Engineering Fluid Mechanics MCQ

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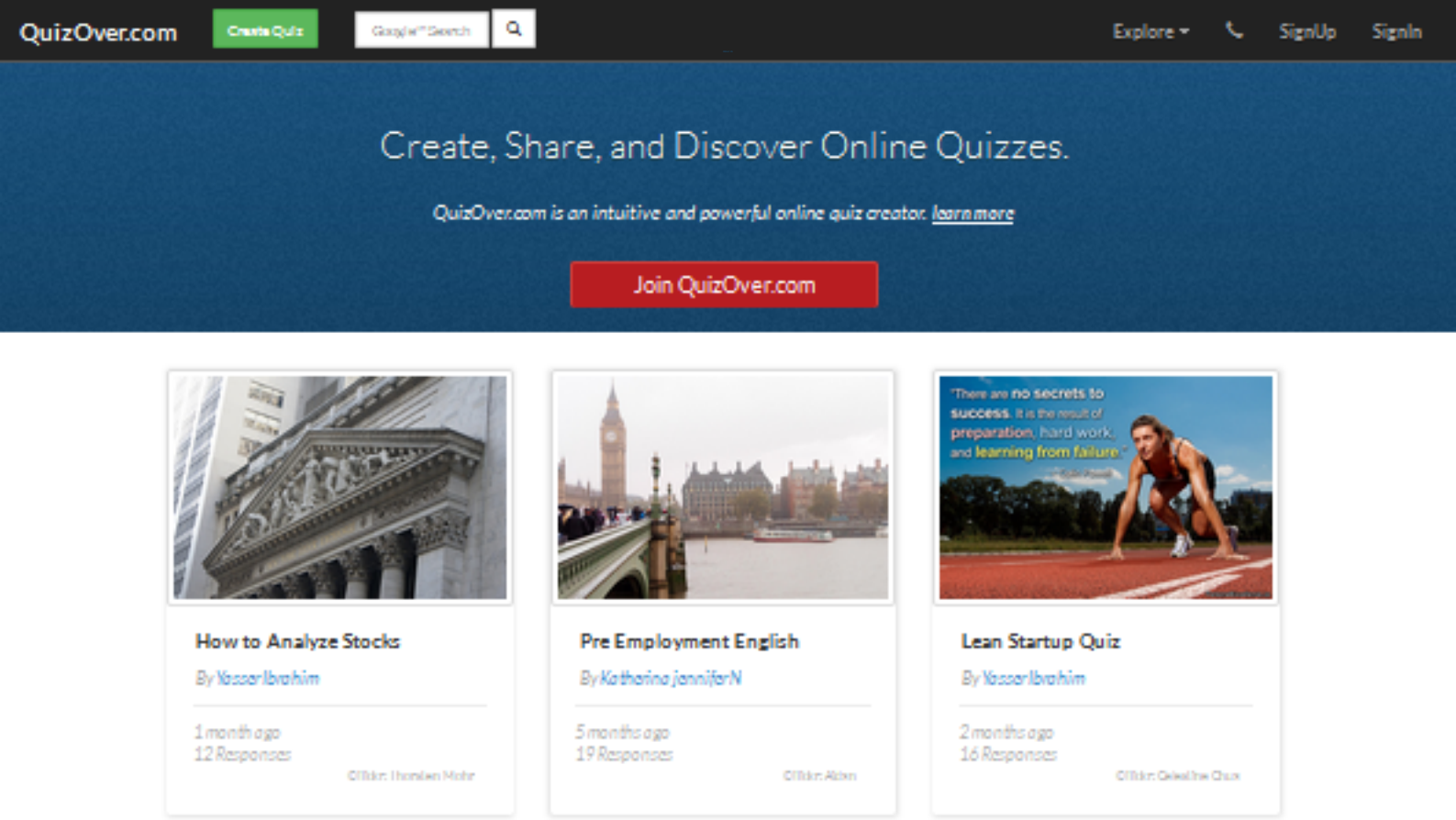

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Stephanie Redfern and Tuan Dinh. Fluid Mechanics. The Saylor Foundation, http://www.saylor.org/courses/me201/

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4. Chapter: Unit 02: Fluid Dynamics and Kinematics

1. Unit 02: Fluid Dynamics and Kinematics Questions

4.1.1. Which of the following are required in order to use Bernoulli's equ...

Author: Stephanie Redfern

Which of the following are required in order to use Bernoulli's equation? I. Steady flow II. Flow along a streamline III. Inviscid flow IV. Incompressible flow

Please choose only one answer:

- I, II, III, and IV
- I and II only
- I, II, and III only
- II and III only
- III and IV only

4.1.2. Which of the following statements accurately describes Eulerian and...

Author: Stephanie Redfern

Which of the following statements accurately describes Eulerian and Lagrangian mechanics or reference frames?

Please choose only one answer:

- A neutrally buoyant weather balloon makes pressure measurements in an Eulerian reference frame.
- An anemometer at the top of Mount Washington makes wind velocity measurements in an Eulerian reference frame.
- The fixed laboratory reference frame is a Lagrangian reference frame.
- Neither Lagrangian nor Eulerian viewpoints can be exactly correct.

4.1.3. For ideal (no frictional losses) flow of an incompressible fluid th...

Author: Stephanie Redfern

For ideal (no frictional losses) flow of an incompressible fluid through a sudden expansion, which of the following best describes how the Bernoulli equation predicts that the pressure will change?

Please choose only one answer:

- The pressure will be lower after the expansion than before.
- The pressure will be the same before and after the expansion.
- The pressure will be larger after the expansion than before.
- The flow will stagnate after the expansion.

4.1.4. How high can a 5 hP pump move 5 gal/min of water in Earth's gravity...

Author: Stephanie Redfern

How high can a 5 hP pump move 5 gal/min of water in Earth's gravity if there are no frictional losses?

Please choose only one answer:

- 1.2 m
- 12 m
- 120 m
- 1200 m

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4.1.5. Which of the following expresses Reynolds' transport theorem?

Author: Stephanie Redfern

Which of the following expresses Reynolds' transport theorem?

Please choose only one answer:

- The volume integral of the derivative of a scalar or vector field over a time-dependent volume is equal to the volume integral of the velocity of the field plus the surface integral of the product of the outward boundary speed and the field.
- The derivative of the volume integral of a scalar or vector field over a time-dependent volume is equal to the volume integral of the derivative of the field plus the surface integral of the product of the outward boundary speed and the field.
- The derivative of the volume integral of a scalar or vector field over a time-dependent volume is equal to the volume integral of the derivative of the divergence of the field plus the surface integral of the product of the outward boundary speed and the field.
- The derivative of the volume integral of a scalar or vector field over a time-dependent volume is equal to the volume integral of the derivative of the field plus the volume integral of the product of the outward boundary speed and the field.

4. Chapter: Unit 01: Introduction to Fluid Statics and Flow Phenomena

1. Unit 01: Introduction to Fluid Statics and Flow Phenomena Questions

4.1.1. Which of the following situations might be much better described by...

Author: Stephanie Redfern

Which of the following situations might be much better described by compressible flow than incompressible flow?

Please choose only one answer:

- Water flow over Niagra Falls
- Air flow over a supersonic plane
- Oil flow through a lubrication layer
- Air flow in your lungs

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4.1.2. Which of the following best describes the continuum hypothesis for ...

Author: Stephanie Redfern

Which of the following best describes the continuum hypothesis for a fluid?

Please choose only one answer:

- A fluid deforms continuously.
- Fluid properties do not undergo a jump at a boundary.
- Pressure changes as a continuous function in space.
- The properties of a small averaging volume are the same as those for a macroscopic fluid.

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4.1.3. Which of the following best characterizes a "fluid"?

Author: Stephanie Redfern

Which of the following best characterizes a "fluid"?

Please choose only one answer:

- A fluid flows under the influence of a pressure gradient.
- A fluid deforms in response to stress.
- A fluid has viscosity.
- A fluid ceases to flow if there is no pressure gradient.

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4.1.4. Which of the following is an appropriate unit for fluid density?

Author: Stephanie Redfern

Which of the following is an appropriate unit for fluid density?

Please choose only one answer:

- m[sup]3[/sup]/kg
- kg/ft[sup]2[/sup]
- mkg/s
- lb[sub]m[/sub]/yard[sup]3[/sup]

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4.1.5. Ice has a density of 0.91667 g/cm[sup]3[/sup]. Seawater has a surfa...

Author: Stephanie Redfern

Ice has a density of 0.91667 g/cm[sup]3[/sup]. Seawater has a surface density of about 1.03 g/cm[sup]3[/sup]. Which of the following best represents the fraction of an iceberg that appears above the water surface according to this data?

Please choose only one answer:

- 9%
- 14%
- 18%
- 11%
- 33%

4.1.6. Over which of the following length scales is the continuum hypothes...

Author: Stephanie Redfern

Over which of the following length scales is the continuum hypothesis invalid for air at standard temperature and pressure (STP)?

I. inches

II. 0.1 nanometers

III. 10 nanometers

IV. 1 micron

Please choose only one answer:

- I and IV only
- I only
- I, III, and IV only
- I, II, III, and IV

4.1.7. What is the static pressure at a depth of 100 meters under sea wate...

Author: Stephanie Redfern

What is the static pressure at a depth of 100 meters under sea water on Earth?

Please choose only one answer:

- 10 atm
- 8000 torr
- 100,000 Pa
- 1000 psi
- 10 Pa

4.1.8. Which of the following best describes the relative magnitudes of th...

Author: Stephanie Redfern

Which of the following best describes the relative magnitudes of the vapor pressures of water from a small droplet and from a flat surface?

Please choose only one answer:

- The vapor pressure from a flat surface is larger than that from a droplet.
- The vapor pressure from a droplet is equal to that from a flat surface.
- The vapor pressure from the droplet is larger than that from a flat surface.
- The vapor pressure from a small droplet is very, very small.

4.1.9. Which of the following is appropriate units for dynamic viscosity? ...

Author: Stephanie Redfern

Which of the following is appropriate units for dynamic viscosity? I. Pa s II. kg/(m s) III. psi hr IV. torr min

Please choose only one answer:

- I, II, III, and IV
- II only
- I and II only
- IV only
- I only

4.1.10. Which of the following statements best describes the difference bet...

Author: Stephanie Redfern

Which of the following statements best describes the difference between a pathline and a streakline?

Please choose only one answer:

- A pathline corresponds to the locations of displacements resulting from instantaneous labeling at a point and continuous observation, and the streakline corresponds to the converse.
- A streakline results from the locations of displacements resulting from instantaneous labeling at a point and continuous observation, and the pathline corresponds to the converse.
- There is no difference.
- The streakline and the pathline characterize different flow speeds.

4. Chapter: Unit 05: Dimensional Analysis

1. Unit 05: Dimensional Analysis Questions

4.1.1. Recall that the tank filling problem in Subunit 3.4 resulted in an ...

Author: Stephanie Redfern

Recall that the tank filling problem in Subunit 3.4 resulted in an ordinary differential equation dh/dt A = Q - fh, where h is the height of fluid in the tank, Q is the volumetric flow rate in, H is the height of the tank, A is the cross sectional area of the tank, and f is a parameter with units of length[sup]2[/sup]/time. We may write this equation in a dimensionless form d d = 1 - (fH/Q) , where = h/H. Which of the following definitions of is consistent with the dimensionless equation?

Please choose only one answer:

- tQ/AH
- fH/Q
- tf/AQ
- fAQ/t

4.1.2. Which of the following combinations of physical quantities is dimen...

Author: Stephanie Redfern

Which of the following combinations of physical quantities is dimensionless (= mass density, D is a length scale, v is a velocity, is kinematic viscosity, = dynamic viscosity, m = mass flow rate, Q = volumetric flow rate)?

Please choose only one answer:

- v/
- D/(v)
- m/ (D)
- v / (m)

4.1.3. Which of the following best describes the physical meaning of the F...

Author: Stephanie Redfern

Which of the following best describes the physical meaning of the Froude number?

Please choose only one answer:

- Ratio of boundary layer thickness to solid object length scale
- Ratio of a characteristic velocity to a gravitationally induced velocity
- Ratio of lowest and highest mass densities in the flow field
- Ratio of a characteristic length times a characteristic velocity to the acceleration of gravity

4.1.4. Which of the following best describes the physical meaning of the R...

Author: Stephanie Redfern

Which of the following best describes the physical meaning of the Reynolds number?

Please choose only one answer:

- Ratio of viscous drag to inertia
- Ratio of inertia to viscous drag
- Ratio of viscous drag to form drag
- Ratio of form drag to viscous drag

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4.1.5. We wish to perform wind tunnel tests on a 1/10 size model of an aut...

Author: Stephanie Redfern

We wish to perform wind tunnel tests on a 1/10 size model of an automobile. The model is geometrically similar to the full size automobile. If we wish our experiments to be dynamically similar to the full scale performance of the automobile we must have equivalent Re in addition to several other factors. If we wish to use air, then what should be the wind speed in the tunnel to mimic a full-scale automobile at 60 mph?

Please choose only one answer:

- 6 mph
- 36 mph
- 60 mph
- 600 mph

4. Chapter: Unit 03: Finite and Differential Control Volume Analysis

1. Unit 03: Finite and Differential Control Volume Analysis Questions

4.1.1. A hydroelectric dam on the Ochlockonee River was built in 1929. The...

Author: Stephanie Redfern

A hydroelectric dam on the Ochlockonee River was built in 1929. The elevation change in water level from above the dam to below the dam is about 10 m. The hydroelectric plant on the dam is capable of producing as much as 12 MW of electrical power. Which of the following is the best estimate of the flow rate of water through the dam at peak generation rate?

Please choose only one answer:

- 100,000 m[sup]3[/sup]/s
- 10,000 m[sup]3[/sup]/s
- 1000 m[sup]3[/sup]/s
- 100 m[sup]3[/sup]/s
- 10 m[sup]3[/sup]/s

4.1.2. Consider a garden hose (3/4 inch internal diameter) through wh...

Author: Stephanie Redfern

Consider a garden hose (3/4 inch internal diameter) through which water is flowing at a rate of 1 gallon/minute. At the end of the hose is a 1/8" diameter nozzle. Which of the following most closely matches the magnitude of the rate of change in momentum of the water through the nozzle?

Please choose only one answer:

- 0.5 N
- 9 N
- 8.5 N
- 9.5 N

4.1.3. Consider a cylindrical tank 1 m in diameter and 10 m high. The...

Author: Stephanie Redfern

Consider a cylindrical tank 1 m in diameter and 10 m high. The tank is being filled with a liquid at a rate of 10 gallons/min. Which of the following best represents the rate of change of fluid level (or height) in the tank?

Please choose all the answers that apply:

- 1 m/hr
- 2.9 m/hr
- 0.05 m/hr
- 0.08 m/hr

4.1.4. Consider a tank 1 m in diameter and 10 m high. The tank is being fi...

Author: Stephanie Redfern

Consider a tank 1 m in diameter and 10 m high. The tank is being filled with a liquid at a rate of 10 gallons/min. The liquid drains from the tank at a rate Q = f h, where h is the height of liquid in the tank, and f is 1 gal/(min m). Which of the following best represents how long it takes to fill the tank to a height of 5 m?

Please choose only one answer:

- 1.44 hours
- 172 minutes
- 144 minutes
- 1.72 hours

4. Chapter: Unit 06: Analysis of Simple Flow Geometries (Pipe Flow and Boundary Layers)

1. Unit 06: Analysis of Simple Flow Geometries (Pipe Flow and Boundary Layers) Questions

4.1.1. Consider fully turbulent flow of water in a 90 degree bend in a 4-i...

Author: Stephanie Redfern

Consider fully turbulent flow of water in a 90 degree bend in a 4-inch ID pipe. The radius of curvature of the bend is 12 cm. The flow rate is 50 ft[sup]3[/sup]/min. Which of the following most closely matches the pressure drop though the bend?

Please choose only one answer:

- 7.5 atm
- 75 Pa
- 750 psi
- 750 Pa

4.1.2. Estimate (through calculation) the time required for a 2 mm diamete...

Author: Stephanie Redfern

Estimate (through calculation) the time required for a 2 mm diameter brass ball bearing to fall through 30 cm of 100% glycerol at 20 degrees C. Which of the following values best matches your estimate?

Please choose only one answer:

- 1 minute
- 5 minutes
- 30 minutes
- 1 hour

4.1.3. Consider a conceptual model of a flagpole exposed to wind. We will ...

Author: Stephanie Redfern

Consider a conceptual model of a flagpole exposed to wind. We will approximate the flagpole as a smooth 3 inch OD cylinder 15 m long. The flagpole is exposed to hurricane force winds at 75 mph. Estimate the total transverse force on the flagpole. Which of the following ranges most closely matches your estimate?

Please choose only one answer:

- 20-100 N
- 300-900 N
- 3000-5000 N
- 1-5 N
- 100-300 N

4.1.4. Which of the following is true for Hagen-Poiseuille flow or fully d...

Author: Stephanie Redfern

Which of the following is true for Hagen-Poiseuille flow or fully developed laminar pipe flow?

I. P = 128 L Q/(R[sup]4[/sup])

II. Fluid velocity depends upon axial and radial positions in the pipe.

III. The velocity profile may be parabolic or almost plug (flat) like.

IV. The pressure drop is proportional to viscosity, pipe length, and flow rate, and inversely proportional to the fourth power of the pipe diameter.

V. Fluid velocity only depends upon radial position in the pipe.

Please choose only one answer:

- IV and V only
- I only
- I and II onlly
- III only
- I. II. and III only

4.1.5. Consider steam flowing at 100 ft[sup]3[/sup]/min in a 4 inch diamet...

Author: Stephanie Redfern

Consider steam flowing at 100 ft[sup]3[/sup]/min in a 4 inch diameter pipe. The inlet temperature of the steam is 400 F. The inlet pressure of the steam to the pipe is 50 psia. The pipe is well insulated. The surface roughness of the pipe given by e/D = 0.01. Which of the following most closely represents the pressure drop of the steam over a 40 m section of the pipe?

Please choose only one answer:

- 40 psi
- 0.4 atm
- 400 Pa
- 4 Pa

4.1.6. At approximately which value of Re does flow change from laminar to...

Author: Stephanie Redfern

At approximately which value of Re does flow change from laminar to turbulent in a smooth pipe?

Please choose only one answer:

- 5 x 10[sup]4[/sup]
- 2 x 10[sup]3[/sup]
- 5 x 10[sup]3[/sup]
- 2 x 10[sup]2[/sup]

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4. Chapter: Unit 07: Compressible Flow

1. Unit 07: Compressible Flow Questions

4.1.1. Which of the following represents a compressible-flow version of Be...

Author: Stephanie Redfern

Which of the following represents a compressible-flow version of Bernoulli's equation?

Please choose only one answer:

- $$ \int_{p_0}^{p} \, 1/\rho \, dP + 1/2 \, v^2 + \rho g = constant$$
- $$ \int_{p_0}^{p} \, 1/\rho \, dP + {{1}\over{2}} \, \rho v^2 + \rho gh = constant$$
- $$ \int_{p_0}^{p} \, 1/\rho \, dP + {{1}\over{2}} \, v^2 + h g = constant$$
- $$ \int_{p_0}^{p} \, 1/\rho \, dP + {{1}\over{2}} \, v^2 + \rho g h = constant$$

4.1.2. Which of the following is the best explanation for why rocket engin...

Author: Stephanie Redfern

Which of the following is the best explanation for why rocket engine nozzles are made of convergent-divergent sections? I. Flow does become supersonic in a purely convergent flow. II. The divergent section is important for controlling thrust direction. III. The combination reduces resonant disturbances to the mechanical structure of the nozzle. IV.. The symmetry of the device aids in analysis and manufacture.

Please choose only one answer:

- I and II only
- I and III only
- I only
- I, II, III, and IV
- III and IV only

4.1.3. The 747 airliner is capable of approximately Mach 0.9 at altitude. ...

Author: Stephanie Redfern

The 747 airliner is capable of approximately Mach 0.9 at altitude. The claimed air speed is about 590 mph. What is the temperature of air used in that calculation?

Please choose only one answer:

- 100 °C
- 60 °C
- 20 °C
- 0 °C

4. Chapter: Unit 04: Application of Differential Analysis

1. Unit 04: Application of Differential Analysis Questions

4.1.1. Which of the following expresses the continuity equation (conservat...

Author: Stephanie Redfern

Which of the following expresses the continuity equation (conservation of mass) for an incompressible fluid at steady state?

Please choose only one answer:

- $$ \bf{v} = 0$$
- $$ {{\partial \bf{v}} \over {\partial t}} + \nabla \cdot t = 0 $$
- $$\bf{\nabla \cdot v} = 0$$
- $$ {{\partial \rho} \over {\partial t}} + \bf{v} = 0 $$

4.1.2. In the notation of your resource materials for Unit 4 (page 20), wh...

Author: Stephanie Redfern

In the notation of your resource materials for Unit 4 (page 20), which of the following terms in the Navier-Stokes equations represents momentum transport by convection?

Please choose only one answer:

- v[sub]r[/sub]/r[sup]2[/sup]
- v [sub]r[/sub] v[sub]r[/sub]/r
- -p/r
- - v[sub]r[/sub]/z

4.1.3. In your resource materials for Unit 4, what does represent?

Author: Stephanie Redfern

In your resource materials for Unit 4, what does represent?

Please choose only one answer:

- g
- p/h
- gz
- /p

4.1.4. Integration of the momentum conservation equation for fully develop...

Author: Stephanie Redfern

Integration of the momentum conservation equation for fully developed pipe flow leads to a term C[sub]1[/sub] ln r. Which of the following are good arguments for C[sub]1[/sub] being zero? I. The velocity is finite at the center of the pipe. II. The velocity is azimuthally symmetric (does not depend on angle). III. The velocity is zero at the wall (no slip). IV. The radial gradient of velocity at the center of the pipe is zero.

Please choose only one answer:

- I, II, and IV only
- I and IV only
- II only
- II and IV only
- III only

4.1.5. For liquid flow in an open channel, which of the following is an ap...

Author: Stephanie Redfern

For liquid flow in an open channel, which of the following is an appropriate boundary condition for the liquid flow problem at the liquid-gas interface?

I. The velocity of the gas is zero at the interface.

II. The velocity of the gas and liquid are the same at the interface.

III. There is no momentum transfer across the interface.

IV. The velocity gradients of the gas and liquid are the same at the interface.

Please choose only one answer:

- I only
- I and II only
- I and IV only
- IV only
- II and III only

4.1.6. For liquid flow in an open channel, which of the following is an ap...

Author: Stephanie Redfern

For liquid flow in an open channel, which of the following is an appropriate boundary condition for the liquid flow problem at the liquid-solid interface at the bottom of the channel?

Please choose only one answer:

- No slip
- Zero velocity gradient
- Zero velocity
- Zero normal stress

4.1.7. Which of the following best represents the simplified conservation ...

Author: Stephanie Redfern

Which of the following best represents the simplified conservation of axial momentum equation in differential form for fully developed pipe flow of a Newtonian fluid? (Here w is the axial velocity component.) I. $${{1}\over{r}} {{\partial}\over{\partial r}} (r {{\partial w} \over {\partial r}})= - {{1}\over{\mu}} {{\partial p}\over{\partial z}}$$ II. $${{1}\over{r}} {{\partial}\over{\partial r}} (w {{\partial w} \over {\partial r}})= {{1}\over{\mu}} {{\partial p}\over{\partial z}}$$ III. $${{1}\over{r}} {{\partial}\over{\partial r}} (r {{\partial w} \over {\partial r}})= {{1}\over{\mu}} {{\partial p}\over{\partial z}}$$ IV. $${{1}\over{r}} {{\partial}\over{\partial r}} (r {{\partial w} \over {\partial r}})= {{w}\over{\mu}} {{\partial p}\over{\partial z}}$$

Please choose only one answer:

- I only
- II only
- III and IV only
- I, II, and IV only
- II and III only

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