TOPIC: 191002
KNOWLEDGE: K1.02 [2.7/2.9]
QID: P6 (B1806)

Density input is normally used in steam flow instruments to convert _____ into _____.

A. mass flow rate; volumetric flow rate

B. volumetric flow rate; mass flow rate

C. mass flow rate; differential pressure

D. differential pressure; volumetric flow rate

ANSWER: B.

TOPIC: 191002
KNOWLEDGE: K1.02 [2.7/2.9]
QID: P305 (B2906)

If the steam pressure input to a density-compensated steam flow instrument fails high, the associated flow rate indication will...

A. decrease, because the density input has decreased.

B. increase, because the density input has decreased.

C. decrease, because the density input has increased.

D. increase, because the density input has increased.

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.02 [2.7/2.9]
QID: P406 (B1606)

The density compensating input to a steam flow instrument is used to convert volumetric flow rate to...

A. velocity flow rate.

B. gallons per minute.

C. mass flow rate.

D. differential flow rate.

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.02 [2.7/2.9]
QID: P705 (B708)

A steam flow measuring instrument uses density compensation and square root compensation to convert the differential pressure across a flow element to flow rate in lbm/hr.

The purpose of square root compensation in this flow measuring instrument is to convert _____ to _____.

A. volumetric flow rate; mass flow rate

B. volumetric flow rate; differential pressure

C. differential pressure; mass flow rate

D. differential pressure; volumetric flow rate

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.02 [2.7/2.9]
QID: P1212

If the steam pressure input to a density-compensated steam flow instrument fails low, the indicated flow rate will...

A. increase, because the density input has increased.

B. decrease, because the density input has increased.

C. increase, because the density input has decreased.

D. decrease, because the density input has decreased.

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.02 [2.7/2.9]
QID: P2505 (B2506)

A main steam flow rate measuring instrument uses a steam pressure input to produce main steam flow rate indication in lbm/hr. Assuming volumetric steam flow rate does not change, a steam pressure decrease will cause indicated steam flow rate to...

A. decrease because the density of the main steam has decreased.

B. increase because the specific volume of the main steam has increased.

C. remain the same because steam pressure does not affect the mass flow rate of main steam.

D. remain the same because the steam pressure input compensates for changes in steam pressure.

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.02 [2.7/2.9]
QID: P3605 (B3608)

A steam flow measuring instrument uses density compensation and square root extraction to convert the differential pressure across the flow element to flow rate in lbm/hr.

The purpose of density compensation in this flow measuring instrument is to convert _____ to _____.

A. volumetric flow rate; mass flow rate

B. volumetric flow rate; differential pressure

C. differential pressure; mass flow rate

D. differential pressure; volumetric flow rate

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.02 [2.7/2.9]
QID: P4603 (B4604)

A main steam flow rate differential pressure detector was properly calibrated to produce a main steam flow rate indication of 500,000 lbm/hr with the following initial input conditions:

Detector high pressure input: 1,000 psia
Detector low pressure input: 950 psia

The current detector input conditions are as follows:

Detector high pressure input: 985 psia
Detector low pressure input: 935 psia

Assume that the detector and associated circuitry do not have steam density compensation. Also assume that the main steam quality and volumetric flow rate do not change.

The current main steam flow rate indication is _____ 500,000 lbm/hr; and the current main steam flow rate is _____ 500,000 lbm/hr.

A. equal to; greater than

B. less than; greater than

C. equal to; less than

D. greater than; less than

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.02 [2.7/2.9]
QID: P4703 (B4704)

A nuclear power plant is initially operating with the following main steam parameter values:

Main steam pressure: 1,000 psia
Main steam flow rate: 500,000 lbm/hr

Main steam pressure decreases and stabilizes at 950 psia.

Assume 100 percent quality saturated steam and that main steam volumetric flow rate is the same before and after the pressure change.

Which one of the following is the approximate mass flow rate of main steam after the pressure change?

A. 528,000 lbm/hr

B. 500,000 lbm/hr

C. 472,000 lbm/hr

D. 444,000 lbm/hr

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.02 [2.7/2.9]
QID: P6103 (B6104)

Consider water flowing through a frictionless venturi with no heat gain or loss.

For the above system, flow rate through the venturi is proportional to the square root of differential pressure. For steam flow, the relationship must be modified to account for changes in steam _____ as it flows through the venturi.

A. velocity

B. enthalpy

C. internal energy

D. specific volume

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.02 [2.7/2.9]
QID: P6403

A nuclear power plant is operating at 100 percent power with constant steam generator water levels. Only main feedwater is entering the steam generators and only main steam is leaving the steam generators. Both the main feedwater mass flow rate and main steam mass flow rate instruments use venturi flow sensing elements.

For the above conditions, the indication that most accurately reflects the mass flow rate through a steam generator will typically be the mass flow rate indication for...

A. main feedwater, because condensation can adversely affect the characteristics of a steam flow venturi.

B. main feedwater, because steam generator pressure changes affect the specific volume of steam more than water.

C. main steam, because the enthalpy of high quality steam flowing through a venturi is constant, unlike the enthalpy of water.

D. main steam, because a given mass flow rate of steam through a venturi develops a larger pressure change than the same mass flow rate of water.

ANSWER: B.

TOPIC: 191002
KNOWLEDGE: K1.03 [2.7/2.9]
QID: P206

The most probable cause for fluctuating indication from a liquid flow rate differential pressure detector is...

A. gas or steam being trapped in the liquid.

B. unequal temperature gradients in the liquid.

C. vortexing of the liquid passing through the flow device.

D. the valve on the high pressure sensing line being partially closed.

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.03 [2.7/2.9]
QID: P905

A properly calibrated water flow detector is located several feet below a horizontal pipe containing the detector's sensing element. The detector is removed for inspection and then reconnected to the sensing element with its low-pressure sensing line filled with air and its high-pressure sensing line filled with water.

If the water system is operating, indicated flow rate will be...

A. zero.

B. equal to actual flow rate but greater than zero.

C. lower than actual flow rate.

D. higher than actual flow rate.

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.04 [2.7/2.7]
QID: P8 (B607)

If the equalizing valve for a differential pressure flow detector is opened in an operating system, the associated flow indication will...

A. increase by 50 percent.

B. decrease by 50 percent.

C. increase to maximum.

D. decrease to minimum.

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.04 [2.7/2.7]
QID: P307 (B307)

Which one of the following will cause indicated volumetric flow rate to be lower than actual volumetric flow rate when using a differential pressure flow detector that is connected to a calibrated orifice?

A. System pressure decreases.

B. The orifice erodes over time.

C. Debris becomes lodged in the orifice.

D. A leak develops in the low pressure sensing line.

ANSWER: B.

TOPIC: 191002
KNOWLEDGE: K1.04 [2.7/2.7]
QID: P706 (B707)

Flow rate is being measured using a differential pressure flow detector and a calibrated orifice. If actual flow rate remains constant, which one of the following will cause indicated flow rate to be higher than actual flow rate?

A. The flow detector equalizing valve is inadvertently opened.

B. A leak develops in the high pressure sensing line.

C. Debris becomes lodged in the orifice.

D. The orifice erodes over time.

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.04 [2.7/2.7]
QID: P1007 (B1907)

Refer to the drawing of a pipe elbow used for flow measurement in a cooling water system (see figure below).

A differential pressure (D/P) flow detector is connected to instrument lines A and B.

If instrument line A develops a leak, indicated flow rate will _____ due to a _____ measured D/P.

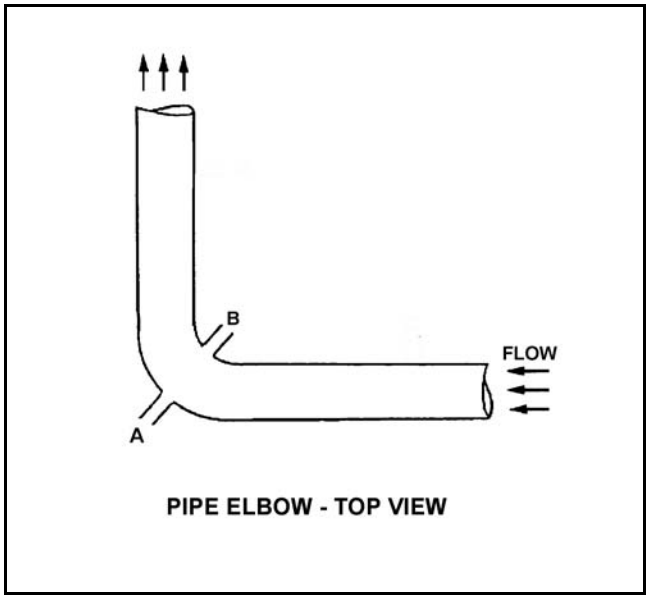
A. increase; larger

B. increase; smaller

C. decrease; larger

D. decrease; smaller

ANSWER: D.



TOPIC: 191002
KNOWLEDGE: K1.04 [2.7/2.7]
QID: P1205 (B1506)

If the orifice in a differential pressure (D/P) flow sensor erodes such that the orifice opening becomes larger, indicated flow rate will _____ due to a _____ D/P across the orifice.

A. increase; larger

B. increase; smaller

C. decrease; larger

D. decrease; smaller

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.04 [2.7/2.7]
QID: P1608 (B1608)

Refer to the drawing of a horizontal pipe elbow (top view) in an operating water system (see figure below).

Three separate differential pressure flow detectors are connected to taps A, B, C, and D as follows:

| Detector | Taps |
|---|---|
| X | A and D |
| Y | B and D |
| Z | C and D |

Assuming zero head loss in this section of pipe, how will the detectors be affected if tap D ruptures?

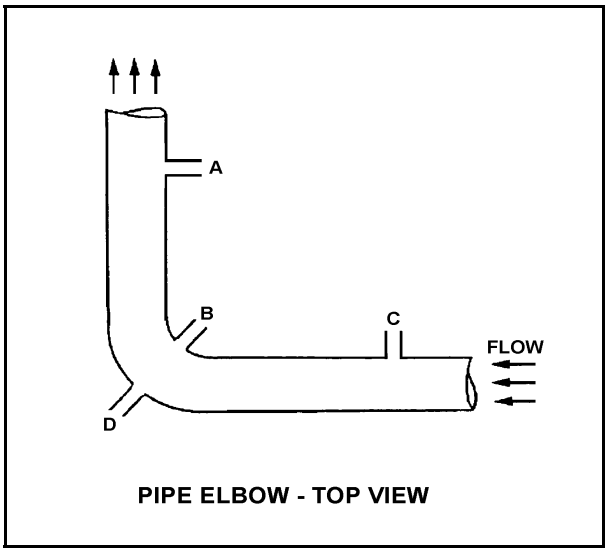
A. All detectors will fail low.

B. All detectors will fail high.

C. Two detectors will fail low and one will fail high.

D. Two detectors will fail high and one will fail low.

ANSWER: A.



TOPIC: 191002
KNOWLEDGE: K1.04 [2.7/2.7]
QID: P2107 (B2209)

Refer to the drawing of a pipe elbow used for flow measurement in a cooling water system (see figure below).

A differential pressure (D/P) flow detector is connected to instrument lines A and B.

If instrument line B develops a leak, indicated flow rate will _____ due to a _____ measured D/P.

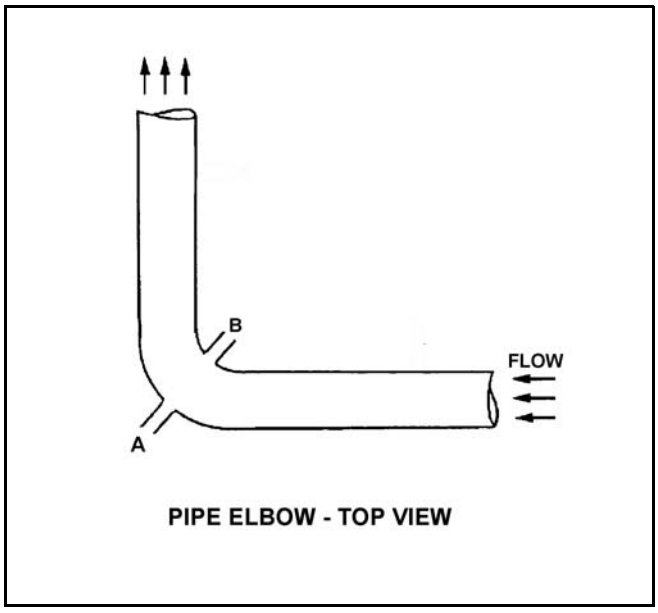
A. increase; larger

B. increase; smaller

C. decrease; larger

D. decrease; smaller

ANSWER: A.



TOPIC: 191002
KNOWLEDGE: K1.04 [2.7/2.7]
QID: P2305 (B2310)

An orifice is being used in an operating cooling water system to measure flow rate. Which one of the following will cause the differential pressure sensed across the orifice to decrease?

A. System pressure decreases.

B. System flow rate decreases.

C. Debris becomes lodged in the orifice.

D. A leak develops in the low pressure sensing line.

ANSWER: B.

TOPIC: 191002
KNOWLEDGE: K1.04 [2.7/2.7]
QID: P2307 (B2307)

Refer to the drawing of a horizontal pipe elbow (top view) in an operating water system (see figure below).

Three separate bellows differential pressure flow detectors are connected to taps A, B, C, and D as follows:

| Detector | Taps |
|---|---|
| X | A and D |
| Y | B and D |
| Z | C and D |

Assume that water is incompressible and there is no head loss in this section of pipe. How will the detectors be affected if system flow rate remains the same while system pressure increases from 1,000 psig to 1,200 psig?

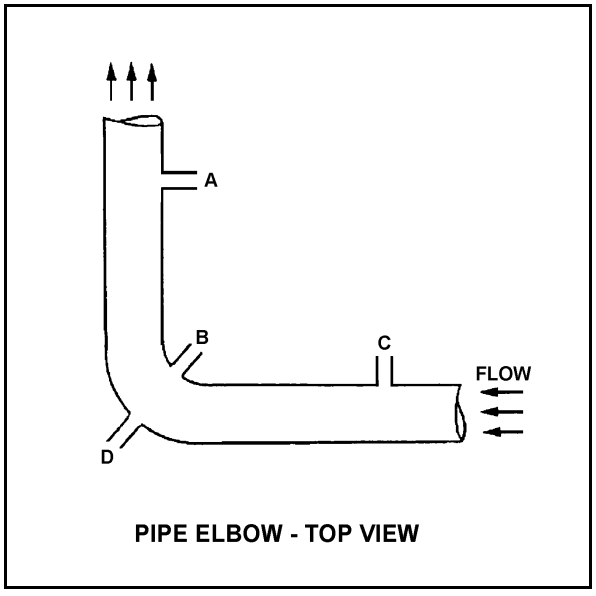
A. All detectors will indicate higher flow.

B. Only two detectors will indicate higher flow.

C. Only one detector will indicate higher flow.

D. Detector indication will not change.

ANSWER: D.



TOPIC: 191002
KNOWLEDGE: K1.04 [2.7/2.7]
QID: P2807 (B1007)

Refer to the drawing of a pipe elbow used for flow measurement (see figure below).

At which one of the following locations is the highest pressure sensed? (Assume a constant pipe diameter and zero head loss in this section of pipe.)

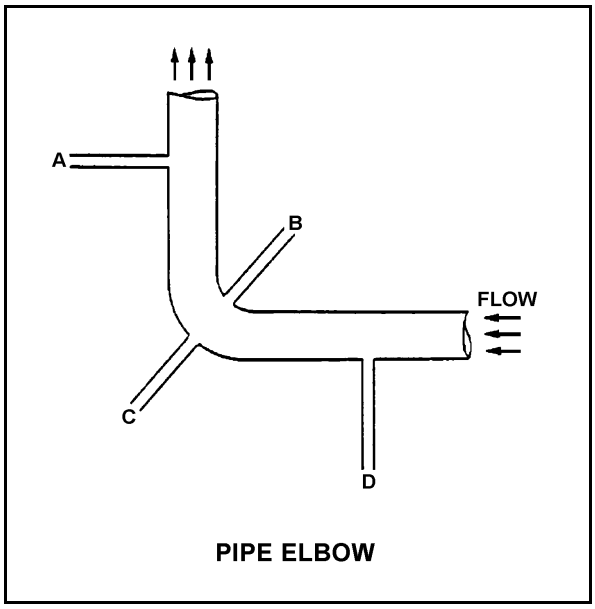
A. Point A

B. Point B

C. Point C

D. Point D

ANSWER: C.



TOPIC: 191002
KNOWLEDGE: K1.04 [2.7/2.7]
QID: P2905 (B3108)

Refer to the drawing of a horizontal pipe elbow (top view) in an operating water system (see figure below).

Three separate bellows-type differential pressure flow detectors are connected to taps A, B, C, and D as follows:

| Detector | Taps |
|---|---|
| X | A and D |
| Y | B and D |
| Z | C and D |

Assuming zero head loss in this section of pipe, how will the detectors be affected if tap B experiences a significant leak? (Assume water system pressure does not change.)

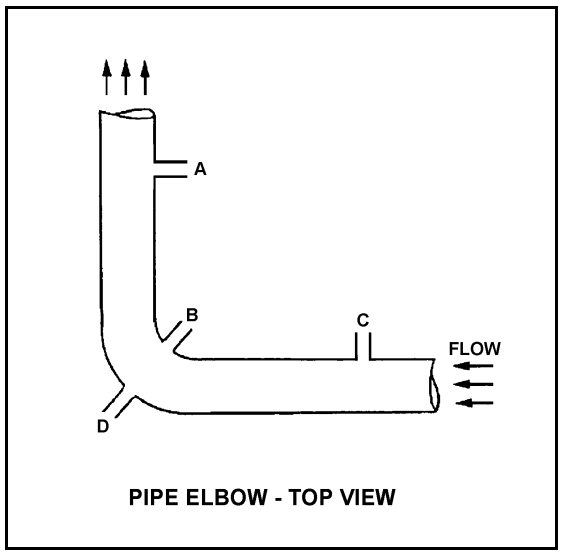
A. All detectors will fail low.

B. All detectors will fail high.

C. Only one detector will fail, and it will fail low.

D. Only one detector will fail, and it will fail high.

ANSWER: D.



TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P9

Flow detectors (such as an orifice, flow nozzle, and venturi tube) measure flow rate using the principle that flow rate is...

A. directly proportional to the differential pressure (D/P) squared.

B. inversely proportional to the D/P squared.

C. directly proportional to the square root of the D/P.

D. inversely proportional to the square root of the D/P.

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P308 (B305)

A cooling water system is operating at steady-state conditions indicating 900 gpm with 60 psid across the flow transmitter venturi. If cooling water flow rate is increased to 1,800 gpm, flow transmitter venturi delta-P will be approximately...

A. 85 psid.

B. 120 psid.

C. 175 psid.

D. 240 psid.

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P607 (B608)

The flow rate of a fluid passing through a venturi can be determined by measuring the...

A. differential pressure of the fluid as it passes through the venturi.

B. change in the velocity of the fluid as it passes through the venturi.

C. linear displacement of a metering plug installed in the throat of the venturi.

D. rotation of a paddle wheel type device installed in the throat of the venturi.

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P707 (B706)

A cooling water system is operating at a steady-state flow rate of 700 gpm with 60 psid across the flow transmitter venturi. If cooling water flow rate is increased to 1,000 gpm, differential pressure across the flow transmitter venturi will be approximately...

A. 85.7 psid.

B. 122.4 psid.

C. 171.4 psid.

D. 244.8 psid.

ANSWER: B.

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P807 (B807)

Refer to the drawing of a venturi flow element (see figure below) with direction of fluid flow indicated by the arrow.

Where should the high pressure tap of a differential pressure flow detector be connected?

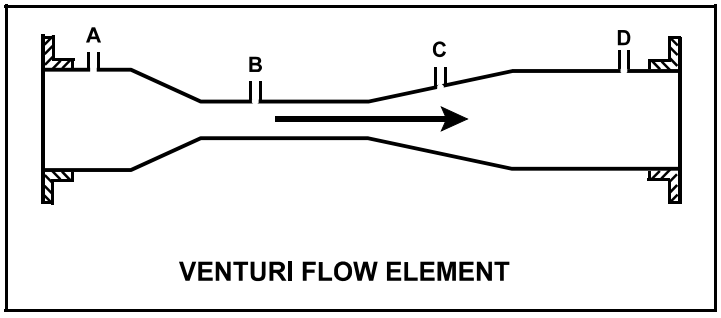
A. Point A

B. Point B

C. Point C

D. Point D

ANSWER: A.



TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P907 (B1905)

A differential pressure (D/P) detector is being used to measure main steam flow rate. At a steam flow rate of $5 \times 10^6$ lbm/hr measured D/P is 40 psid.

If steam flow changes such that current D/P is 30 psid, what is the approximate current steam flow rate?

A. $2.1 \times 10^6$ lbm/hr

B. $3.5 \times 10^6$ lbm/hr

C. $3.7 \times 10^6$ lbm/hr

D. $4.3 \times 10^6$ lbm/hr

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P908 (B2106)

Which one of the following flow measuring elements produces the largest unrecoverable head loss when used in an operating fluid system?

A. Venturi

B. Flow nozzle

C. Pipe elbow

D. Orifice

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P1106 B3306)

Refer to the drawing of a venturi flow element in an operating cooling water system (see figure below).

At what point does the lowest pressure exist?

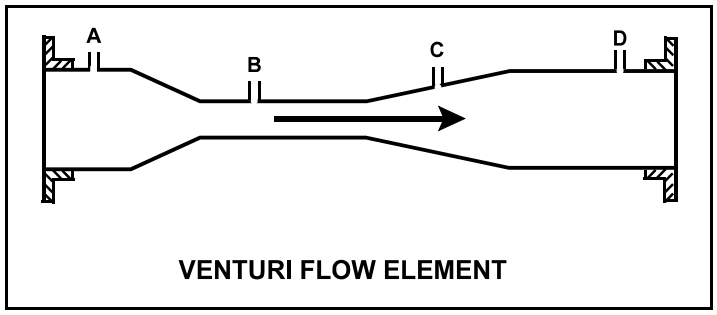
A. Point A

B. Point B

C. Point C

D. Point D

ANSWER: B.




**VENTURI FLOW ELEMENT**

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P1308 (B907)

Refer to the drawing of a venturi flow element for an operating cooling water system (see figure below).

The greatest differential pressure (D/P) will be sensed by a D/P flow detector if the low pressure sensing line is connected at _____ and the high pressure sensing line is connected at _____.

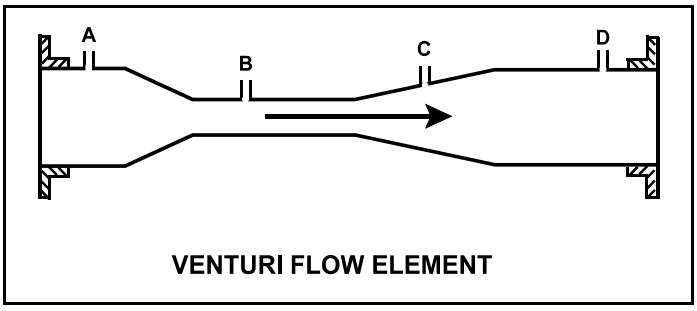
A. B; A

B. B; C

C. D; A

D. D; C

ANSWER: A.



TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P1407

A cooling water system is operating at a steady-state flow rate of 500 gpm with 60 psid across the flow transmitter venturi. If cooling water flow rate is increased to 1000 gpm, differential pressure across the flow transmitter venturi will be approximately...

A. 85 psid.

B. 120 psid.

C. 240 psid.

D. 480 psid.

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P1606 (B407)

Refer to the drawing in which subcooled water is flowing through a convergent-divergent venturi (see figure below). The pipe diameters at P1 and P2 are equal.

Compared to the conditions at the inlet of the venturi (P1), the pressure at the outlet of the venturi (P2) has _____ and the mass flow rate of the water at the outlet of the venturi has _____. (Assume "real" conditions.)

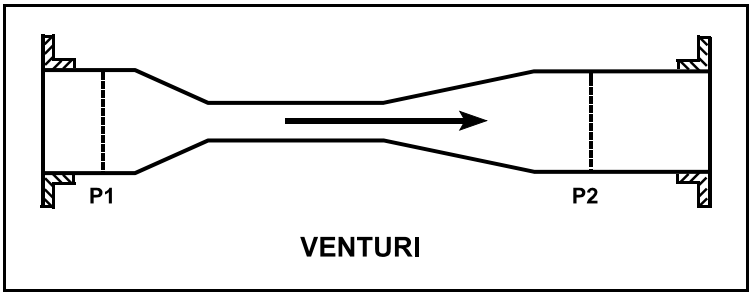
A. remained the same; remained the same

B. remained the same; decreased slightly

C. decreased slightly; remained the same

D. decreased slightly; decreased slightly

ANSWER: C.



TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P1808

Subcooled water is flowing through a venturi flow element. When the water reaches the throat of the venturi, the _____ water pressure and the _____ water velocity occurs.

A. highest; highest

B. lowest; lowest

C. lowest; highest

D. highest; lowest

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P1873 (B1773)

Subcooled water is flowing through each of the following devices. Which one of the devices will produce an outlet pressure that is greater than the inlet pressure?

A. Convergent nozzle

B. Divergent nozzle

C. Orifice

D. Flow restrictor

ANSWER: B.

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P1906 (B1408)

Refer to the drawing of a pipe elbow used for flow measurement (see figure below).

At which one of the following pairs of connection points will the greatest differential pressure be sensed? (Assume ideal fluid flow conditions.)

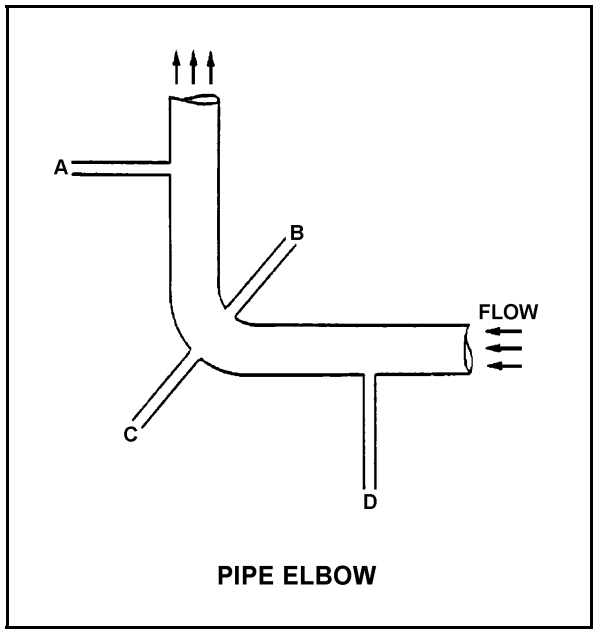
A. Points A and B

B. Points B and C

C. Points C and D

D. Points D and A

ANSWER: B.



TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P2306 (B2306)

A venturi is used to measure flow rate in a cooling water system. As the water flows from the throat to the discharge of the venturi, water pressure will _____ and volumetric flow rate will _____. (Assume water is incompressible.)

A. increase; remain the same

B. increase; increase

C. decrease; remain the same

D. decrease; decrease

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P2406 (B2206)

A cooling water system is operating at a steady-state flow rate of 700 gpm with 60 psid across a flow transmitter venturi. If cooling water flow rate is increased to 900 gpm, differential pressure across the flow transmitter venturi will be approximately...

A. 68 psid.

B. 77 psid.

C. 99 psid.

D. 127 psid.

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P2506 (B2606)

A venturi is being used to measure flow rate in a cooling water system. As the cooling water flows from the inlet to the throat of the venturi, water pressure will _____ and volumetric flow rate will _____. (Assume water is incompressible.)

A. increase; remain the same

B. increase; increase

C. decrease; remain the same

D. decrease; increase

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P2507 (B2508)

A differential pressure detector is being used with an orifice plate to measure water flow rate through a pipe. When the flow detector was last calibrated, the following parameters were observed:

Upstream Pressure: 125 psig
Downstream Pressure: 116 psig

Actual Flow Rate: 100 gpm
Indicated Flow Rate: 100 gpm

Significant erosion of the orifice has occurred since the calibration such that actual flow rate through the orifice has increased to 120 gpm while the upstream and downstream pressures have changed to 110 psig and 106 psig respectively.

What is the approximate flow rate that is currently indicated?

A. 44 gpm

B. 67 gpm

C. 81 gpm

D. 120 gpm

ANSWER: B.

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P2606

A cooling water system is operating at steady-state conditions at 900 gpm with 64 psid across the flow transmitter venturi. Cooling water flow rate changes such that venturi differential pressure decreases to 36 psid.

Which one of the following is the new system flow rate?

A. 506 gpm

B. 576 gpm

C. 675 gpm

D. 745 gpm

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P2808 (B2806)

A differential pressure detector is being used with an orifice plate to measure water flow rate through a pipe. When the flow detector was last calibrated, the following parameters were observed:

Upstream Pressure: 135 psig
Downstream Pressure: 120 psig

Actual Flow Rate: 100 gpm
Indicated Flow Rate: 100 gpm

Significant erosion of the orifice plate opening has occurred since the last calibration such that actual flow rate through the orifice has increased to 120 gpm while the upstream and downstream pressures have changed to 124 psig and 109 psig respectively.

What is the approximate currently indicated flow rate?

A. 44 gpm

B. 67 gpm

C. 100 gpm

D. 120 gpm

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P3207 (B3206)

A cooling water system uses a horizontal venturi with a differential pressure flow detector to provide cooling water flow rate indication. Water enters and leaves the venturi at 70°F, 120 psig and 20 ft/sec. Water velocity at the throat of the venturi is 45 ft/sec. Assume water is incompressible and the venturi experiences no unrecoverable head loss.

What is the approximate pressure of the water at the throat of the venturi?

A. 109 psig

B. 98 psig

C. 86 psig

D. 71 psig

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P3306 (B2010)

A cooling water system is operating at steady-state conditions. A calibrated system flow meter indicates 600 gpm with 50 psid across the flow transmitter venturi.

If cooling water flow rate is increased to 900 gpm, differential pressure across the flow transmitter venturi will be approximately...

A. 63 psid.

B. 75 psid.

C. 97 psid.

D. 112 psid.

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P3706 (B3706)

The following is the current calibration data for an orifice plate that is being used for water flow rate measurement:

Upstream Pressure: 135 psig
Downstream Pressure: 120 psig
Flow Rate: 100 gpm

During a surveillance the following pressures are observed across the orifice plate:

Upstream Pressure: 124 psig
Downstream Pressure: 117 psig

What is the approximate water flow rate through the orifice plate?

A. 47 gpm

B. 57 gpm

C. 68 gpm

D. 78 gpm

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P3807 (B3807)

Refer to the drawing of a differential pressure manometer (see figure below).

The manometer is filled with water and installed across an orifice in a ventilation duct to determine the rate of air flow. The manometer is currently indicating a water level difference of 16 inches at an air flow rate of 300 $ft^3$/min.

Which one of the following will be the approximate rate of air flow when the manometer indicates a water level difference of 4 inches?

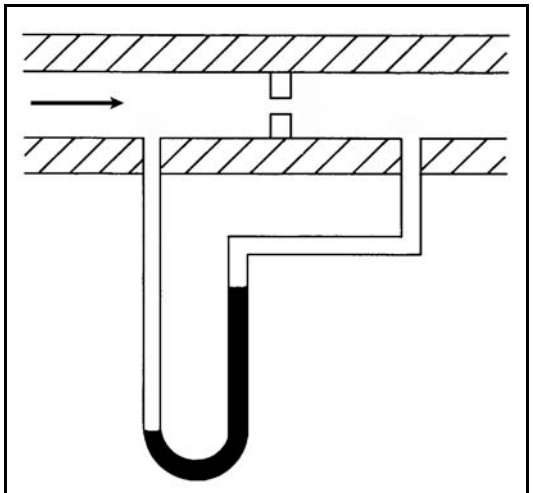
A. 75 $ft^3$/min.

B. 125 $ft^3$/min.

C. 150 $ft^3$/min.

D. 175 $ft^3$/min.

ANSWER: C.



DIFFERENTIAL PRESSURE MANOMETER

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P4003 (B4005)

A differential pressure detector is being used with an orifice plate to measure water flow rate through a pipe. When the flow instrument was last calibrated, the following parameters were observed:

| | | | |
|---|---|---|---|
| Upstream Pressure: | 125 psig | Actual Flow Rate: | 100 gpm |
| Downstream Pressure: | 116 psig | Indicated Flow Rate: | 100 gpm |

Since the calibration, debris has collected in the orifice such that the actual flow rate through the orifice has decreased to 80 gpm while the upstream and downstream pressures have changed to 135 psig and 110 psig, respectively.

What is the approximate flow rate that is currently indicated by the flow instrument?

A. 125 gpm

B. 133 gpm

C. 156 gpm

D. 167 gpm

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P4604 (B4605)

Refer to the drawing of a differential pressure manometer (see figure below).

The manometer is filled with water and installed across an orifice in a ventilation duct to determine the rate of air flow. The manometer is currently indicating a water level difference of 8 inches at an air flow rate of 300 cubic feet per minute ($ft^3$/min).

Which one of the following will be the approximate air flow rate when the manometer indicates a water level difference of 4 inches?

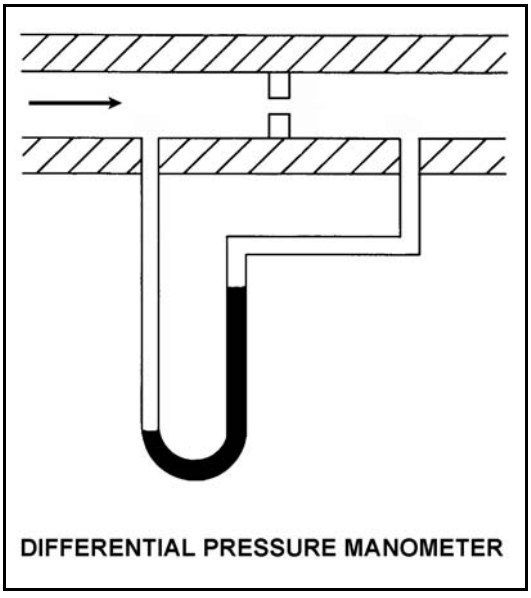
A. 75 $ft^3$/min

B. 150 $ft^3$/min

C. 188 $ft^3$/min

D. 212 $ft^3$/min

ANSWER: D.



DIFFERENTIAL PRESSURE MANOMETER

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P4804 (B4804)

A cooling water system uses a horizontal venturi with a differential pressure flow detector to provide cooling water flow rate indication. Water enters and leaves the venturi at 70°F, 100 psig and 24 ft/sec. Water velocity at the throat of the venturi is 50 ft/sec. Assume water is incompressible and the venturi experiences no unrecoverable head loss.

What is the approximate pressure of the water at the throat of the venturi?

A. 98 psig

B. 94 psig

C. 87 psig

D. 74 psig

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.05 [2.6/2.8]
QID: P6803 (B6804)

Refer to the drawing of a frictionless venturi flow element (see figure below). Subcooled water is flowing through the venturi with the following initial conditions:

Flow rate: 500 gpm
Tap A pressure: 40 psia
Tap B pressure: 36 psia

Flow rate increases to 1,000 gpm, which results in a tap A pressure of 68 psia. What is the new pressure at tap B?

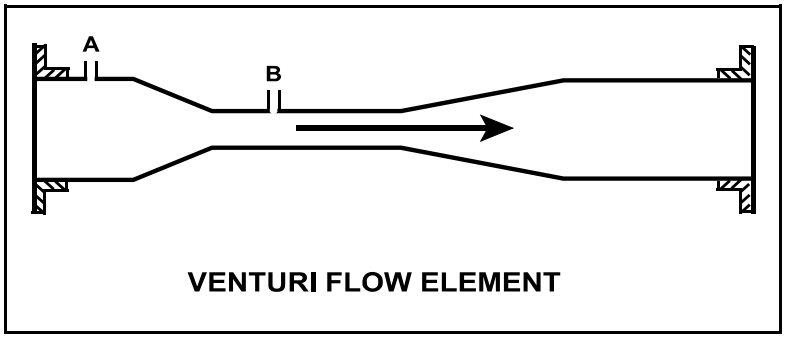
A. 60 psia

B. 52 psia

C. 44 psia

D. 32 psia

ANSWER: B.



TOPIC: 191002
KNOWLEDGE: K1.06 [2.5/2.6]
QID: P208 (B909)

Refer to the drawing of a tank differential pressure (D/P) level detector (see figure below).

The associated level instrument was calibrated with the water in the storage tank at 100°F. If mass in the tank remains constant and the water temperature increases to 120°F, the indicated level will...

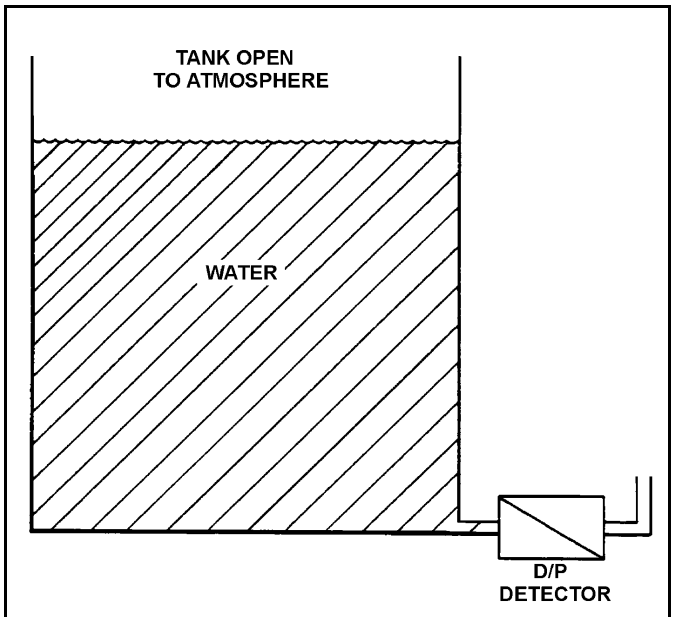
A. increase in direct proportion to the temperature rise.

B. increase but remain less than actual level.

C. decrease in direct proportion to the temperature rise.

D. remain the same although actual level increases.

ANSWER: D.




TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

TOPIC: 191002
KNOWLEDGE: K1.06 [2.5/2.6]
QID: P411

Refer to the drawing of a pressurizer differential pressure (D/P) level detection system (see figure below). The pressurizer level instrument was calibrated while the plant was in a cold shutdown condition.

When the plant is returned to normal operating conditions, pressurizer level will indicate _____ than actual level because a given pressurizer level at normal operating conditions produces a _____ D/P compared to cold shutdown conditions.

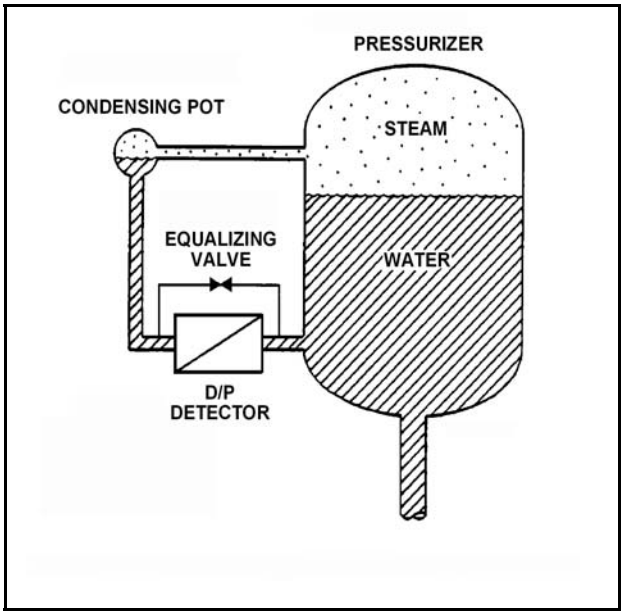
A. higher; smaller

B. higher; larger

C. lower; smaller

D. lower; larger

ANSWER: D.



TOPIC: 191002
KNOWLEDGE: K1.06 [2.5/2.6]
QID: P507

Refer to the drawing of a tank differential pressure level detector that was recently calibrated at a tank water temperature of 80°F (see figure below).

If the mass of the water in the tank remains the same while the tank water temperature is raised from 80°F to 150°F, the indicated level will...

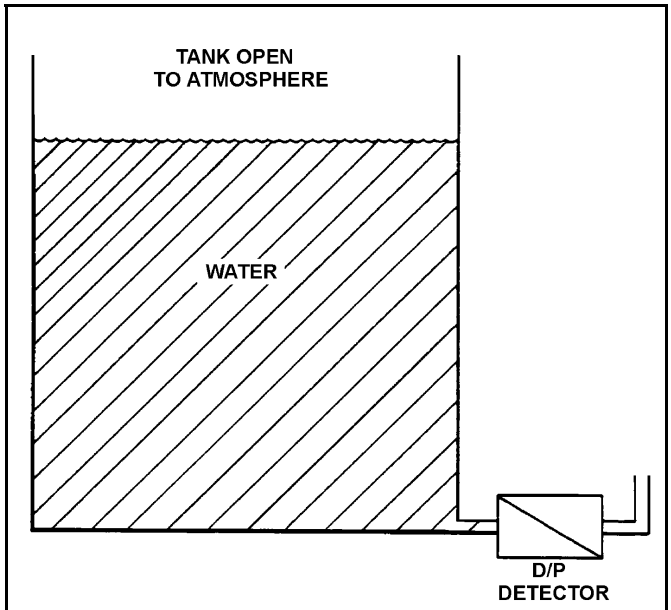
A. remain equal to actual level.

B. increase due to the expansion of the water.

C. remain the same.

D. decrease due to the expansion of the water.

ANSWER: C.




TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

TOPIC: 191002
KNOWLEDGE: K1.06 [2.5/2.6]
QID: P608

Refer to the drawing of two tank differential pressure (D/P) level indicators (see figure below).

Two D/P level indicators are installed on a large water storage tank. Indicator 1 was calibrated at 100°F water temperature and indicator 2 was calibrated at 200°F water temperature.

Assuming both indicators are on scale, which one will indicate the higher level?

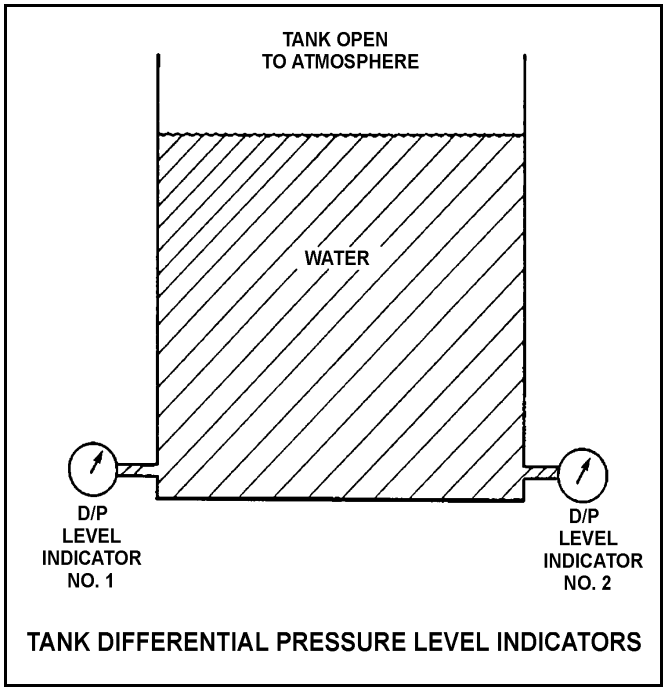
A. Indicator 1 at all water temperatures

B. Indicator 2 at all water temperatures

C. Indicator 1 below 150°F, indicator 2 above 150°F

D. Indicator 2 below 150°F, indicator 1 above 150°F

ANSWER: B.



TANK DIFFERENTIAL PRESSURE LEVEL INDICATORS

TOPIC: 191002
KNOWLEDGE: K1.06 [2.5/2.6]
QID: P808 (B809)

Refer to the drawing of a tank differential pressure (D/P) level detector (see figure below).

The D/P level detector is being used in a level control system that is calibrated to maintain tank level at 80 percent at the current tank temperature of 100°F. If tank temperature gradually increases and stabilizes at 150°F, actual tank level will...

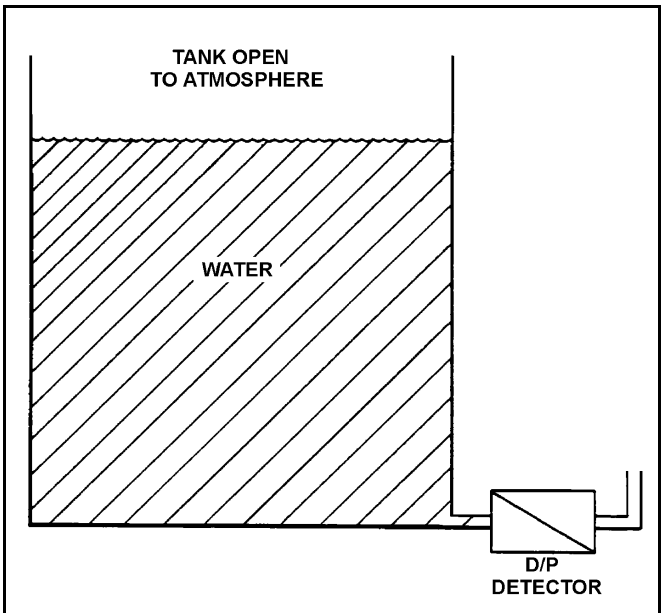
A. remain at 80 percent.

B. increase and stabilize above 80 percent.

C. oscillate around 80 percent.

D. decrease and stabilize below 80 percent.

ANSWER: B.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

TOPIC: 191002
KNOWLEDGE: K1.06 [2.5/2.6]
QID: P1107 (B1507)

Refer to the drawing of two tank differential pressure (D/P) level indicators (see figure below).

Two D/P level indicators are installed on a large water storage tank. Indicator 1 was calibrated at 100°F water temperature and indicator 2 was calibrated at 200°F water temperature.

Assuming both indicators are on scale, which indicator will indicate the lower level?

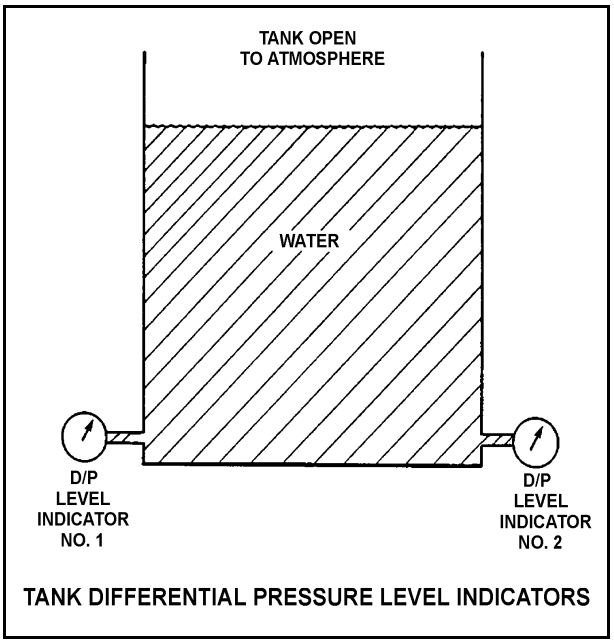
A. Indicator 1 at all water temperatures

B. Indicator 2 at all water temperatures

C. Indicator 1 below 150°F, indicator 2 above 150°F

D. Indicator 2 below 150°F, indicator 1 above 150°F

ANSWER: A.



TANK DIFFERENTIAL PRESSURE LEVEL INDICATORS

TOPIC: 191002
KNOWLEDGE: K1.06 [2.5/2.6]
QID: P1706 (B1706)

Refer to the drawing of two tank differential pressure (D/P) level indicators (see figure below).

Two D/P level indicators are installed on a large water storage tank. Indicator No. 1 was calibrated at 200°F water temperature and indicator No. 2 was calibrated at 100°F water temperature.

Assuming both indicators are on scale, which indicator will indicate the lower level?

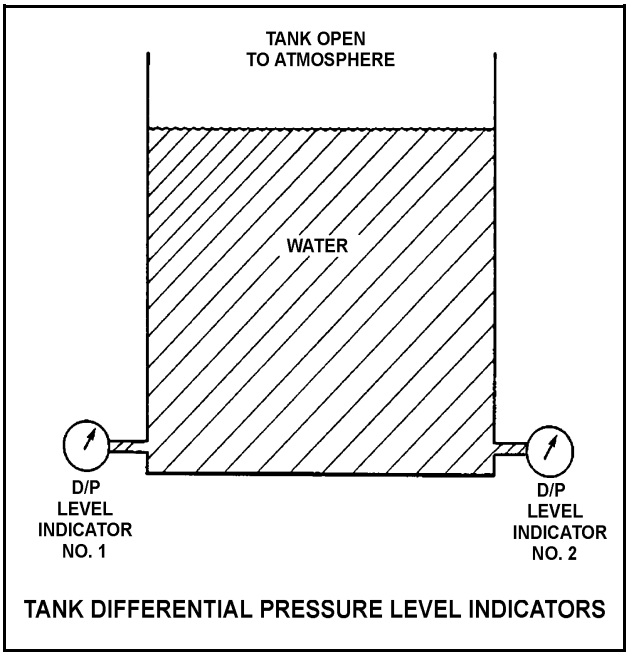
A. Indicator 1 at all water temperatures.

B. Indicator 2 at all water temperatures.

C. Indicator 1 below 150°F, indicator 2 above 150°F.

D. Indicator 2 below 150°F, indicator 1 above 150°F .

ANSWER: B.



TANK DIFFERENTIAL PRESSURE LEVEL INDICATORS

TOPIC: 191002
KNOWLEDGE: K1.06 [2.5/2.6]
QID: P1907

Refer to the drawing of a water storage tank with two differential pressure (D/P) level indicators (see figure below).

Indicator 1 was calibrated at 120°F and indicator 2 was calibrated at 180°F. If tank water temperature is 150°F, then indicator...

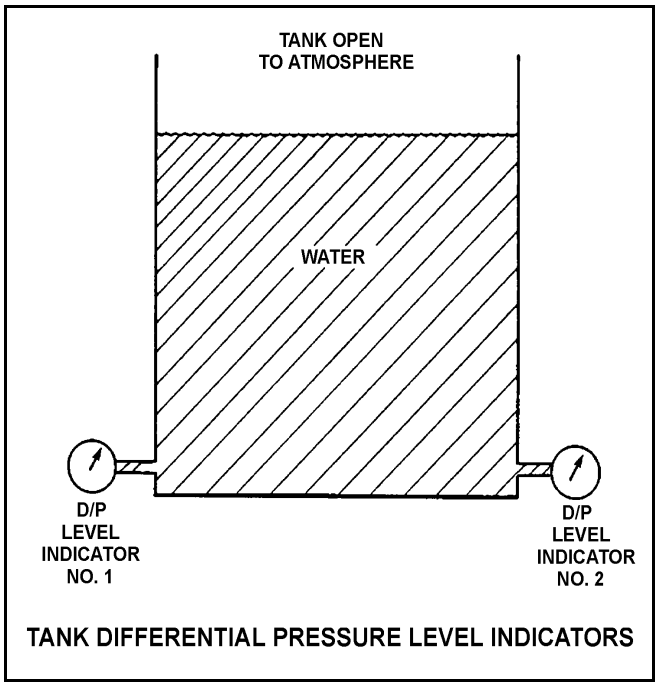
A. 1 will read greater than indicator 2 and greater than actual level.

B. 1 will read greater than indicator 2 and less than actual level.

C. 2 will read greater than indicator 1 and greater than actual level.

D. 2 will read greater than indicator 1 and less than actual level.

ANSWER: C.



TANK DIFFERENTIAL PRESSURE LEVEL INDICATORS

TOPIC: 191002
KNOWLEDGE: K1.06 [2.5/2.6]
QID: P2108 (B2408)

Refer to the drawing of a water storage tank with two differential pressure (D/P) level indicators (see figure below).

Indicator 1 was calibrated at 180°F and indicator 2 was calibrated at 120°F. If current tank water temperature is 150°F, then indicator...

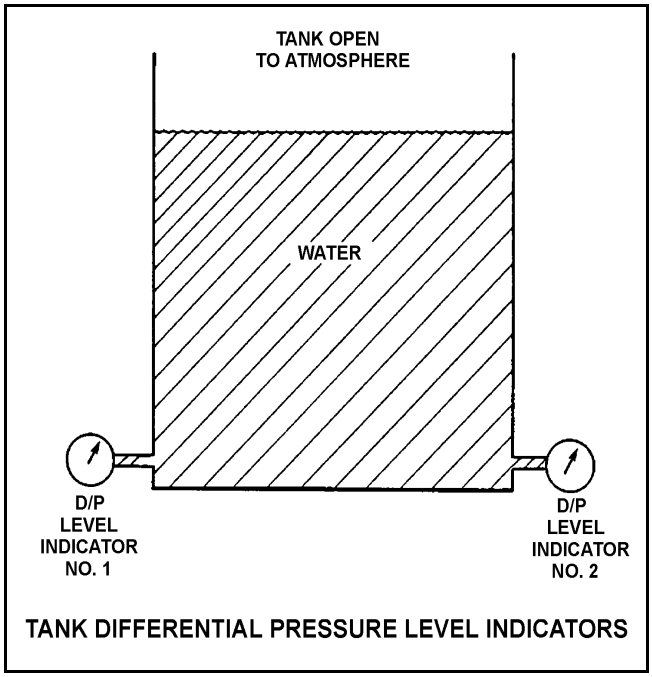
A. 1 will read greater than indicator 2 and greater than actual water level.

B. 1 will read greater than indicator 2 and less than actual water level.

C. 2 will read greater than indicator 1 and greater than actual water level.

D. 2 will read greater than indicator 1 and less than actual water level.

ANSWER: A.



TANK DIFFERENTIAL PRESSURE LEVEL INDICATORS

TOPIC: 191002
KNOWLEDGE: K1.06 [2.5/2.6]
QID: P2308 (B2308)

Refer to the drawing of a steam generator differential pressure (D/P) level detection system that was calibrated at normal operating conditions (see figure below).

A reactor coolant system cooldown has resulted in a decrease in steam generator pressure from 900 psia to 400 psia. Without density compensation of the level instrumentation, at the end of the cooldown, steam generator level indication would indicate _____ than actual level because the density of the water in the _____ has changed significantly.

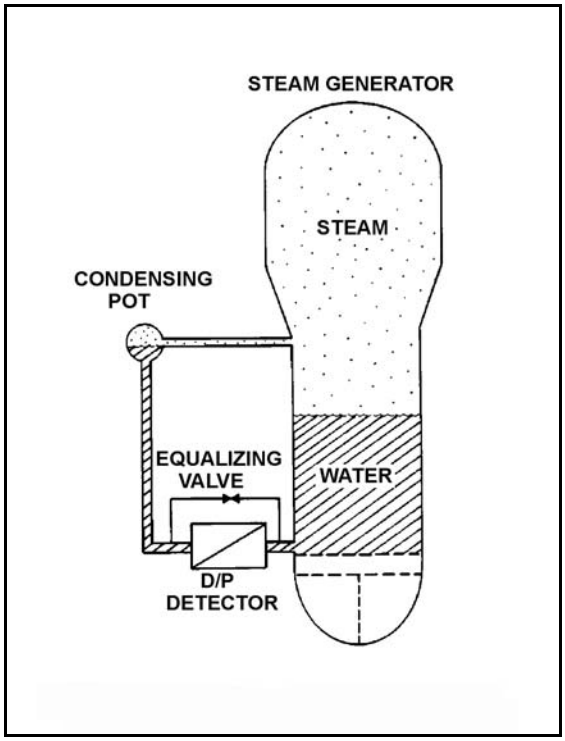
A. lower; reference leg

B. lower; steam generator

C. higher; reference leg

D. higher; steam generator

ANSWER: D.



TOPIC: 191002
KNOWLEDGE: K1.06 [2.5/2.6]
QID: P2509

Refer to the drawing of a steam generator (SG) differential pressure (D/P) level detection system (see figure below) that has been calibrated at the current SG pressure of 400 psia.

A reactor coolant system heatup has resulted in an increase in SG pressure from 400 psia to 900 psia over 4 hours. The ambient air temperature surrounding the SG has remained constant.

Without density compensation of the level instrumentation, at the end of the heatup SG level indication would indicate _____ than actual level because the density of the water in the _____ has changed significantly.

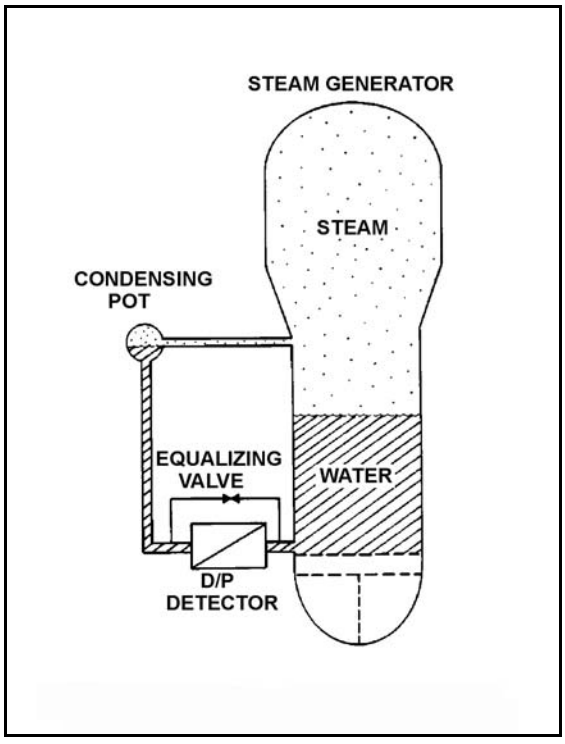
A. higher; steam generator

B. higher; reference leg

C. lower; steam generator

D. lower; reference leg

ANSWER: C.



TOPIC: 191002
KNOWLEDGE: K1.06 [2.5/2.6]
QID: P3208

A nuclear reactor is currently shut down at 140°F and 150 psig. Pressurizer level is being monitored using a normal at-power pressurizer level instrument that was calibrated at normal plant operating conditions.

The pressurizer level instrument indicates _____ than actual pressurizer level because, compared to the calibration conditions, there has been a significant change in the density of the fluid in the _____.

A. lower; reference leg

B. lower; pressurizer

C. higher; reference leg

D. higher; pressurizer

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.06 [2.5/2.6]
QID: P4104

Refer to the drawing of a pressurizer and differential pressure (D/P) level detection system that was recently calibrated at normal operating conditions (see figure below). Assume that the associated pressurizer level instrument does not use density compensation.

With the nuclear power plant shut down at reduced reactor coolant system temperature and pressure, the pressurizer level instrument will indicate _____ than actual water level because the D/P currently sensed by the D/P detector is_____ than the D/P for the same pressurizer water level at normal operating conditions.

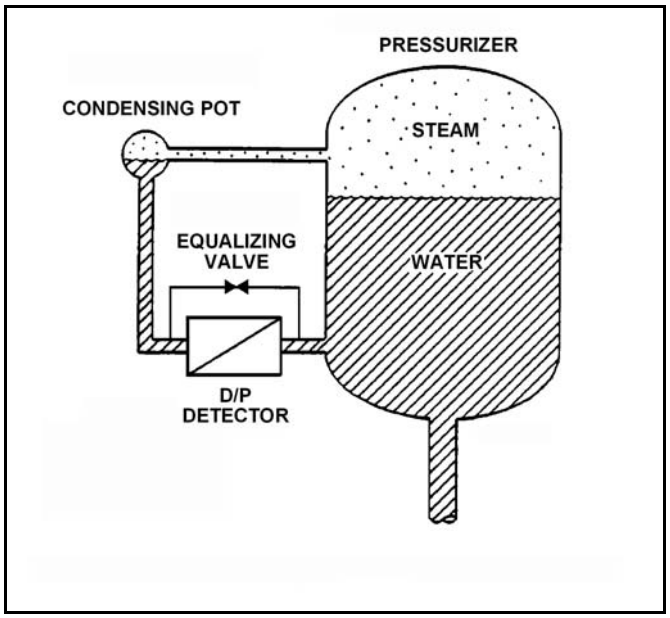
A. lower; smaller

B. lower; larger

C. higher; smaller

D. higher; larger

ANSWER: C.



TOPIC: 191002
KNOWLEDGE: K1.06 [2.5/2.6]
QID: P4204 (B4205)

Refer to the drawing of a water storage tank with two differential pressure (D/P) level indicators (see figure below).

Indicator 1 was calibrated at a tank water temperature of 120°F and indicator 2 was calibrated at 180°F. If tank water temperature is currently 150°F, then indicator...

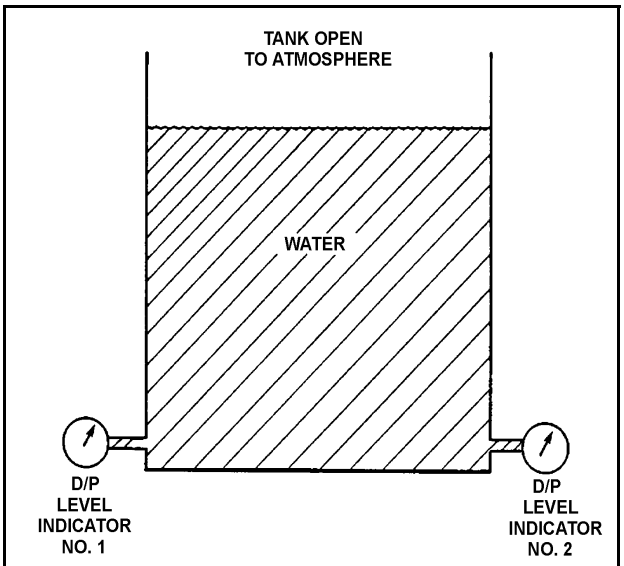
A. 1 will read greater than indicator 2, and indicator 1 will read greater than actual water level.

B. 1 will read greater than indicator 2, and indicator 1 will read less than actual water level.

C. 2 will read greater than indicator 1, and indicator 2 will read greater than actual water level.

D. 2 will read greater than indicator 1, and indicator 2 will read less than actual water level.

ANSWER: C.



TANK DIFFERENTIAL PRESSURE LEVEL INDICATORS

TOPIC: 191002
KNOWLEDGE: K1.06 [2.5/2.6]
QID: P4404

Refer to the drawing of a pressurizer differential pressure (D/P) level detection system (see figure below).

The associated pressurizer level instrument was recently calibrated with the nuclear power plant at normal operating conditions. Assume that the level instrument does not use density compensation.

If the plant is currently shut down at reduced reactor coolant system temperatures and pressure, pressurizer water level will currently indicate _____ than actual water level because, for a given pressurizer water level, the D/P sensed by the D/P detector is currently _____.

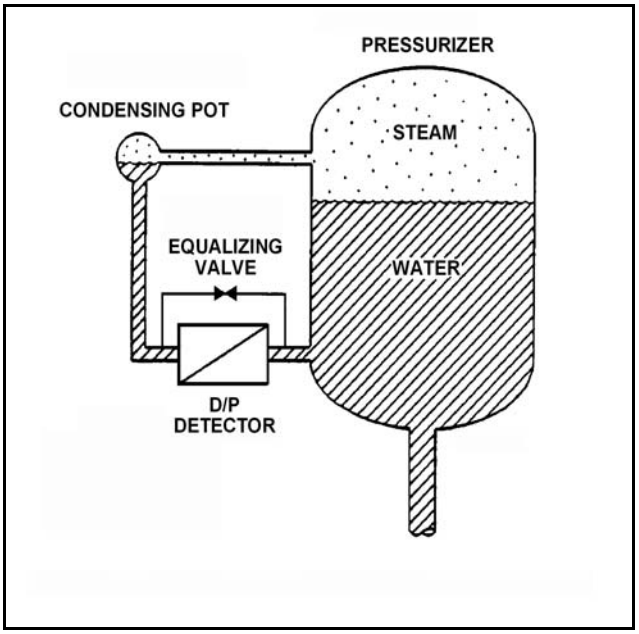
A. higher; smaller

B. higher; larger

C. lower; smaller

D. lower; larger

ANSWER: A.



TOPIC: 191002
KNOWLEDGE: K1.06 [2.5/2.6]
QID: P4504

Refer to the drawing of a differential pressure (D/P) level detection system for a pressurizer at normal operating temperature and pressure (see figure below).

A nuclear power plant uses several differential pressure detectors like the one below to provide multiple channels of pressurizer water level indication. A hot channel was calibrated when the pressurizer was at normal operating temperature. A cold channel was calibrated when the pressurizer was at 160°F.

How will the level indications on the two channels compare when the pressurizer is at normal operating temperature?

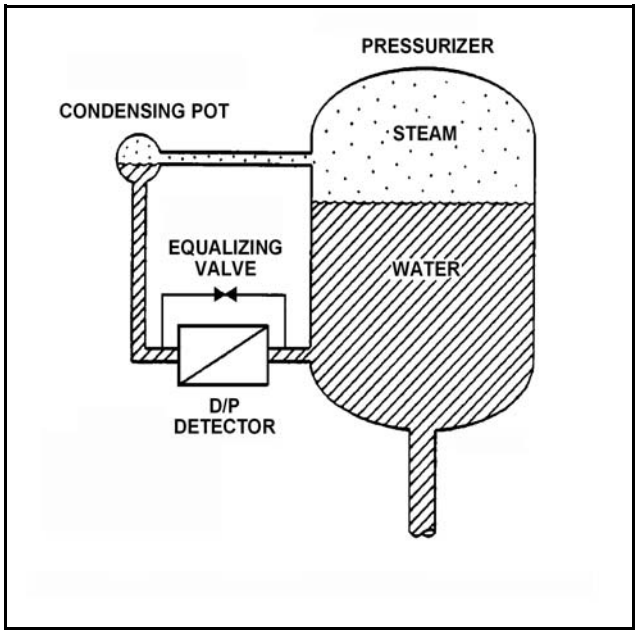
A. The cold channel will indicate higher than the hot channel due to the difference in reference leg water density at the two calibration temperatures.

B. The cold channel will indicate lower than the hot channel due to the difference in reference leg water density at the two calibration temperatures.

C. The cold channel will indicate higher than the hot channel due to the difference in pressurizer water density at the two calibration temperatures.

D. The cold channel will indicate lower than the hot channel due to the difference in pressurizer water density at the two calibration temperatures.

ANSWER: D.



TOPIC: 191002
KNOWLEDGE: K1.06 [2.5/2.6]
QID: P5103

Refer to the drawing of a differential pressure (D/P) level detection system for a pressurizer at normal operating temperature and pressure (see figure below).

A nuclear power plant uses several differential pressure detectors like the one below to provide multiple channels of pressurizer water level indication. A hot channel was calibrated when the pressurizer was at normal operating temperature. A cold channel was calibrated when the pressurizer was at 160°F.

How will the level indications on the two channels compare when the pressurizer is at 160°F?

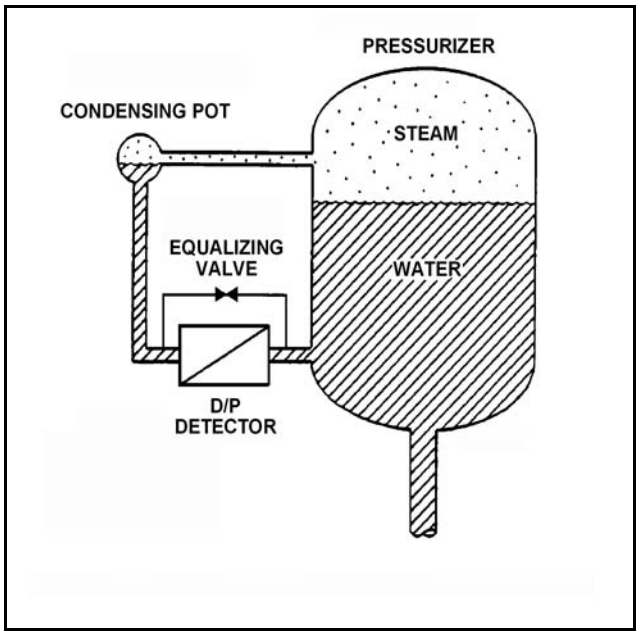
A. The cold channel will indicate higher than the hot channel due to the difference in reference leg water density at the two calibration temperatures.

B. The cold channel will indicate lower than the hot channel due to the difference in reference leg water density at the two calibration temperatures.

C. The cold channel will indicate higher than the hot channel due to the difference in pressurizer water density at the two calibration temperatures.

D. The cold channel will indicate lower than the hot channel due to the difference in pressurizer water density at the two calibration temperatures.

ANSWER: D.



TOPIC: 191002
KNOWLEDGE: K1.06 [2.5/2.6]
QID: P6203

Refer to the drawing of a pressurizer differential pressure (D/P) level detection system (see figure below).

With the pressurizer containing saturated water and steam at 2,250 psia, pressurizer level indication is 20 feet. Assume that reference leg level and temperature do not change. Also, ignore the effect of steam density changes on level indication.

With no change in actual pressurizer level, what will level indication be at 600 psia (saturated)?

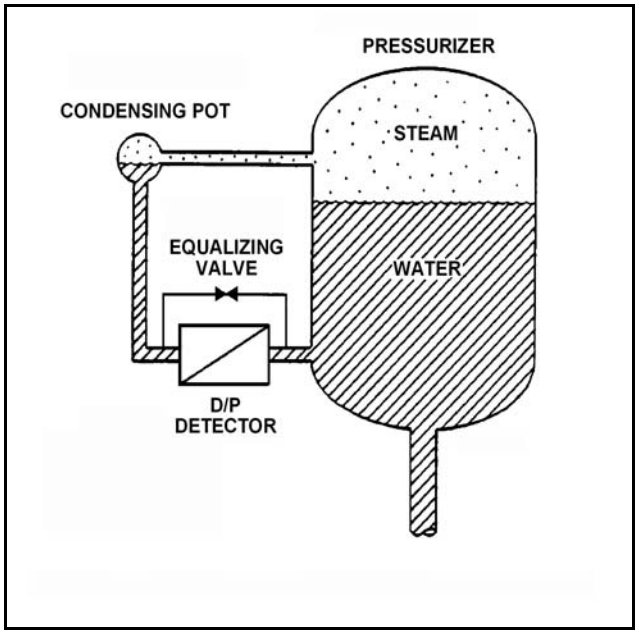
A. 14.9 feet

B. 18.3 feet

C. 22.4 feet

D. 26.8 feet

ANSWER: D.



TOPIC: 191002
KNOWLEDGE: K1.07 [2.5/2.6]
QID: P410

Refer to the drawing of a tank with a differential pressure (D/P) level detection system (see figure below).

If the differential pressure detector equalizing valve is opened, level indication will:

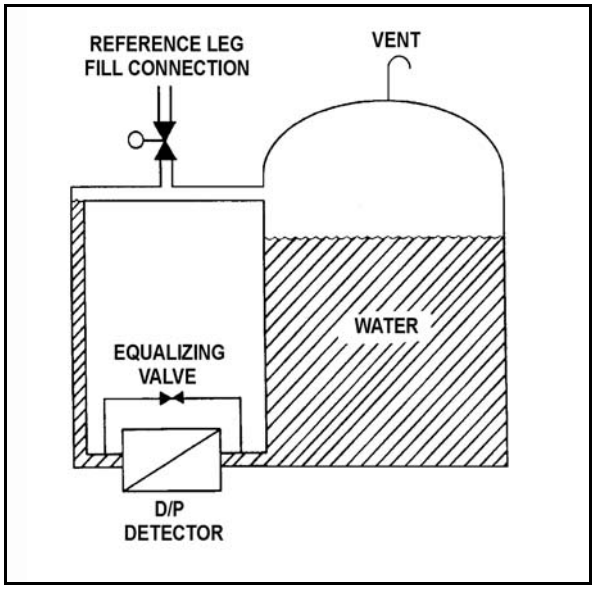
A. decrease and stabilize below actual level.

B. increase and stabilize above actual level.

C. oscillate above and below actual level.

D. remain constant at the current level.

ANSWER: B.



TOPIC: 191002
KNOWLEDGE: K1.07 [2.5/2.6]
QID: P708 (B2609)

Refer to the drawing of a tank differential pressure (D/P) level detector (see figure below).

The level detector is being used in a level control system that is calibrated to maintain tank level at 75 percent at the current water temperature of 90°F. If water temperature gradually increases and stabilizes at 120°F, the level control system will cause <u>actual</u> tank level to...

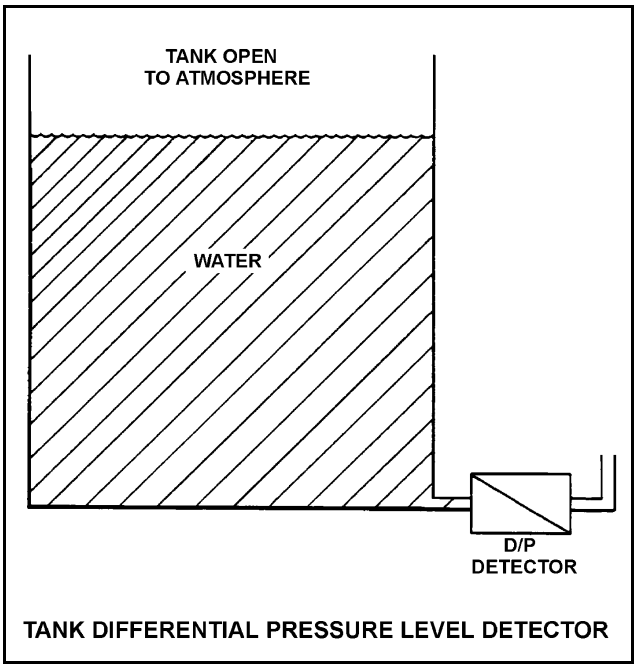
A. remain at 75 percent.

B. increase and stabilize above 75 percent.

C. oscillate around 75 percent.

D. decrease and stabilize below 75 percent.

ANSWER: B.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

TOPIC: 191002
KNOWLEDGE: K1.07 [2.5/2.6]
QID: P910 (B910)

Refer to the drawing of a tank with a differential pressure (D/P) level detection system (see figure below).

The D/P sensed by the detector varies in the _____ direction as the temperature of the water in the tank if the _____ of the tank water is constant. (Assume reference leg and tank water temperatures are initially the same.)

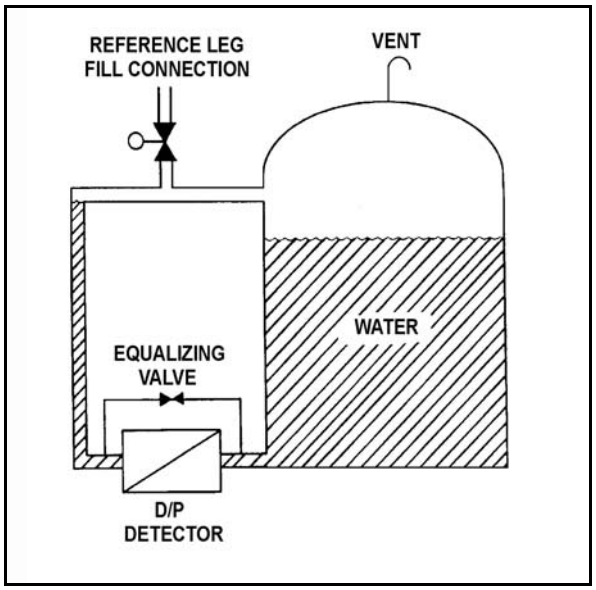
A. same; level

B. inverse; level

C. same; mass

D. inverse; mass

ANSWER: A.



TOPIC: 191002
KNOWLEDGE: K1.07 [2.5/2.6]
QID: P1008 (B1909)

Refer to the drawing of a tank differential pressure (D/P) level detector (see figure below).

The level detector is being used in a level control system that is calibrated to maintain tank level at 75 percent at the current water temperature of 120°F. If water temperature gradually decreases and stabilizes at 90°F, actual tank level will...

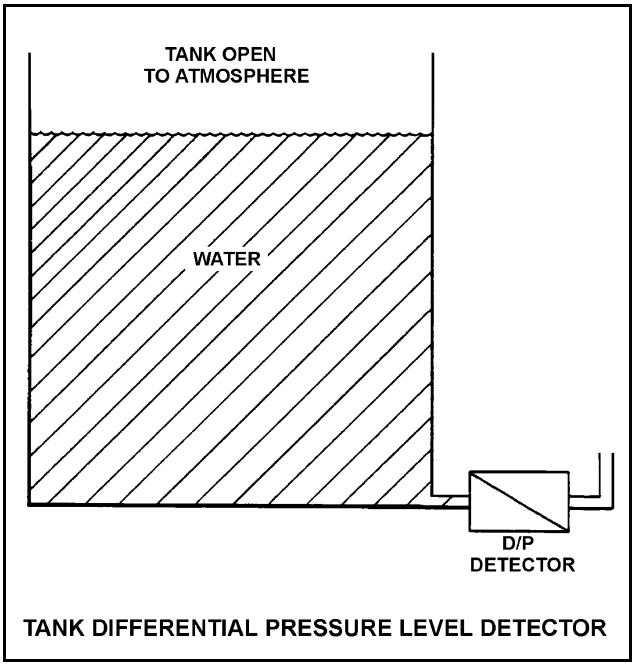
A. remain at 75 percent.

B. increase and stabilize above 75 percent.

C. oscillate around 75 percent.

D. decrease and stabilize below 75 percent.

ANSWER: D.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

TOPIC: 191002
KNOWLEDGE: K1.07 [2.5/2.6]
QID: P1807 (B1211)

A cooling water system is cooling a lube oil heat exchanger. Cooling water system surge tank level is being measured using a differential pressure level detector that has been calibrated at the current water temperature in the tank. A leak in the heat exchanger results in lube oil collecting in the surge tank.

Assuming that the temperature of the contents in the surge tank does not change, indicated tank level will be _____ than actual tank level because lube oil is _____ than water.

A. higher; more dense

B. higher; less dense

C. lower; more dense

D. lower; less dense

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.07 [2.5/2.6]
QID: P2009

Many steam generator water level instruments are designed with a condensing chamber in the reference leg. The purpose of the condensing chamber is to...

A. maintain a constant water level in the reference leg during normal operations.

B. provide reference leg compensation for the steam generator pressure exerted on the variable leg.

C. prevent reference leg flashing during a rapid depressurization of the steam generator.

D. ensure the reference leg temperature remains close to the temperature of the variable leg.

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.07 [2.5/2.6]
QID: P3008 (B3010)

Refer to the drawing of a tank with a differential pressure (D/P) level detection system (see figure below).

Assume that the initial temperature of the reference leg and the water in the tank is 100°F, and that reference leg temperature does not change.

If the temperature of the water in the tank increases by 20°F, the D/P sensed by the detector will _____ if the_____ of the water in the tank is constant.

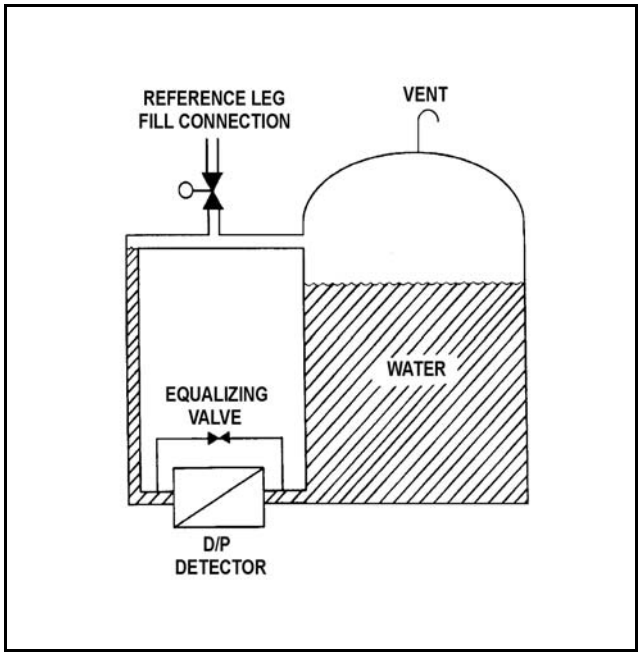
A. increase; level

B. decrease; level

C. increase; mass

D. decrease; mass

ANSWER: A.



TOPIC: 191002
KNOWLEDGE: K1.07 [2.5/2.6]
QID: P3407 (B3408)

Refer to the drawing of a tank with a differential pressure (D/P) level detection system (see figure below). Assume that the initial temperature of the reference leg and the water in the tank are the same, and that reference leg temperature and level do not change.

The level detector is being used in a level control system (not shown) that is calibrated to maintain tank level at 75 percent at the current tank water temperature (70°F) and pressure (5 psig).

If the tank water temperature remains constant, but the tank pressure is increased by 10 psig, the level control system will cause actual tank level to...

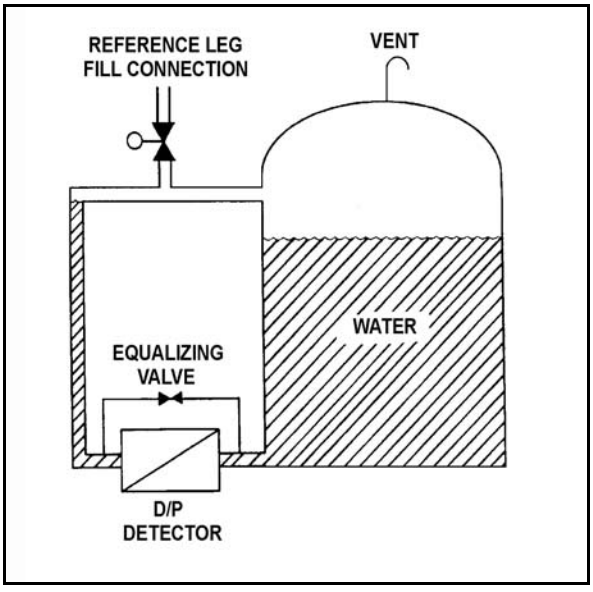
A. remain at 75 percent.

B. increase and stabilize above 75 percent.

C. oscillate around 75 percent.

D. decrease and stabilize below 75 percent.

ANSWER: A.



TOPIC: 191002
KNOWLEDGE: K1.07 [2.5/2.6]
QID: P5003

The downcomer region of a steam generator contains 40 feet of saturated water at 536°F. A steam generator water level detector has a pressure tap located at the bottom of the downcomer region. Approximately how much of the total pressure at the pressure tap is caused by the downcomer water?

A. 0.6 psi

B. 13.0 psi

C. 27.7 psi

D. 156.0 psi

ANSWER: B.

TOPIC: 191002
KNOWLEDGE: K1.07 [2.5/2.6]
QID: P5204

Refer to the drawing of a differential pressure (D/P) level detection system (see figure below) for a pressurizer at normal operating temperature and pressure. The level detector has just been calibrated.

The high pressure side of the detector is connected to the _____; and if the equalizing valve is opened the indicated pressurizer level will be _____ than the actual level.

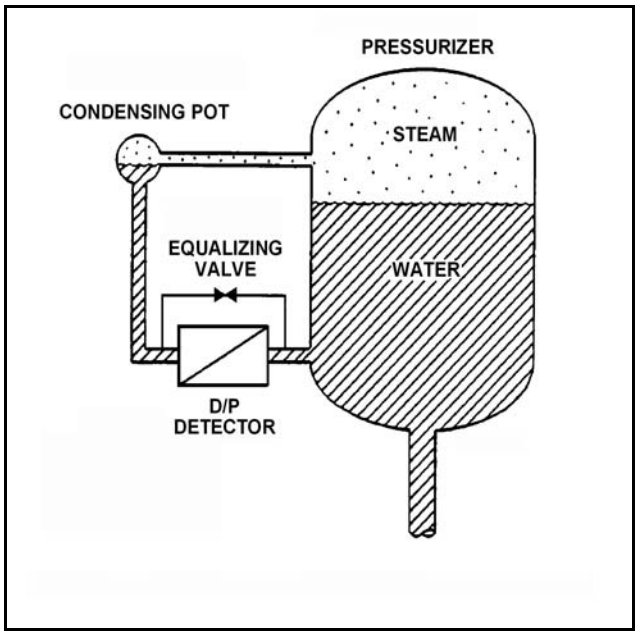
A. condensing pot; lower

B. condensing pot; higher

C. pressurizer; lower

D. pressurizer; higher

ANSWER: B.



TOPIC: 191002
KNOWLEDGE: K1.07 [2.5/2.6]
QID: P6104 (B6105)

Refer to the drawing of a tank differential pressure (D/P) level detection system (see figure below).

The D/P level detector was just calibrated and returned to operation with the following conditions:

- The reference leg contains 20 feet of water at 70°F.
- The tank contains 18 feet of water at 70°F.
- Tank level indication is 18 feet.

Assume the actual tank water level, and the temperature of the water in the tank and reference leg do not change. Which one of the following will be the new tank level indication if the reference leg water level decreases to 18 feet?

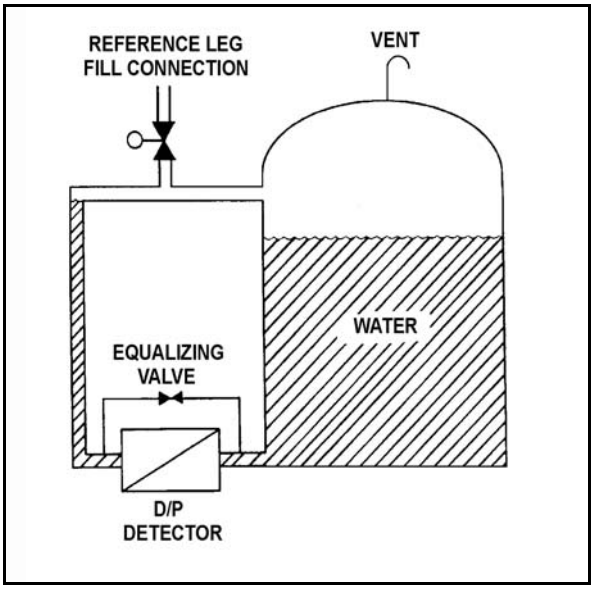
A. 22 feet

B. 20 feet

C. 18 feet

D. 2 feet

ANSWER: B.



TOPIC: 191002
KNOWLEDGE: K1.07 [2.5/2.6]
QID: P6604 (B6606)

Refer to the drawing of a tank differential pressure (D/P) level detection system (see figure below).

The water storage tank is 40 feet tall. The level detection system is calibrated to provide a level indication of 30 feet when the tank and reference leg levels are equal.

If the tank is completely filled with water, the tank level will indicate...

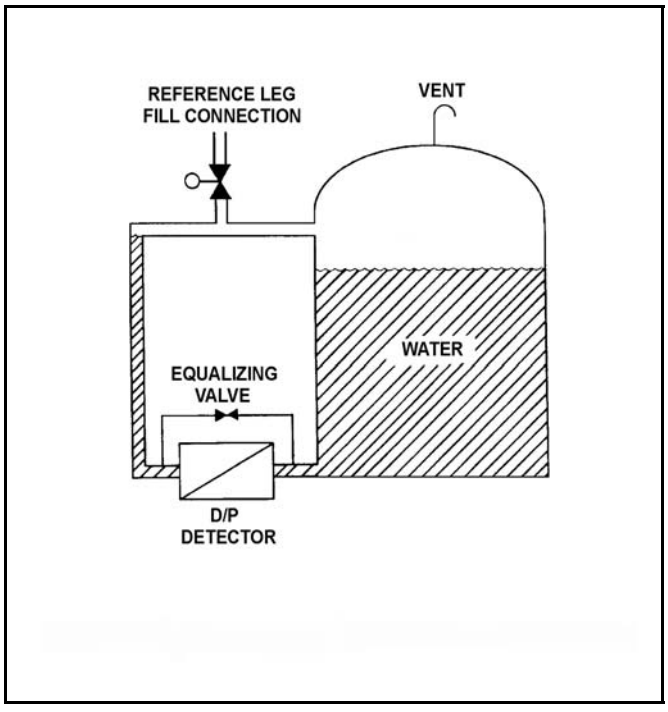
A. less than 30 feet.

B. 30 feet.

C. greater than 30 feet, but less than 40 feet.

D. 40 feet.

ANSWER: B.



TOPIC: 191002
KNOWLEDGE: K1.07 [2.5/2.6]
QID: P6704 (B6705)

Refer to the drawing of a tank with a differential pressure (D/P) level detection system (see figure below).

Assume that the initial temperature of the reference leg and the water in the tank is 100°F, and that reference leg temperature does not change.

If the temperature of the water in the tank increases by 20°F, the D/P sensed by the detector will _____ if the_____ of the water in the tank is constant.

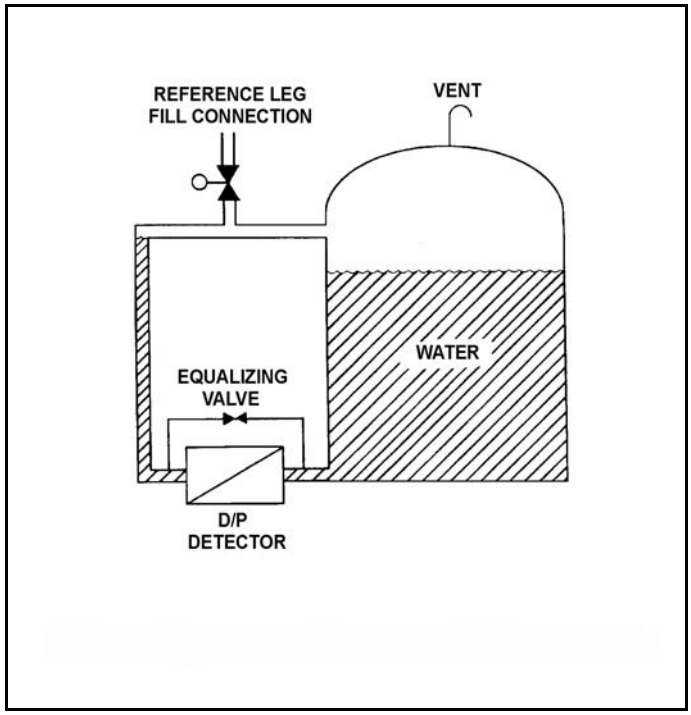
A. decrease; level

B. decrease; mass

C. remain the same; level

D. remain the same; mass

ANSWER: D.



TOPIC: 191002
KNOWLEDGE: K1.08 [2.8/3.1]
QID: P11

Refer to the drawing of a water storage tank with a differential pressure (D/P) level detector (see figure below).

The level instrument has just been calibrated to read actual tank water level. If the reference leg subsequently experiences high ambient temperature, indicated level will...

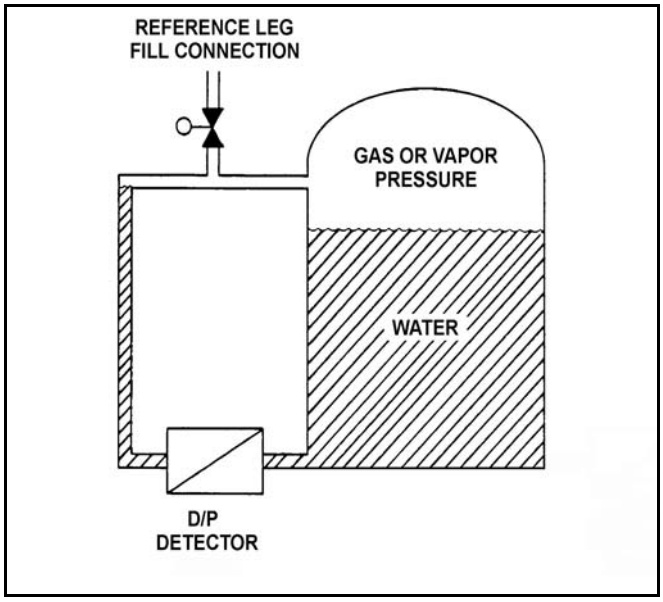
A. equal the actual level.

B. read less than the actual level.

C. read greater than the actual level.

D. drift above and below the actual level.

ANSWER: C.



TOPIC: 191002
KNOWLEDGE: K1.08 [2.8/3.1]
QID: P14 (B510)

Refer to the drawing of a water storage tank with two differential pressure level indicators (see figure below).

Indicator 1 was calibrated at 200°F and indicator 2 was calibrated at 100°F. If tank water temperature is 150°F, then...

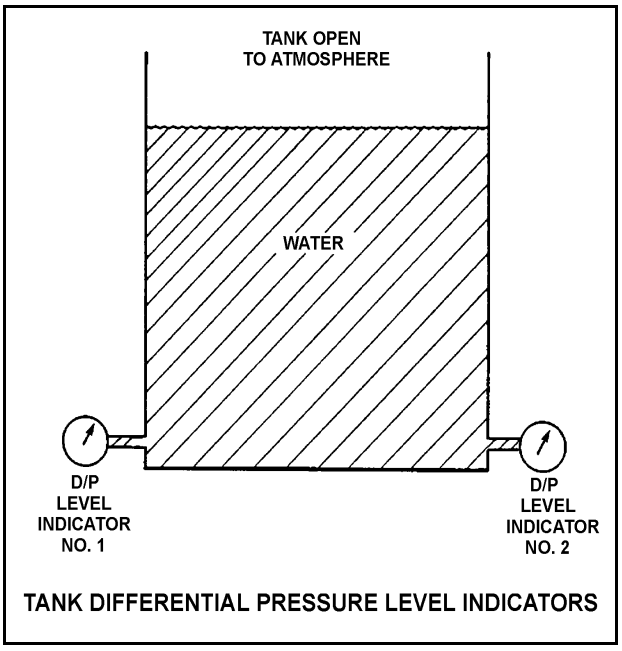
A. indicator 1 will read greater than indicator 2.

B. indicator 2 will read greater than indicator 1.

C. indicator 1 and 2 will read the same.

D. both indicators will be inaccurate, but it is impossible to predict which indicator will read greater.

ANSWER: A.



TANK DIFFERENTIAL PRESSURE LEVEL INDICATORS

TOPIC: 191002
KNOWLEDGE: K1.08 [2.8/3.1]
QID: P609 (B12)

Refer to the drawing of four tank differential pressure (D/P) level detectors (see figure below).

The tanks are identical with equal water levels and both are pressurized to 20 psig. All detectors were calibrated at the current water temperature and 70°F external (ambient) temperature.

Which detectors will provide the most accurate level indication following an increase in external (ambient) temperature from 70°F to 100°F? (Assume tank contents temperatures and external pressure do not change.)

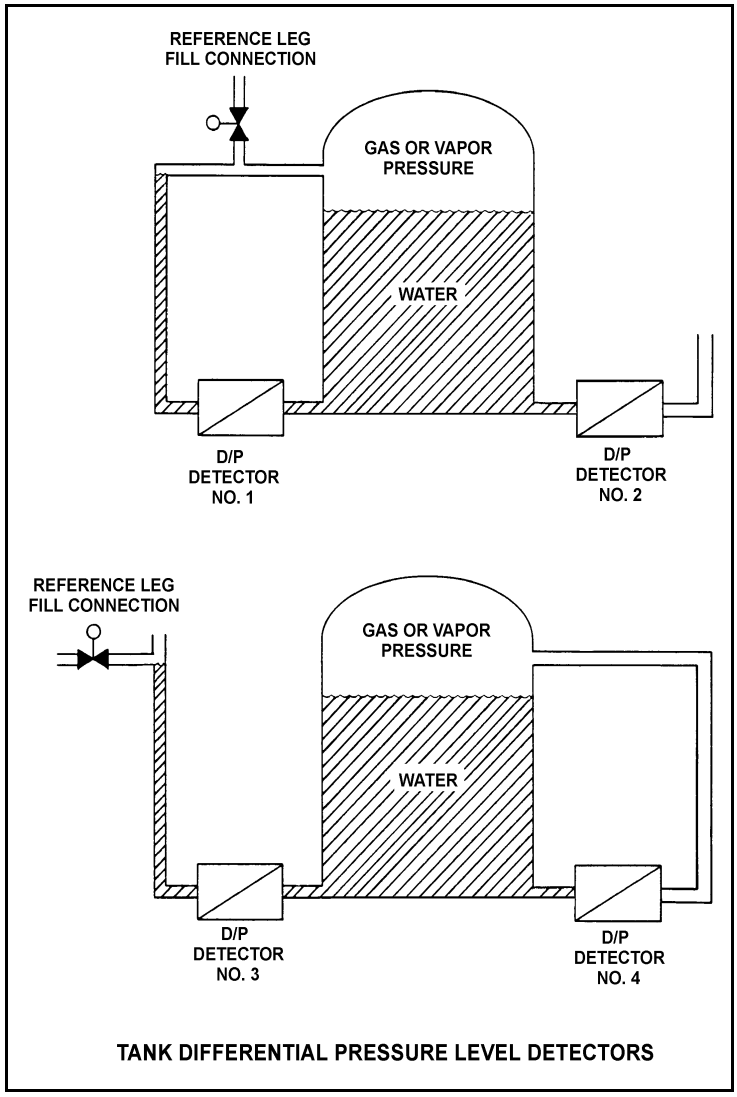
A. 1 and 3

B. 2 and 4

C. 1 and 4

D. 2 and 3

ANSWER: B.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTORS

TOPIC: 191002
KNOWLEDGE: K1.08 [2.8/3.1]
QID: P1108 (B1609)

Refer to the drawing of a tank differential pressure (D/P) level detection system (see figure below).

A calibrated D/P level detector is being used to measure level in a vented tank inside the auxiliary building. If building pressure increases with no change in temperature, the associated level indication will...

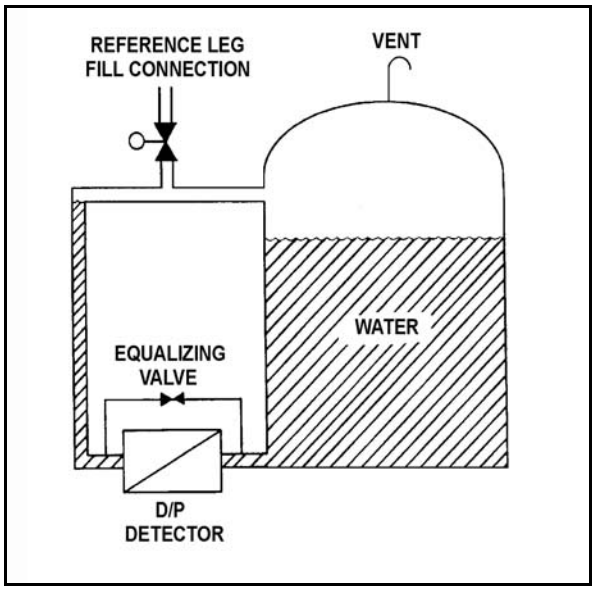
A. decrease, then increase and stabilize at the actual level.

B. decrease and stabilize below the actual level.

C. increase and stabilize above the actual level.

D. remain at the actual level.

ANSWER: D.



TOPIC: 191002
KNOWLEDGE: K1.08 [2.8/3.1]
QID: P1411

Refer to the drawing of a pressurizer differential pressure (D/P) level detection system (see figure below).

With the nuclear power plant in cold shutdown conditions, a pressurizer level D/P instrument, which was calibrated while the plant was at normal operating conditions, will indicate _____ than actual level because the D/P sensed by the detector at cold shutdown conditions will be _____ than at normal operating conditions. (Assume actual pressurizer level has not changed.)

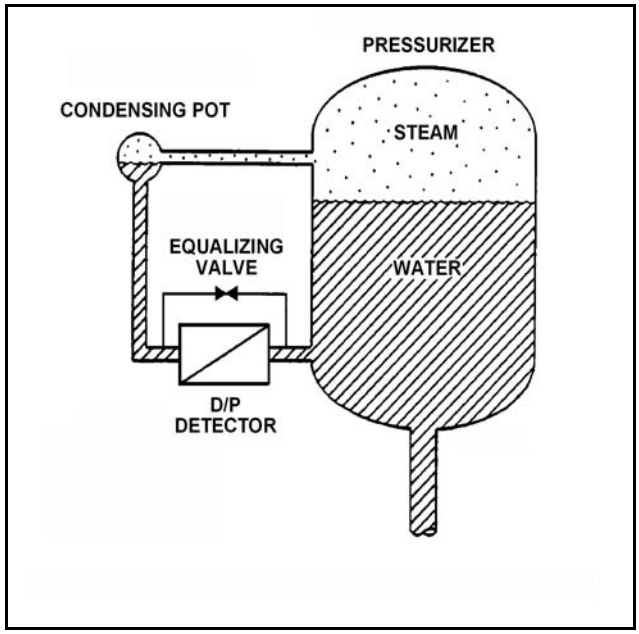
A. lower; larger

B. lower; smaller

C. higher; larger

D. higher; smaller

ANSWER: D.



TOPIC: 191002
KNOWLEDGE: K1.08 [2.8/3.1]
QID: P1607 (B1409)

Refer to the drawing of a tank differential pressure (D/P) level detector (see figure below).

The associated level instrument was calibrated with the water in the tank at 120°F. If the mass of water in the tank remains constant and the water temperature decreases to 100°F, the indicated level will...

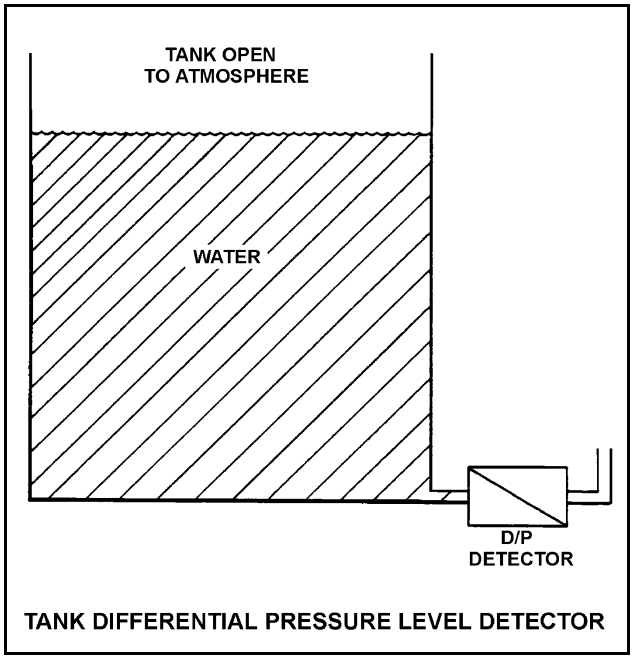
A. remain the same although actual level increases.

B. remain the same although actual level decreases.

C. increase in direct proportion to the temperature decrease.

D. decrease in direct proportion to the temperature decrease.

ANSWER: B.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

TOPIC: 191002
KNOWLEDGE: K1.08 [2.8/3.1]
QID: P2810 (B2808)

Refer to the drawing of a pressurizer level detection system (see figure below). The differential pressure (D/P) detector was calibrated while the nuclear power plant was at normal operating conditions.

With the plant initially at normal operating conditions, a pressurizer steam space leak occurred. The pressurizer pressure decreased by 300 psia, and the ambient air temperature surrounding the reference leg increased by 80°F, where these parameters stabilized.

If the actual pressurizer water level is 60 percent, the reduced pressurizer pressure will tend to make the indicated pressurizer level read _____ than actual; and the increased reference leg temperature will tend to make the indicated pressurizer level read _____ than actual.

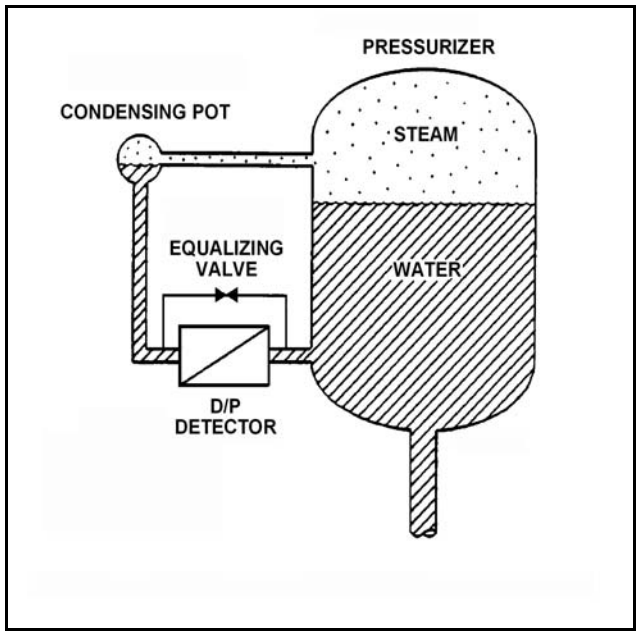
A. higher; higher

B. higher; lower

C. lower; higher

D. lower; lower

ANSWER: A.



TOPIC: 191002
KNOWLEDGE: K1.08 [2.8/3.1]
QID: P4004 (B4006)

Refer to the drawing of an open water storage tank with a differential pressure (D/P) level detector (see figure below).

The level instrument has just been calibrated to indicate actual tank water level. Assume that tank water temperature and level remain constant. If the reference leg temperature increases by 20°F, indicated tank water level will...

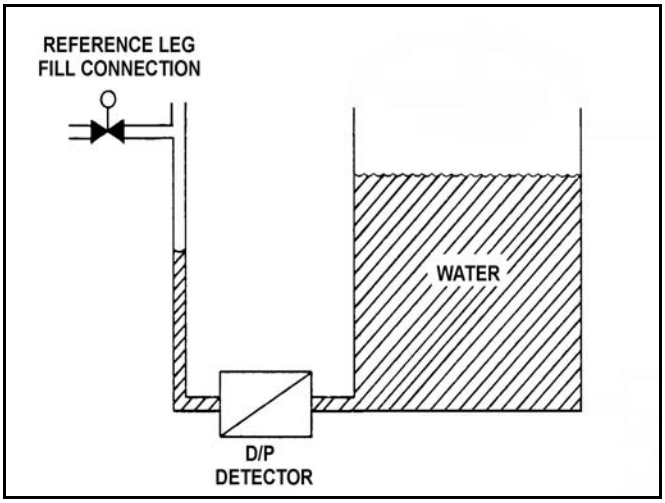
A. be unpredictable.

B. equal the actual level.

C. be less than the actual level.

D. be greater than the actual level.

ANSWER: B.



TOPIC: 191002
KNOWLEDGE: K1.09 [2.9/3.0]
QID: P12

The level indication for a wet reference leg differential pressure (D/P) level instrument will fail low as a result of...

A. a break on the reference leg.

B. a rupture of the diaphragm in the D/P cell.

C. the reference leg flashing to steam.

D. a break on the variable leg.

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.09 [2.9/3.0]
QID: P209 (B1010)

Refer to the drawing of a steam generator differential pressure (D/P) level detection system (see figure below).

Which one of the following failures will cause the associated steam generator level indicator to indicate the lowest level?

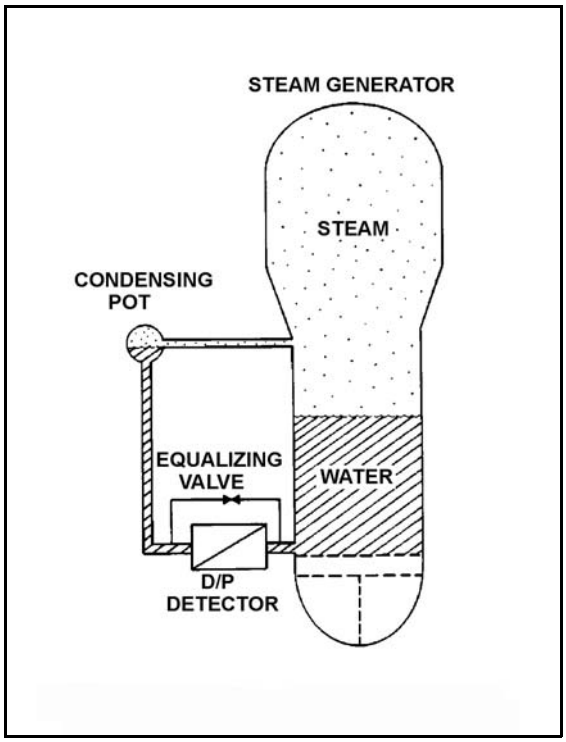
A. The D/P detector diaphragm ruptures.

B. The reference leg ruptures.

C. The variable leg ruptures.

D. The equalizing valve is opened.

ANSWER: C.



TOPIC: 191002
KNOWLEDGE: K1.09 [2.9/3.0]
QID: P309 (B308)

Refer to the drawing of a tank with a differential pressure (D/P) level detection system (see figure below).

Tank water level indication will be <u>lower</u> than actual level when reference leg temperature is _____ than calibration conditions or when there is a break in the _____ leg of the D/P cell.

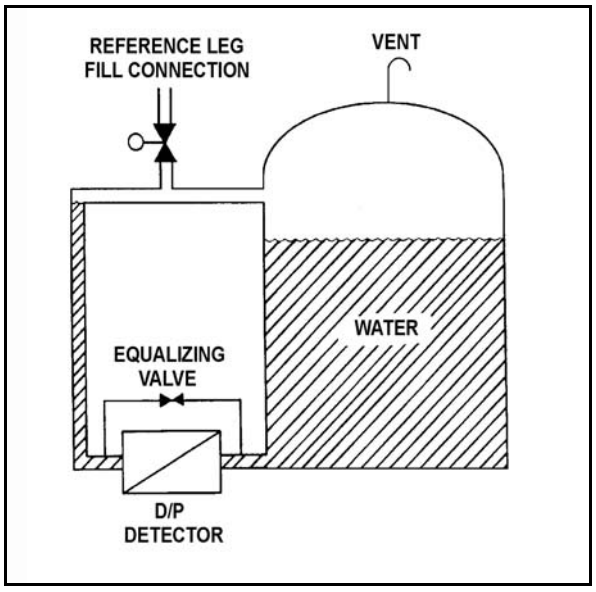
A. less; reference

B. less; variable

C. greater; reference

D. greater; variable

ANSWER: B.



TOPIC: 191002
KNOWLEDGE: K1.09 [2.9/3.0]
QID: P911 (B3508)

Refer to the drawing of a steam generator (SG) differential pressure level detection system ( see figure below) that was recently calibrated at normal operating conditions.

With the nuclear reactor shut down, SG pressures were inadvertently decreased from 900 psig to 700 psig in 5 minutes due to operator error. SG pressures were stabilized at 700 psig, but during the pressure decrease a small amount of water in the condensing pot flashed to steam. Assume the reference leg water remains subcooled, except for the small amount of water that flashes to steam in the condensing chamber.

As a result of the small loss of condensing pot water, SG level will indicate _____ than actual level; and as the condensing pot refills, indicated level will _____.

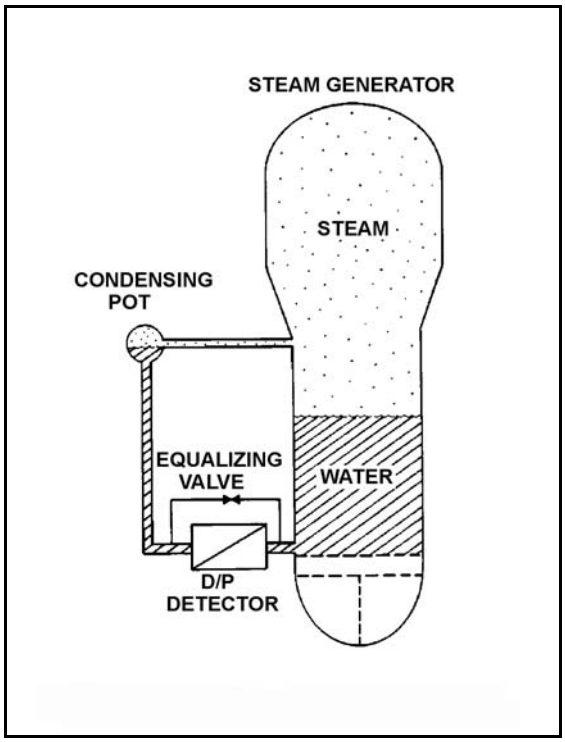
A. higher; decrease and stabilize above the actual level

B. higher; decrease and stabilize below the actual level

C. lower; increase and stabilize above the actual level

D. lower; increase and stabilize below the actual level

ANSWER: A.



TOPIC: 191002
KNOWLEDGE: K1.09 [2.9/3.0]
QID: P2408 (B1212)

Refer to the drawing of a steam generator (SG) with a differential pressure (D/P) level detection system (see figure below).

Which one of the following events will result in a steam generator level indication that is greater than actual level?

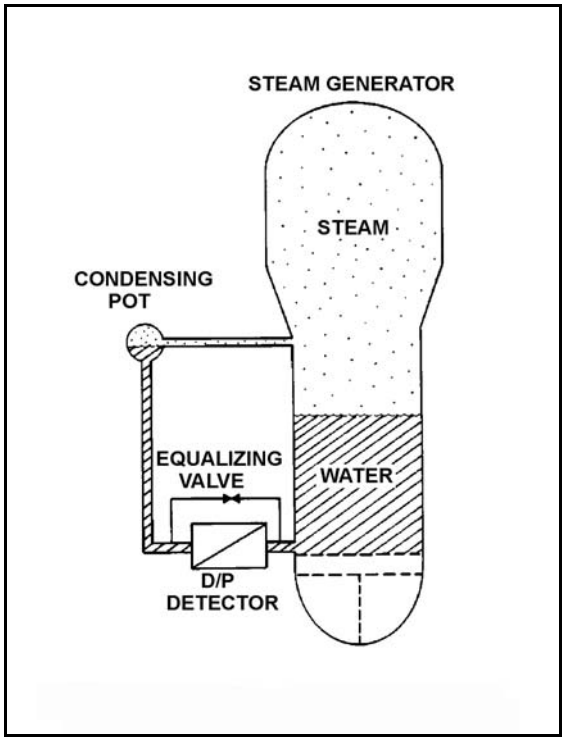
A. The SG pressure increases by 50 psia.

B. The variable leg breaks and completely drains.

C. A portion of the reference leg water flashes to steam.

D. The temperature surrounding the SG and reference leg decreases by 30°F.

ANSWER: C.



TOPIC: 191002
KNOWLEDGE: K1.09 [2.9/3.0]
QID: P2609

Refer to the drawing of a steam generator (SG) differential pressure (D/P) level detection system (see figure below).

The SG is at normal operating temperature and pressure with accurate level indication. Which one of the following events will result in a SG level indication that is greater than actual level?

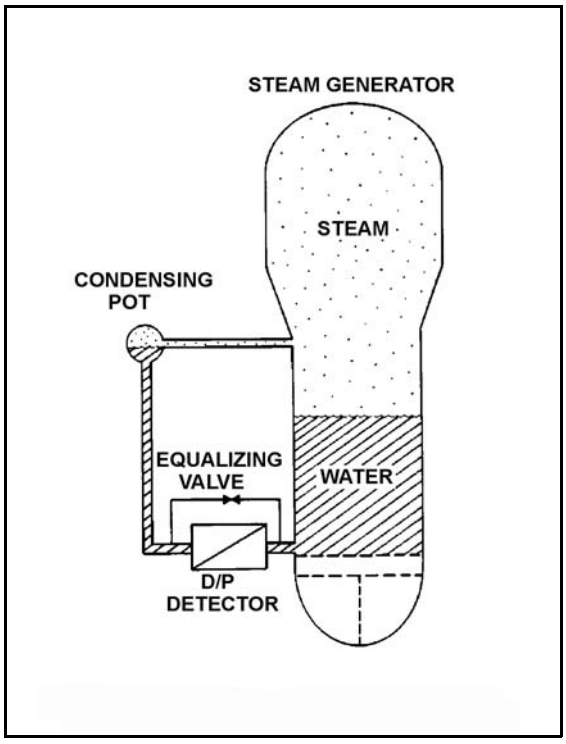
A. The external pressure surrounding the D/P detector increases by 2 psi.

B. SG pressure increases by 50 psi with no change in actual water level.

C. Actual SG level increases by 6 inches.

D. The temperature of the reference leg increases by 20°F.

ANSWER: D.



TOPIC: 191002
KNOWLEDGE: K1.09 [2.9/3.0]
QID: P2708

Refer to the drawing of a steam generator (SG) differential pressure (D/P) level detection system (see figure below).

The SG is supplying steam at normal operating temperature and pressure and the level instrumentation has just been calibrated. Which one of the following events will result in a SG level indication that is less than actual level?

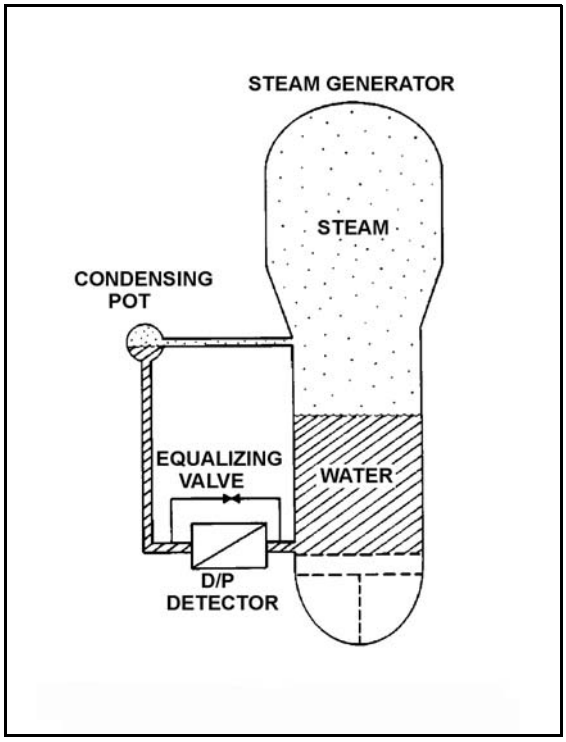
A. SG pressure increases by 50 psi.

B. Actual SG water level decreases by 6 inches.

C. The external pressure surrounding the D/P detector decreases by 2 psi.

D. The temperature surrounding the reference leg increases by 20°F.

ANSWER: A.



TOPIC: 191002
KNOWLEDGE: K1.09 [2.9/3.0]
QID: P2907 (B1410)

Refer to the drawing of a steam generator (SG) differential pressure (D/P) level detection system (see figure below).

The SG is at normal operating temperature and pressure with accurate level indication. Which one of the following events will result in a SG level indication that is lower than actual level?

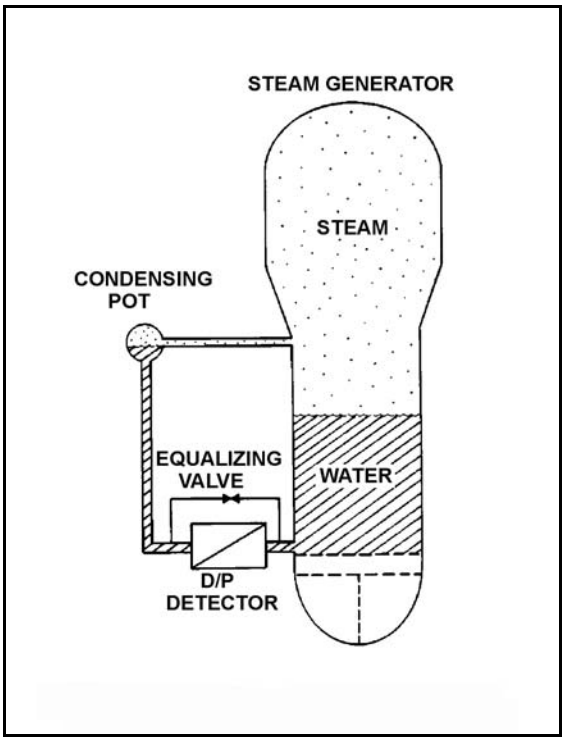
A. Actual SG level decreases by 6 inches.

B. The temperature surrounding the reference leg decreases by 20°F.

C. The external pressure surrounding the D/P detector decreases by 2 psi.

D. SG pressure decreases by 50 psi with no change in actual water level.

ANSWER: B.



TOPIC: 191002
KNOWLEDGE: K1.09 [2.9/3.0]
QID: P3808

Refer to the drawing of a pressurizer differential pressure (D/P) level detection system (see figure below).

A nuclear reactor is shutdown with the reactor coolant system being maintained at 100 psia. The level detector has just been calibrated. Suddenly a rupture in the condensing pot of the level detector results in a rapid drop of the condensing pot pressure to atmospheric pressure.

Given the following current conditions:

- The condensing pot is at atmospheric pressure.
- Pressurizer pressure is 98 psia and slowly decreasing.
- Bulk reference leg temperature is 120°F.
- Actual pressurizer level has not changed significantly.

Which one of the following describes the current pressurizer level indication from the detector?

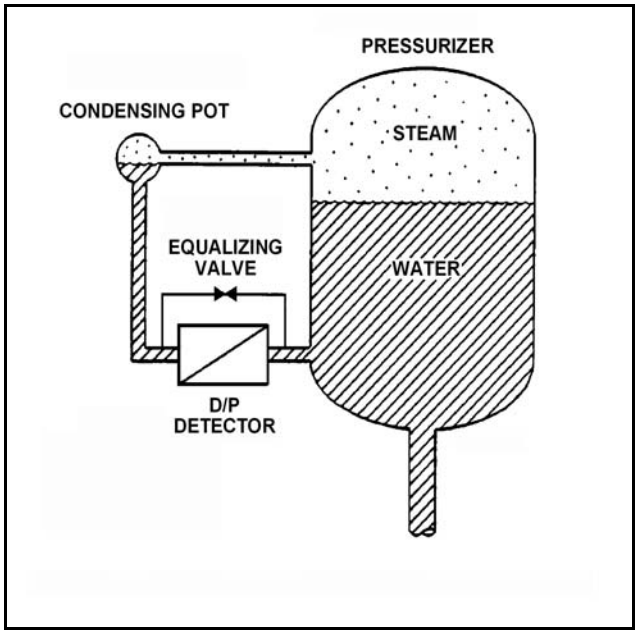
A. Offscale low because the bulk of the water in the reference leg has flashed to steam.

B. Offscale high because the bulk of the water in the reference leg has flashed to steam.

C. Offscale low because the static pressure on the reference leg is much less than the static pressure in the pressurizer.

D. Offscale high because the static pressure on the reference leg is much less than the static pressure in the pressurizer.

ANSWER: D.



TOPIC: 191002
KNOWLEDGE: K1.10 [2.3/2.5]
QID: P310

Semiconductor strain gages are often used in transmitters for...

A. reactor coolant pressure instruments.

B. reactor coolant temperature instruments.

C. control rod position instruments.

D. steam generator level instruments.

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.10 [2.3/2.5]
QID: P413 (B410)

If the pressure sensed by a bourdon tube increases, the curvature of the detector will _____ because the greater force is being applied to the _____ curve of the detector.

A. increase; outer

B. increase; inner

C. decrease; outer

D. decrease; inner

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.10 [2.3/2.5]
QID: P810

In a diaphragm type pressure detector, pressure is measured using the _____ of the diaphragm.

A. rotational movement

B. axial deflection

C. change in circumference

D. change in diameter

ANSWER: B.

TOPIC: 191002
KNOWLEDGE: K1.10 [2.3/2.5]
QID: P1508 (B1011)

A bourdon tube works on the principle that when the pressure inside the tube decreases, the tube tends to: (Assume detected pressure remains above atmospheric pressure.)

A. coil due to an increased pressure-induced force on the outside of the tube.

B. straighten due to an increased pressure-induced force on the outside of the tube.

C. coil due to the spring action of the metal overcoming the pressure-induced force on the inside of the tube.

D. straighten due to the spring action of the metal overcoming the pressure-induced force on the inside of the tube.

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.10 [2.3/2.5]
QID: P2109 (B2109)

A centrifugal pump is taking suction from the bottom of a vented cylindrical storage tank that contains 100,000 gallons of water at 60°F. A pressure gauge at the inlet to the pump indicates 40 psig. Over the next several days storage tank temperature increases to 90°F with no change in tank water level and no change in head loss in the pump suction line.

Which one of the following is the current pressure at the inlet to the pump?

A. 31.2 psig

B. 34.6 psig

C. 37.4 psig

D. 39.8 psig

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.11 [2.7/3.0]
QID: P210 (B210)

A simple bellows pressure detector is connected to a cooling water system. The detector is located in the reactor containment and has its low pressure side vented to the containment atmosphere. Current system pressure indication is 100 psig.

If a main steam line break raises containment pressure by 40 psig, the system pressure indication will: (Disregard any temperature effect on the pressure detector.)

A. increase by 40 psig.

B. increase by the square root of 40 psig.

C. decrease by 40 psig.

D. decrease by the square root of 40 psig.

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.11 [2.7/3.0]
QID: P509 (B1310)

A cooling water system bourdon tube pressure detector is located inside a sealed building and system pressure currently indicates 50 psig. A building ambient temperature increase of 20°F will cause a _____ change in indicated system pressure, and a building pressure increase of 20 psig will cause a _____ change in indicated system pressure.

A. significant; significant

B. negligible; significant

C. significant; negligible

D. negligible; negligible

ANSWER: B.

TOPIC: 191002
KNOWLEDGE: K1.11 [2.7/3.0]
QID: P611

A bellows pressure transmitter with its low-pressure side vented to containment atmosphere is being used to measure reactor coolant system (RCS) pressure. A decrease in the associated pressure indication could be caused by either a containment pressure _____ or a RCS pressure _____.

A. decrease; decrease

B. increase; increase

C. decrease; increase

D. increase; decrease

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.11 [2.7/3.0]
QID: P710 (B711)

Cooling water system pressure is being monitored by a simple diaphragm pressure detector with its low pressure side vented to the containment. If a main steamline rupture raises containment pressure by 20 psi, cooling water system pressure indication will: (Disregard any temperature effect on the detector.)

A. increase by 20 psi.

B. decrease by 20 psi.

C. increase by the square root of 20 psi.

D. decrease by the square root of 20 psi.

ANSWER: B.

TOPIC: 191002
KNOWLEDGE: K1.11 [2.7/3.0]
QID: P3509 (B2912)

The pressure within a cooling water system is 100 psig, as indicated by a bourdon tube pressure detector. The cooling water system and the detector are located inside a reactor containment building. The pressure detector case is vented to the containment building, which is currently at atmospheric pressure.

If a steam line rupture raises the containment building pressure by 20 psi, the cooling water system pressure indication will... (Disregard any temperature effect on the detector.)

A. decrease to 80 psig.

B. decrease by a small, but indeterminate amount.

C. increase to 120 psig.

D. increase by a small, but indeterminate amount.

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.12 [2.8/2.9]
QID: P211 (B212)

A bourdon-tube pressure detector was indicating 50 percent of scale when it was suddenly exposed to a high-pressure transient that caused permanent strain to the bourdon tube. The detector remained intact and actual pressure was restored to its original value.

During the pressure transient, the affected pressure indication initially went off-scale high. After the original pressure was restored, the indication was...

A. unpredictable.

B. less than 50 percent of scale.

C. 50 percent of scale.

D. greater than 50 percent of scale.

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.12 [2.8/2.9]
QID: P510 (B1610)

Refer to the drawing of a bellows-type differential pressure (D/P) detector (see figure below).

The spring in this detector (shown in a compressed state) has weakened from long-term use. If the actual D/P is constant, how will indicated D/P respond as the spring weakens?

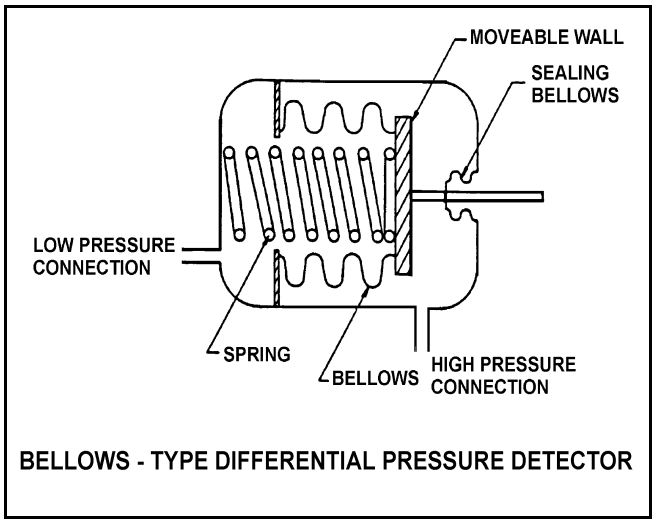
A. Increase, because the spring will expand more.

B. Decrease, because the spring will expand more.

C. Increase, because the spring will compress more.

D. Decrease, because the spring will compress more.

ANSWER: C.



BELLOWS - TYPE DIFFERENTIAL PRESSURE DETECTOR

TOPIC: 191002
KNOWLEDGE: K1.12 [2.8/2.9]
QID: P511

If a bourdon tube pressure detector is over-ranged sufficiently to permanently distort the bourdon tube, subsequent pressure measurement will be inaccurate because the _____ of the detector tube will be inaccurate.

A. distance moved by the tip

B. change in the length

C. expansion of the cross-sectional area

D. change in the volume

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.12 [2.8/2.9]
QID: P1011 (B2910)

A properly calibrated 0 to 100 psia diaphragm pressure detector is connected to a pressurized system; the low pressure side of the detector is vented to the atmosphere. The detector is currently producing a system pressure indication of 75 psia.

If the detector diaphragm ruptures, indicated pressure will be approximately...

A. 0 psia.

B. 15 psia.

C. 60 psia.

D. 90 psia.

ANSWER: B.

TOPIC: 191002
KNOWLEDGE: K1.12 [2.8/2.9]
QID: P2211 (B1908)

Refer to the drawing of a bellows-type pressure detector (see figure below).

A bellows-type pressure detector with its low-pressure side vented to containment atmosphere is being used to measure pressurizer pressure. A decrease in the associated pressure indication will be caused by either a containment pressure _____ or a _____.

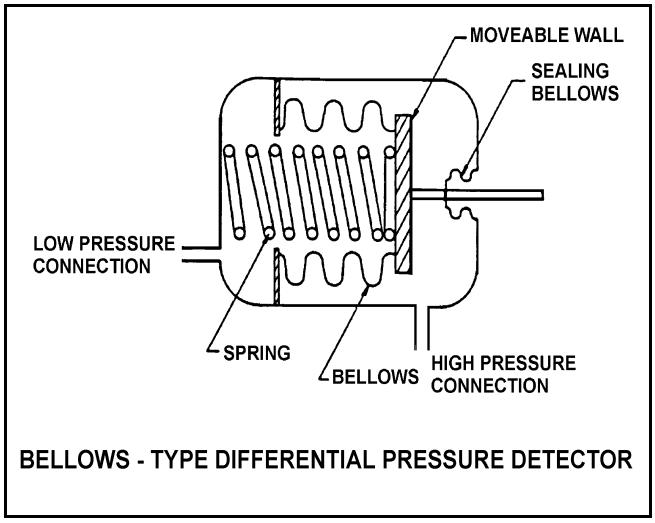
A. increase; ruptured bellows

B. increase; broken spring

C. decrease; ruptured bellows

D. decrease; broken spring

ANSWER: A.



BELLOWS - TYPE DIFFERENTIAL PRESSURE DETECTOR

TOPIC: 191002
KNOWLEDGE: K1.12 [2.8/2.9]
QID: P2610 (B610)

Refer to the drawing of a bellows-type differential pressure (D/P) detector (see figure below).

The spring in this detector (shown in a compressed state) has weakened from long-term use. If the actual D/P is constant, how will indicated D/P respond as the spring weakens?

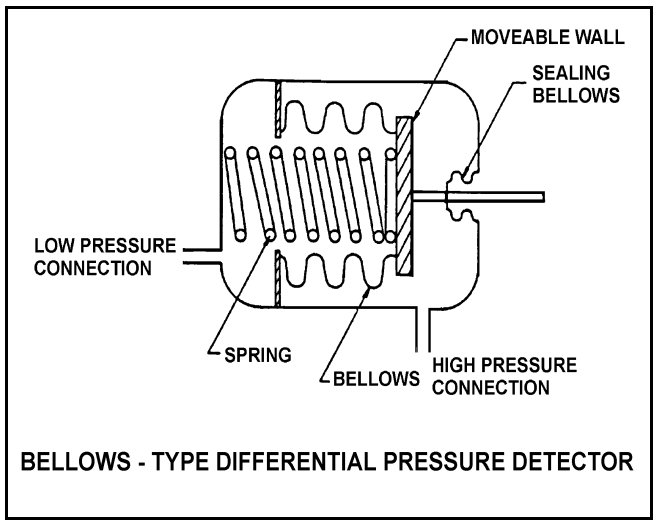
A. Decrease, because the high pressure will compress the spring more

B. Increase, because the high pressure will compress the spring more

C. Decrease, because the spring will expand more

D. Increase, because the spring will expand more

ANSWER: B.



BELLOWS - TYPE DIFFERENTIAL PRESSURE DETECTOR

TOPIC: 191002
KNOWLEDGE: K1.13 [2.6/2.8]
QID: P13

A resistance temperature detector operates on the principle that the change in electrical resistance of...

A. two dissimilar metals is directly proportional to the temperature change measured at their junction.

B. two dissimilar metals is inversely proportional to the temperature change measured at their junction.

C. a metal is directly proportional to its change in temperature.

D. a metal is inversely proportional to its change in temperature.

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.13 [2.6/2.8]
QID: P212

A resistance temperature detector operates on the principle that the change in metal resistance is _____ proportional to the change in _____.

A. inversely; metal temperature

B. inversely; metal temperature squared

C. directly; metal temperature

D. directly; metal temperature squared

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.13 [2.6/2.8]
QID: P311

When comparing a thermocouple to a resistance temperature detector, the thermocouple...

A. generally measures temperature less accurately.

B. requires an external power supply to produce an electrical output.

C. is unable to withstand high temperatures.

D. generally responds much slower to a temperature change.

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.13 [2.6/2.8]
QID: P812

If the reference junction temperature of a thermocouple remains constant, the output voltage of the thermocouple is _____ proportional to the _____.

A. directly; measuring junction temperature

B. directly; square root of the measuring junction temperature

C. inversely; measuring junction temperature

D. inversely; square root of the measuring junction temperature

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.13 [2.6/2.8]
QID: P1209 (B1314)

Refer to the drawing of a simple thermocouple circuit (see figure below).

Thermocouple temperature indication is currently 350°F. A small steam leak occurs that raises reference (cold) junction temperature by 20°F. Assume measuring junction temperature remains constant. Without temperature compensation for the reference junction, the new temperature indication will be...

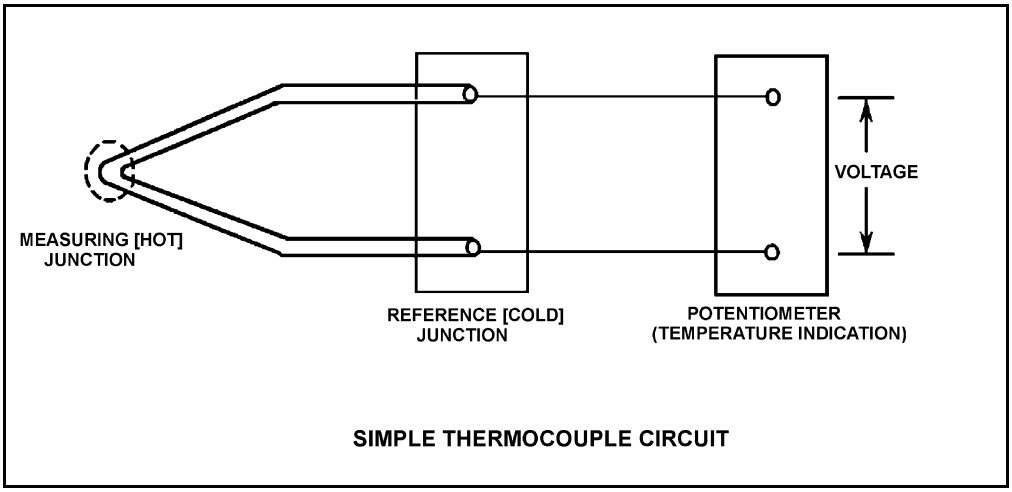
A. 310°F.

B. 330°F.

C. 370°F.

D. 390°F.

ANSWER: B.




SIMPLE THERMOCOUPLE CIRCUIT

TOPIC: 191002
KNOWLEDGE: K1.13 [2.6/2.8]
QID: P1311

A thermocouple operates on the principle that a measurable voltage will be produced when two...

A. similar metals form two junctions at the same temperature.

B. similar metals form two junctions at different temperatures.

C. dissimilar metals form two junctions at the same temperature.

D. dissimilar metals form two junctions at different temperatures.

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.13 [2.6/2.8]
QID: P1412 (B2911)

Refer to the drawing of a simple thermocouple circuit (see figure below).

Thermocouple temperature indication is currently 390°F. A small steam leak occurs that raises reference (cold) junction temperature by 20°F. Assume measuring junction temperature remains constant. Without temperature compensation for the reference junction, the new temperature indication will be...

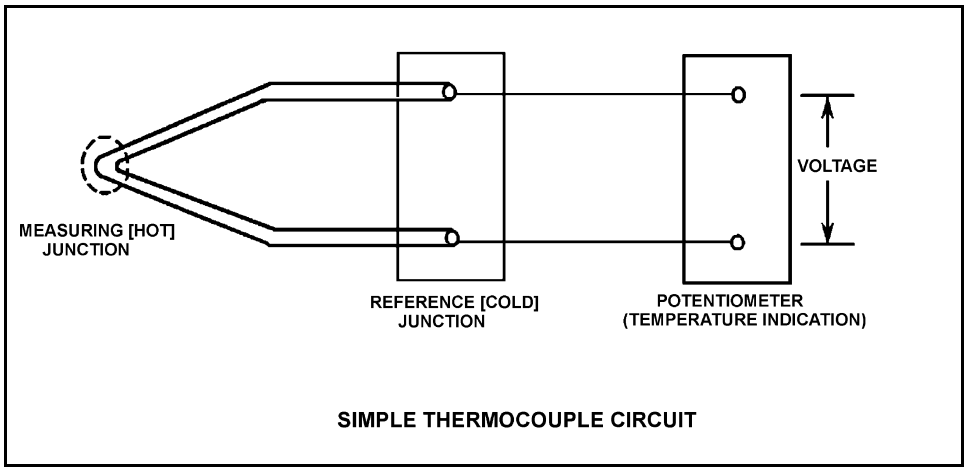
A. 370°F.

B. 390°F.

C. 400°F.

D. 410°F.

ANSWER: A.




SIMPLE THERMOCOUPLE CIRCUIT

TOPIC: 191002
KNOWLEDGE: K1.13 [2.6/2.8]
QID: P1510 (B309)

In contrast to a thermocouple, a resistance temperature detector...

A. is used in high temperature applications.

B. does <u>not</u> require an external power supply for temperature indication.

C. uses a single type of metal or alloy in the sensing element.

D. is commonly placed in direct contact with the monitored substance.

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.13 [2.6/2.8]
QID: P1710 (B1710)

Refer to the drawing of a simple thermocouple circuit (see figure below).

Thermocouple temperature indication is currently 150°F. A small steam leak occurs that raises both the measuring (hot) junction and reference (cold) junction temperatures by 20°F. Without temperature compensation for the reference junction, the new temperature indication will be...

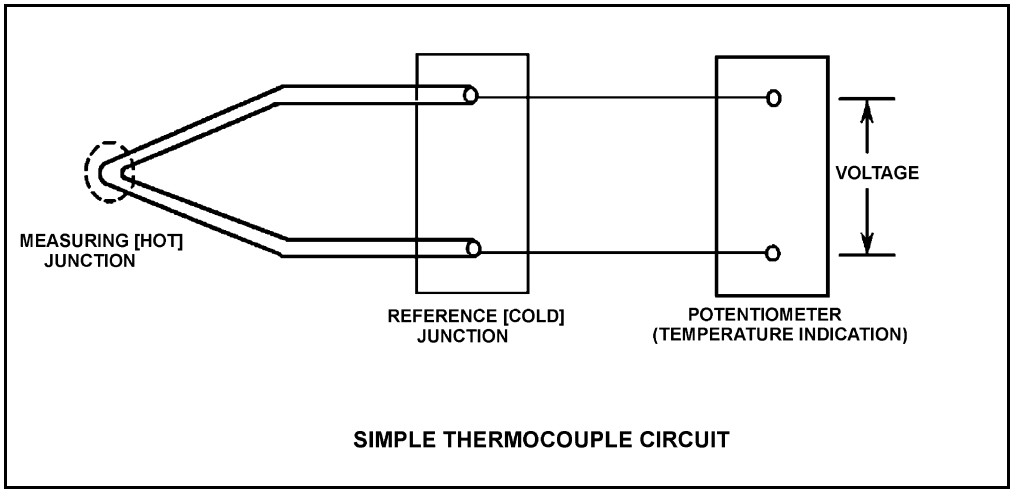
A. 130°F.

B. 150°F.

C. 170°F.

D. 190°F.

ANSWER: B.




SIMPLE THERMOCOUPLE CIRCUIT

TOPIC: 191002
KNOWLEDGE: K1.13 [2.6/2.8]
QID: P2212 (B1510)

Refer to the drawing of a simple thermocouple circuit (see figure below).

Circuit temperature indication is currently 350°F. The reference (cold) junction temperature decreases by 10°F. Assume the measuring junction temperature remains constant. Without temperature compensation for the reference junction, the new temperature indication will be...

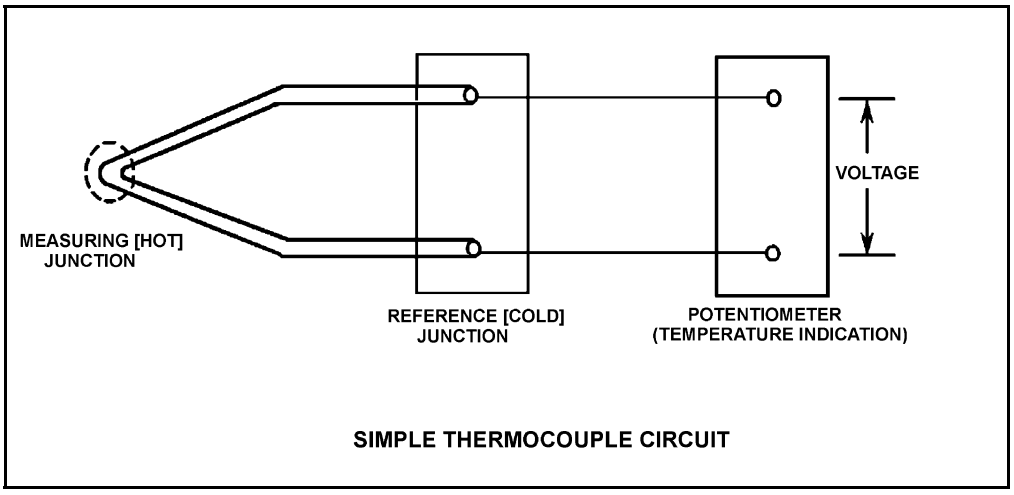
A. 340°F.

B. 350°F.

C. 360°F.

D. 370°F.

ANSWER: C.



TOPIC: 191002
KNOWLEDGE: K1.13 [2.6/2.8]
QID: P2409 (B2412)

What is the purpose of the reference junction panel that is provided with many thermocouple circuits?

A. Ensures that thermocouple output is amplified sufficiently for use by temperature indication devices.

B. Ensures that temperature changes away from the thermocouple measuring junction do not affect thermocouple temperature indication.

C. Ensures that electrical noise in the thermocouple extension wires does not affect thermocouple temperature indication.

D. Ensures that different lengths of thermocouple extension wires do not affect thermocouple temperature indication.

ANSWER: B.

TOPIC: 191002
KNOWLEDGE: K1.13 [2.6/2.8]
QID: P2711 (B2712)

Unlike a resistance temperature detector, a typical thermocouple...

A. uses a single type of metal in the sensing element

B. requires a temperature-controlled reference junction.

C. can provide temperature input to a valve controller in a cooling water system.

D. requires an external power supply to provide indication of temperature.

ANSWER: B.

TOPIC: 191002
KNOWLEDGE: K1.13 [2.6/2.8]
QID: P3011 (B3013)

Refer to the drawing of a simple thermocouple circuit (see figure below).

Thermocouple temperature indication is 410°F with the reference (cold) junction at 125°F. An ambient temperature decrease lowers reference junction temperature to 110°F. Assume the measuring junction temperature remains constant. Without temperature compensation for the reference junction, the new thermocouple temperature indication will be...

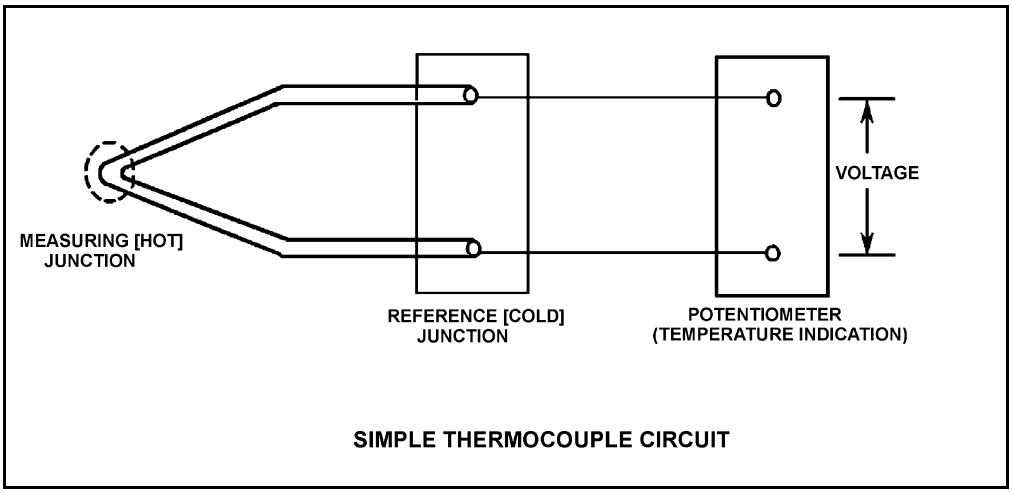
A. 380°F.

B. 395°F.

C. 410°F.

D. 425°F.

ANSWER: D.




SIMPLE THERMOCOUPLE CIRCUIT

TOPIC: 191002
KNOWLEDGE: K1.13 [2.6/2.8]
QID: P4206 (B4206)

Refer to the drawing of a simple thermocouple circuit (see figure below).

Given that the temperatures at the measuring and reference junctions remain constant, if a ventilation system malfunction causes the temperature of the temperature indication panel to increase by 10°F, indicated temperature will...

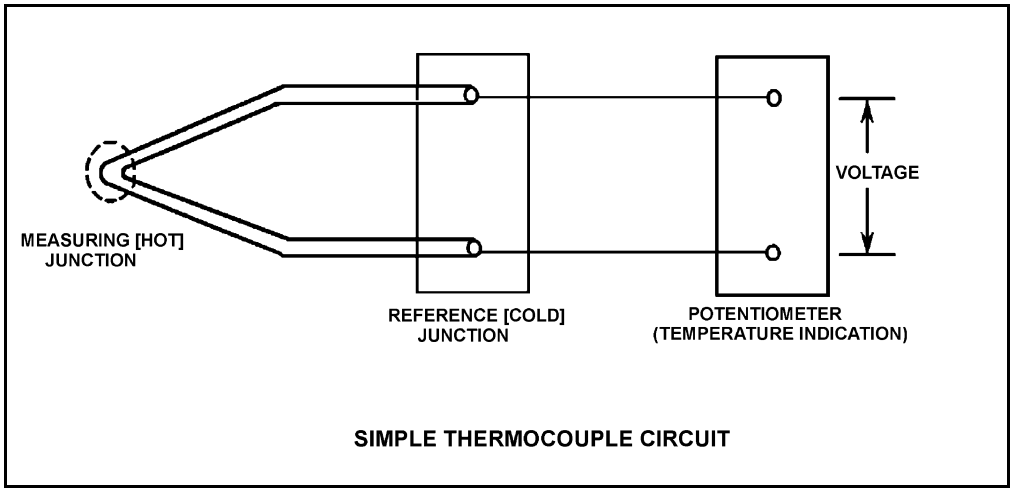
A. not be affected.

B. increase by 10°F.

C. decrease by 10°F.

D. change in an unpredictable manner.

ANSWER: A.



TOPIC: 191002
KNOWLEDGE: K1.13 [2.6/2.8]
QID: P5305 (B5305)

Refer to the drawing of a simple thermocouple circuit (see figure below).

The measuring and reference junctions are located inside the reactor containment building while the potentiometer is located in a remote location outside the containment building. Thermocouple temperature indication is initially 500°F.

An ambient temperature decrease outside the containment building lowers the temperature of the potentiometer by 10°F while the measuring and reference junction temperatures remain constant. Thermocouple temperature indication at the lower ambient temperature will be...

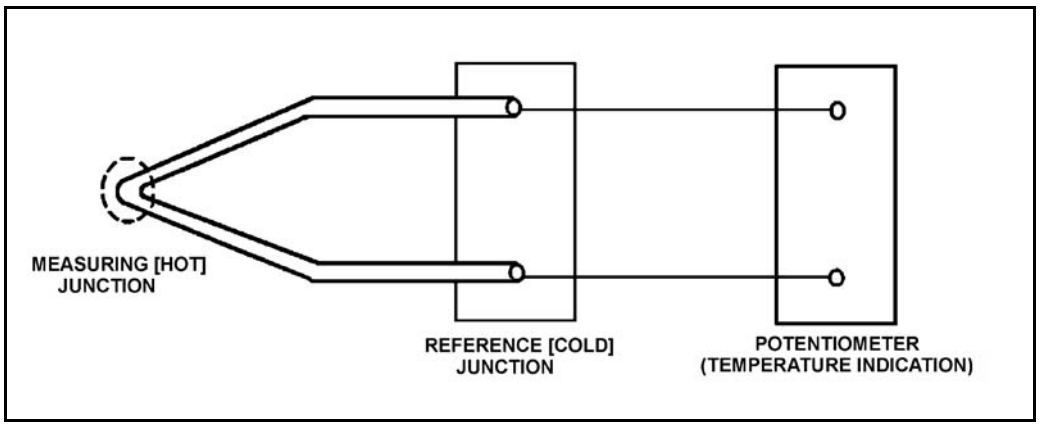
A. 490°F.

B. 500°F.

C. 510°F.

D. unpredictable.

ANSWER: B.



TOPIC: 191002
KNOWLEDGE: K1.13 [2.6/2.8]
QID: P5505 (B5507)

Refer to the drawing of a simple chromel-alumel thermocouple circuit (see figure below).

What is the effect on the thermocouple reference junctions if the chromel and alumel extension wires from the thermocouple connection head to the reference junction panel are replaced with copper wires?

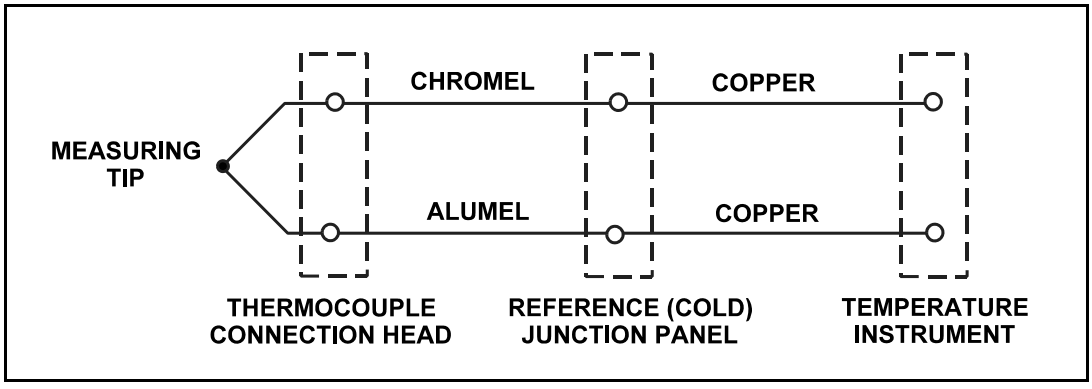
A. The reference junctions will be located in the thermocouple connection head.

B. The reference junctions will still be located in the reference junction panel.

C. The reference junctions will be located in the temperature instrument.

D. There will no longer be any reference junctions.

ANSWER: A.



TOPIC: 191002
KNOWLEDGE: K1.13 [2.6/2.8]
QID: P5805 (B5805)

Which one of the following is a characteristic of a resistance temperature detector but not a thermocouple?

A. Sensing element is made from a single metal or alloy.

B. Requires a reference junction for accurate temperature measurement.

C. Extension leads made from relatively expensive metals or alloys are required for accurate temperature measurement.

D. Temperature measurement relies on a sensor material property that varies directly with the change in the measured temperature.

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.13 [2.6/2.8]
QID: P6004 (B6005)

Refer to the drawing of a simple chromel-alumel thermocouple circuit (see figure below).

What is the effect on the thermocouple reference junctions if the copper extension wires from the reference junction panel to the temperature instrument are replaced with alumel (top) and chromel (bottom) extension wires?

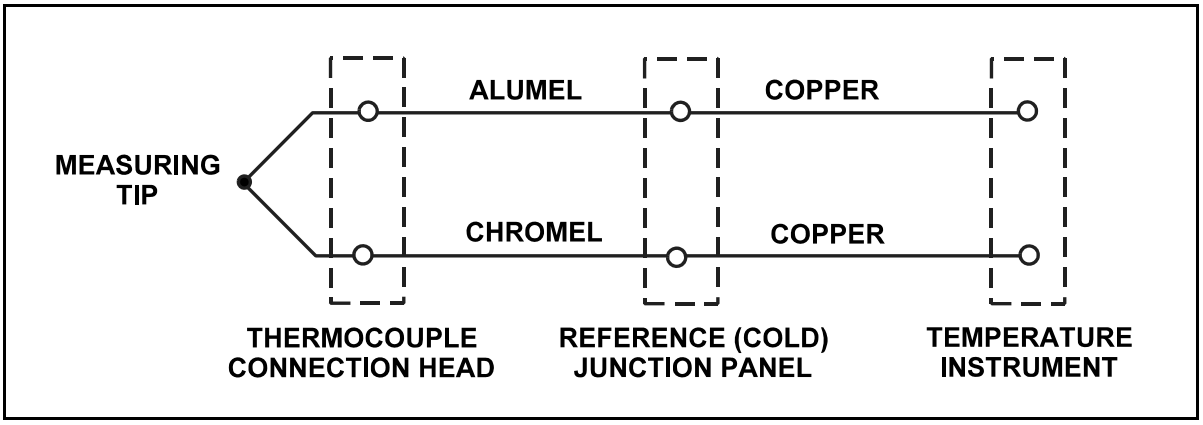
A. The reference junctions will be located in the thermocouple connection head.

B. The reference junctions will still be located in the reference junction panel.

C. The reference junctions will be located in the temperature instrument.

D. There will no longer be any reference junctions.

ANSWER: C.



TOPIC: 191002
KNOWLEDGE: K1.13 [2.6/2.8]
QID: P6305 (B6306)

Refer to the drawing of a simple alumel-chromel thermocouple circuit (see figure below).

The thermocouple, thermocouple connection head, and reference junction panel are located inside a reactor building (RB) while the temperature instrument is located outside the RB. Thermocouple temperature indication is initially 440°F.

A steam leak inside the RB increases the temperatures of the thermocouple connection head and reference junction panel by 40°F, while the temperature at the measuring tip is unchanged. What is the resulting temperature indication?

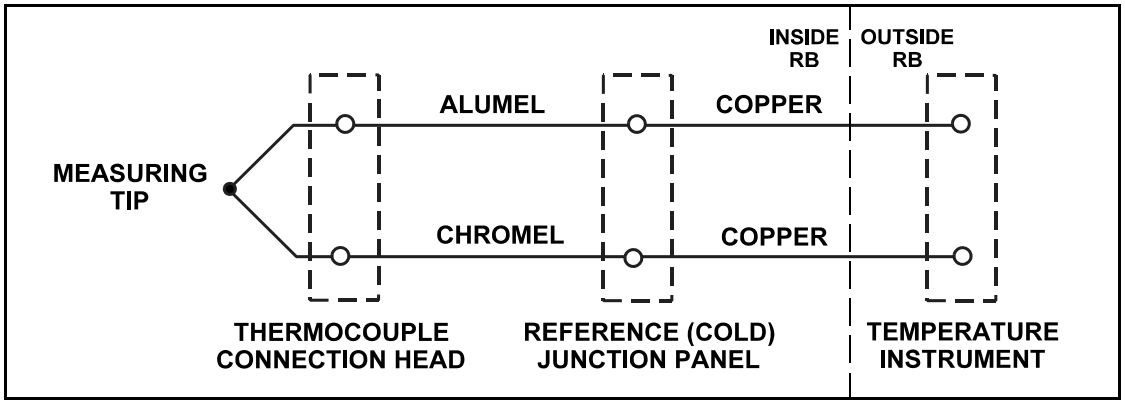
A. 400°F

B. 440°F

C. 480°F

D. 520°F

ANSWER: A.



TOPIC: 191002
KNOWLEDGE: K1.13 [2.6/2.8]
QID: P6504 (B6506)

Because of a thermocouple temperature display failure, the millivolt output of a thermocouple circuit is being converted to temperature using conversion tables. The tables are based on a thermocouple reference junction temperature of 32°F. The actual reference junction is located in a panel that is maintained at 120°F. Room temperature surrounding the panel is 80°F.

What adjustment must be made to the temperature value taken from the conversion tables to calculate the actual temperature at the measuring tip of the thermocouple?

A. Add 48°F.

B. Subtract 48°F.

C. Add 88°F.

D. Subtract 88°F.

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.13 [2.6/2.8]
QID: P6905 (B6905)

A simple two-wire resistance temperature detector (RTD) is being used to measure the temperature of a water system. Copper extension wires run from the RTD to a temperature instrument 40 feet away. If the temperature of the extension wires decreases, the electrical resistance of the extension wires will _____, and the temperature indication will _____ unless temperature compensation is provided.

A. increase; increase

B. increase; decrease

C. decrease; increase

D. decrease; decrease

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.14 [2.8/2.9]
QID: P213

An open circuit in a thermocouple detector causes the affected temperature indication to fail...

A. high.

B. low.

C. to reference junction temperature.

D. as is.

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.14 [2.8/2.9]
QID: P312 (B310)

If shorting occurs within a resistance temperature detector, the associated indication will fail...

A. low.

B. high.

C. as is.

D. to midscale.

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.14 [2.8/2.9]
QID: P414 (B208)

A resistance temperature detector (RTD) is used in a balanced bridge circuit to indicate temperature. If the RTD develops an open circuit (bridge circuit remains intact), temperature indication will fail...

A. high.

B. low.

C. as is.

D. to midscale.

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.14 [2.8/2.9]
QID: P2011 (B2009)

Refer to the drawing of a simple thermocouple circuit (see figure below) that is calibrated for a reference junction temperature of 90°F.

Thermocouple temperature indication is currently 150°F. Indicator range is from 0°F to 2000°F.

If one of the thermocouple extension wires loosens and becomes dislodged from its terminal in the reference junction panel, which one of the following temperature indications will occur?

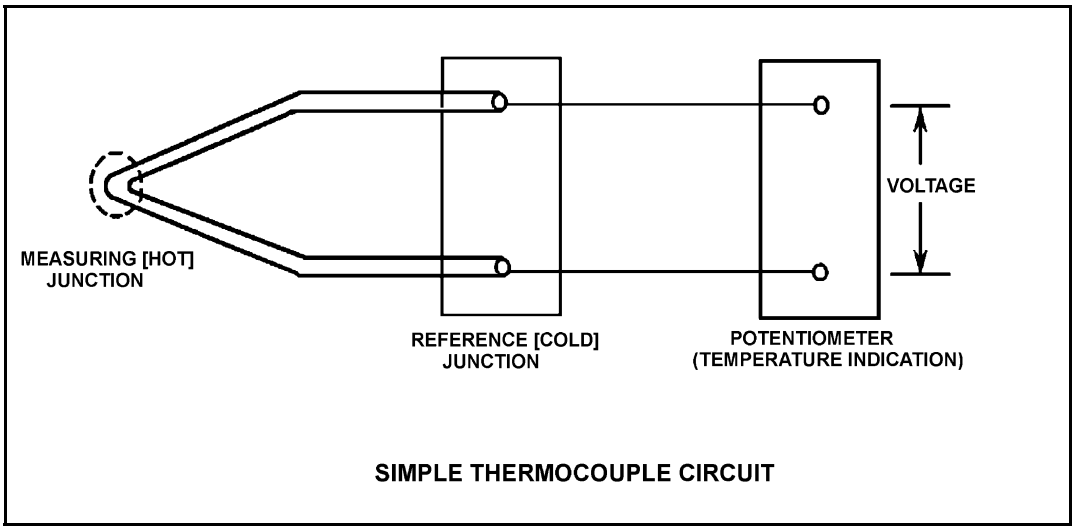
A. Minimum instrument reading (0°F)

B. 60°F

C. 90°F

D. Maximum instrument reading (2000°F)

ANSWER: C.



TOPIC: 191002
KNOWLEDGE: K1.16 [2.3/2.7]
QID: P813 (B812)

What is the most common type of sensor used to provide remote position indication of a valve that is normally either fully open or fully closed?

A. Limit switch

B. Reed switch

C. Servo transmitter

D. Linear variable differential transformer

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.16 [2.3/2.7]
QID: P1313 (B1712)

Which one of the following devices is capable of providing remote indication of valve position on an analog meter in units of "percent of full open"?

A. Reed switch

B. Limit switch

C. Resistance temperature detector

D. Linear variable differential transformer

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.16 [2.3/2.7]
QID: P2611

Refer to the simplified drawing of a control rod position detector (see figure below).

Coils of wire connected to an ac power supply are being used to monitor the position of a control rod in a nuclear reactor. The coils are mounted in a column outside the reactor vessel head such that the steel control rod drive shaft passes upward through the coils as the control rod is withdrawn. Currently, the top of a control rod drive shaft is located between coils A and B as shown. The control rod is to be withdrawn until the top of the control rod drive shaft is located just below coil C.

Compared to the initial coil output currents, after the control rod is withdrawn the output current of coil A will be _____; and the output current of coil B will be _____.

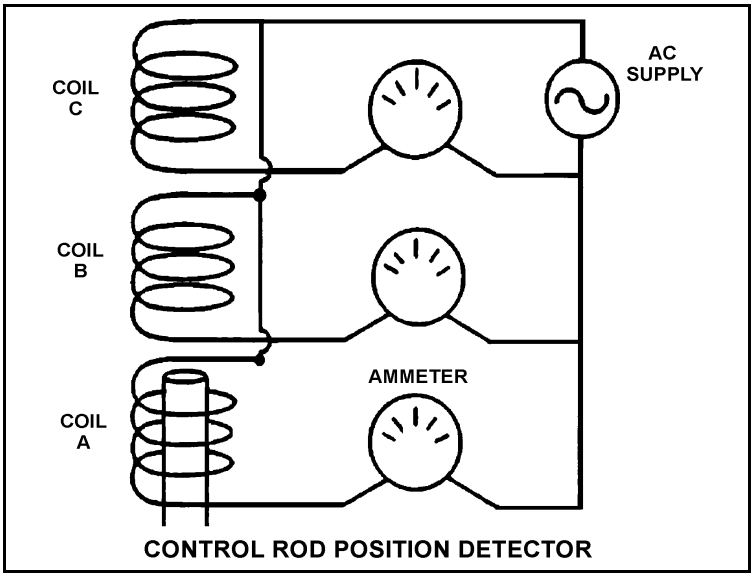
A. higher; higher

B. higher; lower

C. the same; higher

D. the same; lower

ANSWER: D.



TOPIC: 191002
KNOWLEDGE: K1.16 [2.3/2.7]
QID: P2813 (B2811)

Refer to the simplified drawing of a control rod position detector circuit (see figure below).

A magnet on the control rod extension (or drive) shaft sequentially closes individual reed switches mounted vertically adjacent to the control rod drive housing. A constant +5 dc volts is supplied to the input of the resistor network at resistor $R_1$.

A control rod is initially fully inserted such that all reed switch contacts are open; then the rod is withdrawn until reed switch contact $S_1$ is closed. Compared to the initial circuit currents, the current through resistor $R_5$ after the rod withdrawal will be _____, and the output current of the resistor network to the amplifier will be _____.

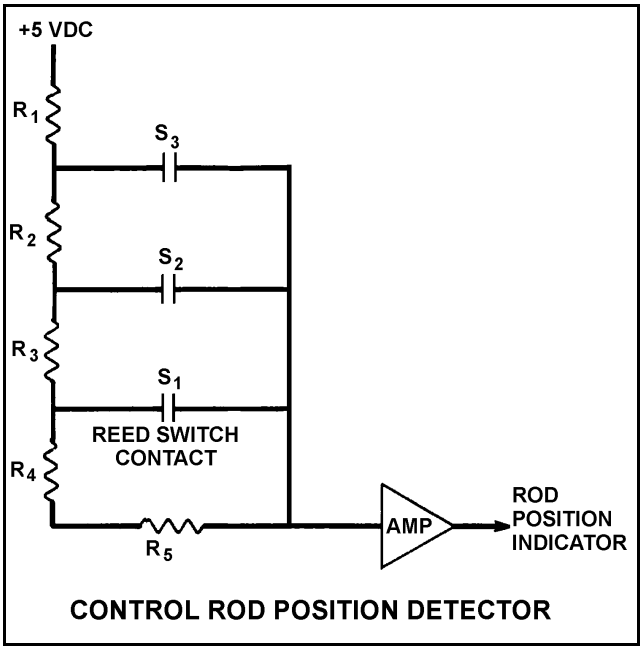
A. lower, higher

B. lower, lower

C. higher, higher

D. higher, lower

ANSWER: A.



TOPIC: 191002
KNOWLEDGE: K1.16 [2.3/2.7]
QID: P2911

Reed switches are being used in an electrical measuring circuit to monitor the position of a control rod in a nuclear reactor. The reed switches are mounted in a column above the reactor vessel such that the control rod drive shaft passes by the reed switches as the control rod is withdrawn.

Which one of the following describes the action that causes the electrical output of the measuring circuit to change as the control rod is withdrawn?

A. An ac coil on the control rod drive shaft induces a voltage into each reed switch as the drive shaft passes by.

B. A metal tab on the control rod drive shaft mechanically closes each reed switch as the drive shaft passes by.

C. The primary and secondary coils of each reed switch attain maximum magnetic coupling as the drive shaft passes by.

D. A permanent magnet on the control rod drive shaft attracts the movable contact arm of each reed switch as the drive shaft passes by.

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.17 [3.3/3.5]
QID: P1612

A nuclear reactor is shut down at 100 cps in the source range when a loss of coolant accident occurs. Assuming that the source neutron flux level remains constant, how and why will excore source range detector outputs change as homogeneous core voiding increases from 20 percent to 40 percent?

A. Increases because more neutron leakage is occurring.

B. Decreases because less neutron leakage is occurring.

C. Increases because $K_{eff}$ is increasing.

D. Decreases because $K_{eff}$ is decreasing.

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.17 [3.3/3.5]
QID: P1910

Just prior to a nuclear power plant outage, the power range nuclear instrumentation was calibrated at 50 percent reactor power. During the outage, 25 percent of the fuel assemblies were shuffled to reduce the power being produced at the center of the core. No fuel assemblies were replaced.

Immediately after the outage, how will reactor power indication compare to actual reactor power when the reactor is stabilized at 50 percent power?

A. Indication will be higher than actual power due to increased neutron leakage.

B. Indication will be higher than actual power due to decreased neutron leakage.

C. Indication will be lower than actual power due to decreased neutron leakage.

D. Indication will be lower than actual power due to increased neutron leakage.

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.17 [3.3/3.5]
QID: P2513

A nuclear power plant startup is in progress immediately following a reactor refueling outage. The external nuclear instrumentation (NI) was calibrated at 50 percent power just prior to the refueling outage and has <u>not</u> been readjusted.

If actual reactor power level is increased to 50 percent and stabilized, NI power level will indicate _____ than actual reactor power level because, when compared to pre-outage 50 percent power level operation, _____.

A. higher; the total core fission rate has increased

B. lower; the total core fission rate has decreased

C. higher; the fission rate in the outer portion of the core has increased

D. lower; the fission rate in the outer portion of the core has decreased

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.17 [3.3/3.5]
QID: P2713

During a refueling outage, the fuel assemblies were reconfigured to reduce the radial power peak at the center of the core while maintaining the same rated thermal power. Excore power range detectors were calibrated at 50 percent power just prior to the outage.

How will actual reactor power compare to indicated reactor power when the nuclear power plant is stabilized at 50 percent power following the outage?

A. Actual reactor power will be higher than indicated reactor power due to increased core neutron leakage.

B. Actual reactor power will be higher than indicated reactor power due to decreased core neutron leakage.

C. Actual reactor power will be lower than indicated reactor power due to decreased core neutron leakage.

D. Actual reactor power will be lower than indicated reactor power due to increased core neutron leakage.

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.17 [3.3/3.5]
QID: P3112

Given:

- The nuclear reactor is shut down.
- The reactor coolant system is at normal operating pressure and temperature.
- The $BF_3$ source range detectors are properly positioned outside the reactor vessel and adjacent to the lower portion of the core.
- All $BF_3$ source range detectors are indicating approximately 100 cps.
- A sudden loss of coolant pressure accident occurs that causes bulk boiling and homogeneous core voiding in the reactor vessel.

Assuming that the source neutron flux level remains constant, how and why will source range detector outputs change as homogeneous core voiding increases from 0 percent to 50 percent?

A. Increase, because the detectors will experience a higher rate of neutron interactions due to the axial power distribution shifting toward the lower portion of the core.

B. Increase, because the detectors will experience a higher rate of neutron interactions due to increasing neutron leakage from the core.

C. Decrease, because the detectors will experience a lower rate of neutron interactions due to a decreasing subcritical multiplication neutron level.

D. Decrease, because the detectors will experience a lower rate of gamma interactions due to decreasing reactor coolant attenuation.

ANSWER: B.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P15 (B314)

Scintillation detectors convert radiation energy into light by a process known as...

A. gas amplification.

B. space charge effect.

C. luminescence.

D. photoionization.

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P16

A $BF_3$ proportional counter is being used to measure neutron level during a reactor startup. Which one of the following describes the method used to ensure that neutron indication is <u>not</u> affected by gamma reactions in the detector?

A. Two counters are used: one sensitive to neutron and gamma and the other sensitive to gamma only. The outputs are electrically opposed to cancel the gamma-induced currents.

B. The $BF_3$ proportional counter measures neutron flux of such high intensity that the gamma signal is insignificant compared to the neutron signal.

C. In a proportional counter, gamma-induced pulses are of insufficient duration to generate a significant output. Only neutron pulses have sufficient duration to be counted by the detector instrumentation.

D. In a proportional counter, neutron-induced pulses are significantly larger than gamma pulses. The detector instrumentation filters out the smaller gamma pulses.

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P214 (B213)

Most of the electrons collected in a fission chamber are released as a result of ionizations caused directly by...

A. fission betas.

B. fission gammas.

C. fission neutrons.

D. fission fragments.

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P215

Which one of the following describes the reason for the high sensitivity of a Geiger-Mueller tube radiation detector?

A. Changes in applied detector voltage have little effect on detector output.

B. Geiger-Mueller tubes are thinner than other radiation detector types.

C. Any incident radiation event causing primary ionization results in ionization of the entire detector gas volume.

D. Geiger-Mueller tubes are operated at relatively low detector voltages, allowing detection of low energy radiation.

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P314

A gas-filled radiation detector that is operating in the ionization region is exposed to a gamma radiation field. If the gamma radiation field is constant and the applied voltage is increased but maintained within the ionization region, the detector output will:

A. increase, because of an increase in secondary ionizations.

B remain the same, because detector output is not affected by a change in voltage in this region.

C increase, because of a decrease in recombination of primary ions.

D remain the same, because the detector is already producing its maximum output.

ANSWER: B.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P316

Which one of the following materials is installed inside an ion chamber that is typically used for thermal neutron detection and reactor power indication?

A. Polyethylene

B. Boron-10

C. Uranium-238

D. Rhodium-103

ANSWER: B.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P614

Refer to the drawing of a gas-filled detector characteristic curve (see figure below).

In a gas-filled radiation detector, operating in the "proportional" region, essentially _____ of the ions caused by incident radiation are collected and the number of ions collected from secondary ionizations is _____ applied voltage.

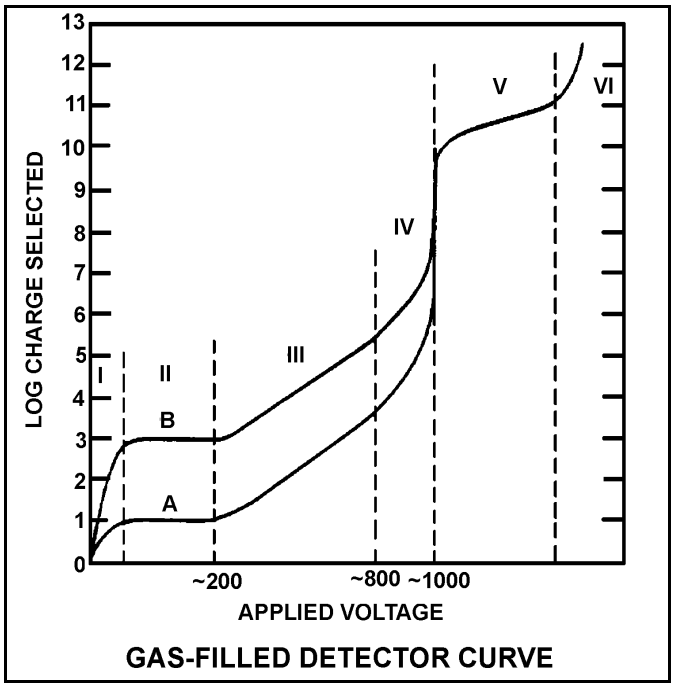
A. all; independent of

B. none; related to

C. all; related to

D. none; independent of

ANSWER: C.



TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P1013

A gas-filled radiation detector that is used to measure thermal neutron flux requires a special feature because thermal neutrons are not directly ionizing particles. Which one of the following will allow thermal neutron detection in a gas-filled detector?

A. Encapsulate the detector with polyethylene

B. Encapsulate the detector with boron-10

C. Line the inside of the detector with polyethylene

D. Line the inside of the detector with boron-10

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P1112

Which one of the following is a characteristic of Geiger-Mueller tube radiation detectors?

A. They can discriminate between neutron and gamma radiation.

B. They can discriminate between gammas of differing energies in the MeV range.

C. They provide an output that is inversely proportional to the applied voltage within the Geiger-Mueller region.

D. They undergo maximum gas amplification whenever an ion is formed in the tube.

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P1213

Which one of the following describes why a $BF_3$ proportional counter can be used in the source range to measure neutron radiation in a radiation field that also contains gamma radiation?

A. Neutrons directly ionize the $BF_3$ gas, producing larger pulses than gammas.

B. Neutrons interacting with the $BF_3$ gas result in the release of alpha particles which produce larger pulses than gammas.

C. Neutrons are captured by boron-10 and produce additional neutrons that completely ionize the fill gas in the detector.

D. The gamma radiation field is insignificant when compared to the neutron field.

ANSWER: B.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P1314

Which one of the following types of radiation will produce the greatest number of ions while passing through 1 centimeter of air? (Assume the same kinetic energy for each.)

A. Alpha

B. Beta

C. Gamma

D. Neutron

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P1513 (B1514)

Which one of the following lists the two types of gas-filled radiation detectors whose outputs will be least affected by a small variation (± 10 volts) in the voltage applied to the detectors? (Assume voltage remains within normal range.)

A. Geiger Mueller and ion chamber

B. Proportional and limited proportional

C. Ion chamber and proportional

D. Limited proportional and Geiger Mueller

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P1613 (B913)

Which one of the following describes a characteristic of a gas-filled radiation detector operating in the Geiger-Mueller region?

A. Radiation types can be identified by pulse height.

B. Specific radionuclides can be identified by energy level.

C. Small variations in applied voltage will result in large changes in detector output.

D. Any type of radiation that ionizes the detector gas will produce the same magnitude detector output pulse.

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P1713 (B1714)

A Geiger-Mueller radiation detector is located in a radiation field consisting of beta, gamma, and fast neutron radiation. Assuming each type of radiation enters the detector gas chamber and ionizes the detector gas, which one of the following describes the resulting detector pulse sizes?

A. Beta radiation will produce a larger pulse size than either gamma or fast neutron radiation.

B. Gamma radiation will produce a larger pulse size than either beta or fast neutron radiation.

C. Fast neutron radiation will produce a larger pulse size than either beta or gamma radiation.

D. Beta, gamma, and fast neutron radiation will produce pulse sizes that are equal in magnitude.

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P1812 (B814)

A gas-filled radiation detector operating in the proportional region is exposed to a constant gamma radiation field. If the applied voltage is increased but maintained within the proportional region, the rate of ion collection will...

A. stay approximately the same because all of the primary ions were already being collected at the lower voltage.

B. stay approximately the same because the ion chamber is operating at saturated conditions.

C. increase because fewer primary ions are recombining in the detector prior to reaching the electrodes.

D. increase because more secondary ionizations are occurring in the detector.

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P1909 (B1113)

Which one of the following is the function of the positive electrode in an ion chamber?

A. Produces ions when exposed to a radiation field

B. Releases electrons to combine with positive ions

C. Performs gas quenching to maximize detector sensitivity

D. Collects electrons released during gas ionization

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P2013 (B313)

An ion chamber radiation detector is exposed to a constant gamma radiation field. If the applied voltage is increased but maintained within the ion chamber region, the rate of ion collection will...

A. increase with voltage because more secondary ionizations are occurring in the detector.

B. increase with voltage because less primary ions are recombining in the detector prior to reaching the electrodes.

C. stay approximately the same because all of the primary ions were already being collected at the lower voltage.

D. stay approximately the same because the ion chamber is operating at saturated conditions.

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P2014 (B2413)

What is the effect on a proportional neutron detector if the detector operating voltage is increased such that the detector operates near the high end of the true proportional region on the gas-filled detector characteristic curve?

A. Neutron-induced pulses will become so large that gamma pulse discrimination is no longer needed, yielding a more accurate neutron count rate.

B. The positive space charge effect will increase and prevent collection of both gamma- and neutron-induced pulses, yielding a less accurate neutron count rate.

C. A high rate of incident gamma radiation will result in the combination of multiple small gamma-induced pulses into larger pulses. The larger combined pulses will be counted as neutron-induced pulses, yielding a less accurate neutron count rate.

D. Detection of any single ionizing event will result in ionizing nearly the entire detector gas volume. The resulting large pulses will prevent the detector from differentiating between radiation types, yielding a less accurate neutron count rate.

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P2313 (B2613)

A gas-filled radiation detector operating in the proportional region is exposed to a constant gamma radiation field. If the applied voltage is decreased but maintained within the proportional region, the rate of ion collection will...

A. stay approximately the same because all of the primary ions were already being collected at the higher voltage.

B. stay approximately the same because the ion chamber is still operating at saturated conditions.

C. decrease because more primary ions are recombining in the detector prior to reaching the electrodes.

D. decrease because fewer secondary ionizations are occurring in the detector.

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P2413 (B2414)

A gas-filled radiation detector operating in the ionization chamber (IC) region is being exposed to a constant gamma radiation field. If the applied voltage is decreased but maintained within the IC region, the rate of ion collection will...

A. stay approximately the same because all of the primary ions continue to be collected and essentially no secondary ionizations are occurring.

B. stay approximately the same because detector operation in the ionization chamber region is characterized by complete ionization of the detector gas.

C. decrease because fewer primary ionizations are occurring in the detector as detector voltage decreases.

D. decrease because fewer secondary ionizations are occurring in the detector as detector voltage decreases.

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P2613 (B1114)

Which one of the following describes the reason for the high sensitivity of a gas-filled ion chamber operating in the Geiger-Mueller region?

A. Any radiation-induced ionization results in a large detector output pulse.

B. Geiger-Mueller detectors are longer than other types of radiation detectors, resulting in greater detector surface area.

C. The detector output is directly proportional to the applied voltage within the Geiger-Mueller region.

D. The high detector voltage allows differentiation between the various radiation types.

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P2913 (B414)

Refer to the drawing of a gas-filled radiation detector characteristic curve (see figure below).

Which one of the following statements describes how a gas-filled radiation detector, operating in the "proportional" region, functions?

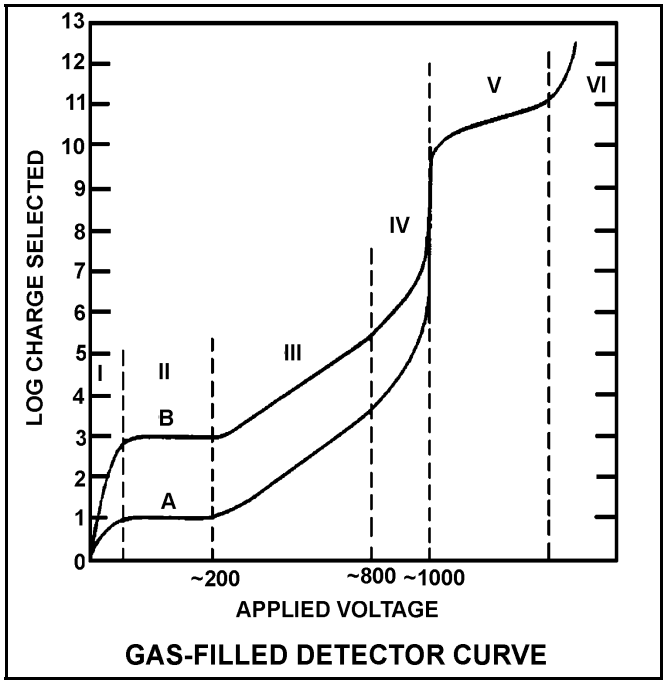
A. Essentially all of the ions from primary ionizations are collected; the number of ions collected from secondary ionizations are independent of the applied voltage on a logarithmic scale.

B. The number of ions collected from both primary and secondary ionizations vary directly with the applied voltage on a logarithmic scale.

C. Essentially all of the ions from primary ionizations are collected; the number of ions collected from secondary ionizations vary directly with the applied voltage on a logarithmic scale.

D. The number of ions collected from both primary and secondary ionizations are independent of the applied voltage on a logarithmic scale.

ANSWER: C.



TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P3413

A boron trifluoride ($BF_3$) detector (proportional counter) is normally used to monitor only source range core neutron level. How will the detector and source range count rate indication be affected if normal detector high voltage is inadvertently applied during nuclear reactor operation in the power range?

A. The $BF_3$ gas will become completely ionized and source range indication will stabilize at a constant low value.

B. The $BF_3$ gas will become completely ionized and source range indication will stabilize at a constant high value.

C. The detector electrodes will become exposed to an extremely high neutron flux and cause a false high reading on the source range indication.

D. The detector electrodes will become exposed to an extremely high gamma flux and cause a false high reading on the source range indication.

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P3906 (B3907)

A beta particle and an alpha particle enter and cause ionization in a gas-filled radiation detector operating in the Geiger-Mueller region. Which one of the following accurately compares the amplitude of the detector pulses caused by each type of radiation?

A. The beta particle pulse will be larger in amplitude.

B. The alpha particle pulse will be larger in amplitude.

C. The pulses will be identical for both types of radiation.

D. Cannot be determined without particle kinetic energy information.

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P4506 (B4507)

A nuclear power plant has been shutdown for one month. A portable gas-filled radiation detector is needed to monitor shutdown reactor core neutron level from a location outside the reactor vessel. The detector must be able to distinguish between ionizations caused by gamma and neutron radiation.

Which region(s) of the gas-filled detector characteristic curve is/are acceptable for operation of the detector?

A. Geiger-Mueller, Ionization, and Proportional regions are all acceptable.

B. Proportional region is acceptable, and Ionization region also may be usable.

C. Ionization region is acceptable, and Geiger-Mueller region also may be usable.

D. Geiger-Mueller region is acceptable, and Proportional region also may be usable.

ANSWER: B.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P4806 (B4807)

Select the option that correctly fills in the blanks.

Quench gases are added to gas-filled radiation detectors that operate in the _____ region; the quench gases prevent a single ionization event from causing _____ in the detector gas volume.

A. ion chamber; multiple discharges

B. ion chamber; secondary ionizations

C. Geiger-Mueller; multiple discharges

D. Geiger-Mueller; secondary ionizations

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P4906 (B4907)

Which one of the following contains the pair of radiation detector types that are the most sensitive to low-energy beta and/or gamma radiation?

A. Geiger-Mueller and scintillation

B. Geiger-Mueller and ion chamber

C. Ion chamber and scintillation

D. Ion chamber and proportional

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P5206 (B5207)

A beta particle and an alpha particle with equal kinetic energies cause ionization in a gas-filled radiation detector. The detector is operating in the ion chamber region of the gas ionization curve. Which one of the following describes the amplitudes of the detector pulses caused by each type of radiation?

A. The beta particle pulse will be larger in amplitude.

B. The alpha particle pulse will be larger in amplitude.

C. The amplitudes of both pulses will be approximately equal for all detector voltages in the ion chamber region.

D. The amplitudes of both pulses will be approximately equal for all detector voltages in the ion chamber region, as well as all detector voltages outside the ion chamber region.

ANSWER: B.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P5306 (B5307)

Which one of the following types of radiation detectors is generally <u>not</u> used for measuring a high-intensity beta and gamma radiation field because of a relatively long detector recovery time, or dead time, following each ionization event.

A. Geiger-Mueller

B. Ion chamber

C. Proportional

D. Scintillation

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P5606 (B5607)

A proportional detector with pulse height discrimination circuitry is being used in a constant field of neutron and gamma radiation to provide source range neutron count rate indication. Assume that the pulse height discrimination setpoint does <u>not</u> change.

If the detector's operating voltage is increased but maintained within the true proportional operating region, count rate indication will increase because...

A. a single neutron- or gamma- induced ionizing event will result in multiple pulses inside the detector.

B. the ratio of the number of neutron-induced pulses to gamma-induced pulses inside the detector will increase.

C. the positive space charge effect will increase and promote the collection of both gamma- and neutron-induced pulses.

D. all detector pulses will increase in amplitude and previously uncounted gamma pulses will be added to the total count rate.

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P6006 (B6007)

Which one of the following types of radiation detectors uses a gas volume for radiation detection and will typically produce the weakest output signal if all detectors are placed in the same gamma radiation field?

A. Geiger-Mueller

B. Ion chamber

C. Proportional counter

D. Scintillation

ANSWER: B.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P6206 (B6206)

Which one of the following types of radiation detectors is typically the <u>least</u> accurate in determining the dose rate to a human body from an unspecified source of radiation?

A. Geiger-Mueller

B. Ion chamber

C. Proportional counter

D. Scintillation

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P6405 (B6407)

A fission chamber detector is located in a constant neutron radiation field and is initially operating in the proportional region of the gas-filled detector ionization curve. If the voltage applied to the detector is changed such that the detector operates in the ion chamber region of the curve, the rate of neutron interactions in the detector will _____, and the amplitude of each neutron-induced detector pulse will _____.

A. increase; increase

B. decrease; decrease

C. remain the same; increase

D. remain the same; decrease

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P6505 (B6507)

Which one of the following describes the positive space charge effect associated with a gas filled radiation detector?

A. Multiple detector pulses result from a single ionization event because positive ions form a cloud around the negative electrode, which increases the electric field strength, thereby initiating secondary ionizations.

B. Multiple detector pulses result from a single ionization event because positive ions form a cloud around the positive electrode, which increases the electric field strength, thereby initiating secondary ionizations.

C. The pulse amplitude resulting from an ionization event is reduced because positive ions form a cloud around the negative electrode, which reduces the electric field strength, thereby limiting secondary ionizations.

D. The pulse amplitude resulting from an ionization event is reduced because positive ions form a cloud around the positive electrode, which reduces the electric field strength, thereby limiting secondary ionizations.

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.18 [2.6/2.8]
QID: P6906 (B6906)

In which usable region(s) of the gas-filled detector ionization curve is the pulse height resulting from the detection of a 1 MeV beta particle the same as a 5 MeV alpha particle?

A. Geiger-Mueller only.

B. Geiger-Mueller and Ionization Chamber.

C. Proportional only.

D. Proportional and Ionization Chamber.

ANSWER: A.

TOPIC: 191002
KNOWLEDGE: K1.19 [3.1/3.3]
QID: P216 (B214)

Which one of the following describes a characteristic of a self-reading pocket dosimeter (SRPD)?

A. The output of an SRPD is a dose rate in mR/hr.

B. SRPDs are primarily sensitive to beta radiation.

C. SRPD readings must be considered inaccurate when they are dropped.

D. SRPDs hold their charge indefinitely when removed from a radiation field.

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.19 [3.1/3.3]
QID: P714 (B714)

Which one of the following types of radiation is the major contributor to the dose indication on a self-reading pocket dosimeter (SRPD)? (also called SRD, PIC, and direct reading dosimeter)

A. Alpha

B. Beta

C. Gamma

D. Neutron

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.19 [3.1/3.3]
QID: P5706 (B5707)

Which one of the following describes a characteristic of a self-reading pocket dosimeter?

A. Provides dose rate indication in mR/hr.

B. More sensitive to gamma radiation than beta radiation.

C. Contains crystals that luminesce when exposed to ionizing radiation.

D. Can be stored as an accurate record of lifetime radiation exposure.

ANSWER: B.

TOPIC: 191002
KNOWLEDGE: K1.19 [3.1/3.3]
QID: P6806 (B6807)

A nuclear plant worker normally wears a thermoluminescent dosimeter (TLD) or similar device for measuring radiation exposure. When a self reading pocket dosimeter (SRPD) is also required, where will the SRPD be worn and why?

A. Below the waist near the TLD to measure radiation from the same source(s).

B. Below the waist away from the TLD to measure radiation from different source(s).

C. Above the waist near the TLD to measure radiation from the same source(s).

D. Above the waist away from the TLD to measure radiation from different source(s).

ANSWER: C.

TOPIC: 191002
KNOWLEDGE: K1.20 [2.5/2.7]
QID: P1114

Which one of the following describes the ion collection that occurs in a proportional counter, such as a $BF_3$ detector?

A. A fraction of the ions created by primary ionizations are collected. No secondary ionizations take place.

B. Virtually all of the ions created by primary ionizations are collected. No secondary ionizations take place.

C. Virtually all of the ions created by primary ionizations along with a fraction of the ions created by secondary ionizations are collected.

D. Virtually all of the ions created by primary and secondary ionizations are collected.

ANSWER: D.

TOPIC: 191002
KNOWLEDGE: K1.20 [2.5/2.7]
QID: P1514 (B511)

A $BF_3$ gas-filled detector, operating in the proportional region, is being used to monitor reactor power while shut down. If a complete loss of detector gas pressure occurs, the instrument indication will fail...

A. upscale.

B. downscale.

C. as is.

D. to midscale.

ANSWER: B.

TOPIC: 191002
KNOWLEDGE: K1.20 [2.5/2.7]
QID: P3714

During reactor power operation, a reactor coolant sample is taken and analyzed. Which one of the following lists three radionuclides that are all indicative of a fuel cladding failure if detected in elevated concentrations in the reactor coolant sample?

A. Lithium-6, cobalt-60, and argon-41

B. Iodine-131, cesium-138, and strontium-89

C. Nitrogen-16, xenon-135, and manganese-56

D. Hydrogen-2 (deuterium), hydrogen-3 (tritium), and oxygen-18

ANSWER: B.

TOPIC: 191002
KNOWLEDGE: K1.20 [2.5/2.7]
QID: P6406

During power operation, a reactor coolant sample is taken and analyzed. Which one of the following lists three nuclides that are each indicative of a possible fuel cladding failure if found to be at elevated concentrations in the reactor coolant sample?

A. Oxygen-18, iron-59, and zirconium-95

B. Cobalt-60, iodine-131, and xenon-135

C. Krypton-85, strontium-90, and cesium-136

D. Hydrogen-2, hydrogen-3, and nitrogen-16

ANSWER: C.