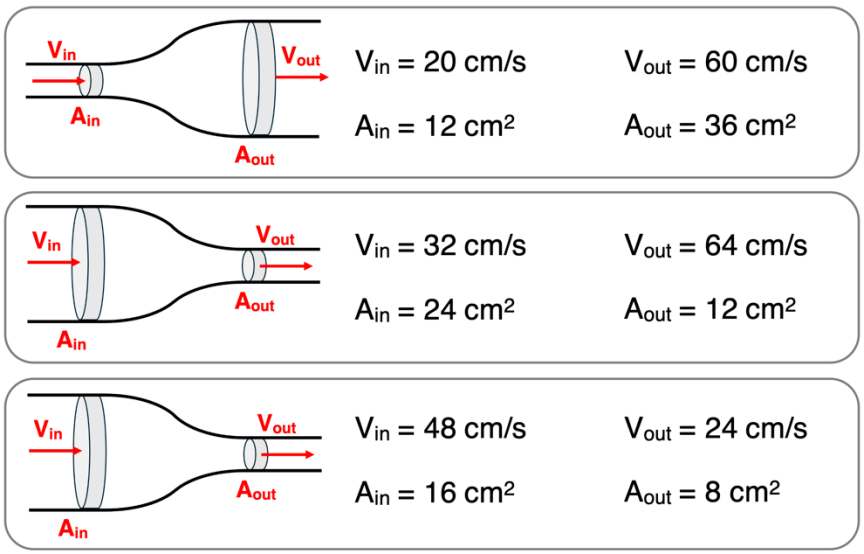
Fluid in a pipe flows from a wide to a narrow section. The cross-sectional areas (A) and flow velocities (V) are listed. Identify all situations that violate the law of conservation of mass.



Question Group 11
Question 39
Fluid in a pipe flows between two sections with different cross-sectional areas. The areas (A) and flow velocities (V) are listed. Identify all situations that violate the law of conservation of mass.

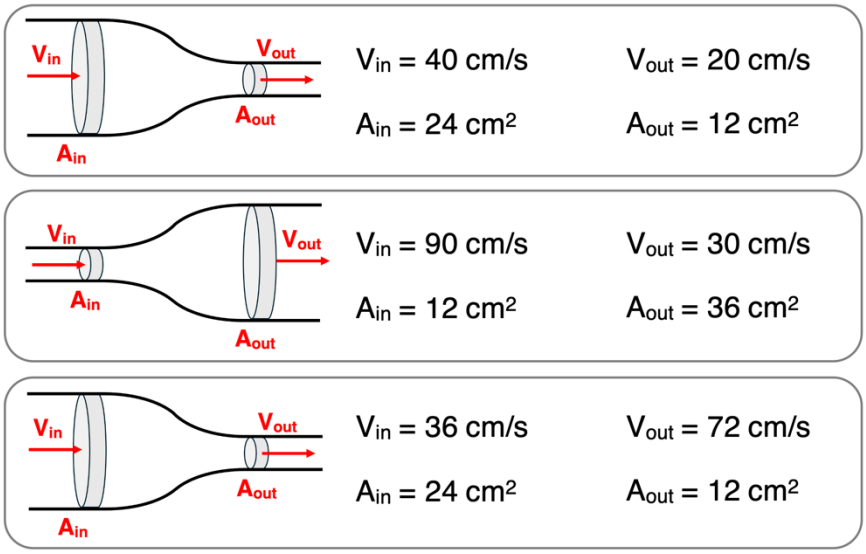


Question 40
Fluid in a pipe flows between two sections with different cross-sectional areas. The areas (A) and flow velocities (V) are listed. Identify all situations that violate the law of conservation of mass.



Question 41

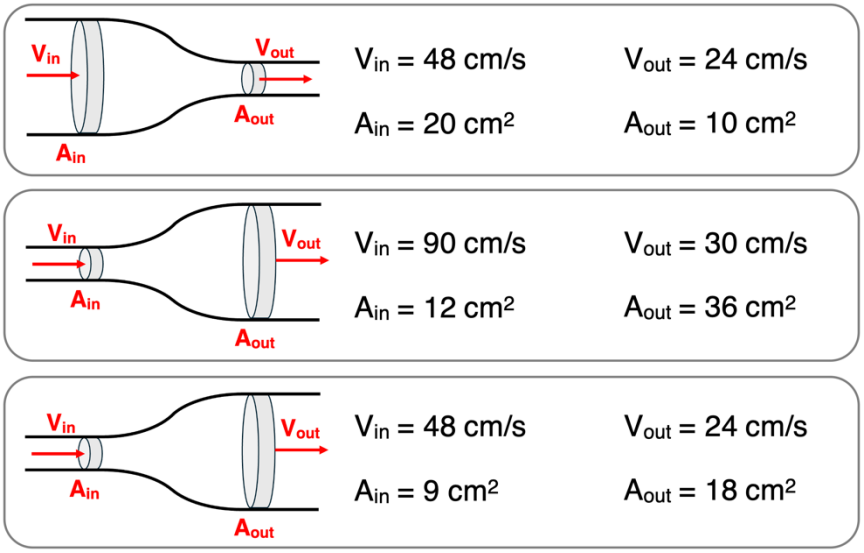
Fluid in a pipe flows between two sections with different cross-sectional areas. The areas (A) and flow velocities (V) are listed. Identify all situations that violate the law of conservation of mass.



Question Group 12

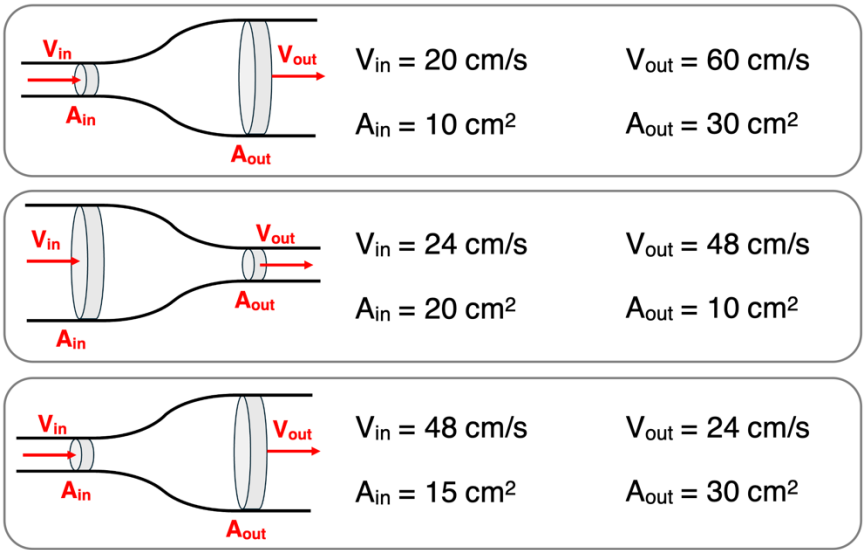
Question 42

Fluid in a pipe flows between two sections with different cross-sectional areas. The areas (A) and flow velocities (V) are listed. Identify all situations that violate the law of conservation of mass.



Question 43

Fluid in a pipe flows between two sections with different cross-sectional areas. The areas (A) and flow velocities (V) are listed. Identify all situations that violate the law of conservation of mass.



Question 44

Fluid in a pipe flows between two sections with different cross-sectional areas. The areas (A) and flow velocities (V) are listed. Identify all situations that violate the law of conservation of mass.