UNITED STATES NUCLEAR REGULATORY COMMISSION
PRESSURIZED WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
MARCH 2017 PWR – FORM A

Please Print

Name: _____

Docket No.: _____

Facility: _____

Start Time: _____ Stop Time: _____

INSTRUCTIONS TO EXAMINEE

Answer all the test items using the answer sheet provided, ensuring a single answer is marked for each test item. Each test item has equal point value. A score of at least 80 percent is required to pass this portion of the NRC operator licensing written examination. All examination materials will be collected 3 hours after the examination begins. This examination applies to a typical U.S. pressurized water reactor (PWR) nuclear power plant.

SECTION	QUESTIONS	% OF TOTAL	SCORE
COMPONENTS	1 - 22		
REACTOR THEORY	23 - 36		
THERMODYNAMICS	37 - 50		
TOTALS	50		

All work performed on this examination is my own. I have neither given nor received aid.

_____

Examinee's Signature

RULES AND INSTRUCTIONS FOR THE
NRC GENERIC FUNDAMENTALS EXAMINATION

During the administration of this examination the following rules apply:

NOTE: The term "control rod" refers to the length of neutron absorber material that can be positioned by the operator to change core reactivity.

NOTE: Numerical answers are rounded to the nearest whole number unless otherwise indicated.

1. Print your name in the blank provided on the cover sheet of the examination.

2. Fill in your individual docket number.

3. Fill in the name of your facility.

4. Fill in your start and stop times at the appropriate times.

5. Two aids are provided for your use during the examination:

   (1) An Equations and Conversions Sheet contained within the examination copy, and

   (2) Steam tables and Mollier Diagram provided by your proctor.

6. Place your answers on the answer sheet provided. Credit will only be given for answers properly marked on this sheet. Follow the instructions for filling out the answer sheet.

7. Scrap paper will be provided for calculations.

8. Cheating on the examination will result in the automatic forfeiture of this examination. Cheating could also result in severe penalties.

9. Restroom trips are limited. Only **one** examinee may leave the room at a time. In order to avoid the appearance or possibility of cheating, avoid all contact with anyone outside the examination room.

10. After you have completed the examination, sign the statement on the cover sheet indicating that the work is your own and you have neither given nor received any assistance in completing the examination. Either pencil or pen may be used.

11. Turn in your examination materials, answer sheet on top, followed by the examination copy and the examination aids, e.g., steam tables, handouts, and scrap paper.

12. After turning in your examination materials, leave the examination area as defined by the proctor. If after leaving you are found in the examination area while the examination is in progress, your examination may be forfeited.

GENERIC FUNDAMENTALS EXAMINATION
EQUATIONS AND CONVERSIONS SHEET

EQUATIONS

$\dot{Q} = \dot{m}c_p\Delta T$

$\dot{Q} = \dot{m}\Delta h$

$\dot{Q} = UA\Delta T$

$\dot{Q} \propto \dot{m}^3_{\text{Nat Circ}}$

$\Delta T \propto \dot{m}^2_{\text{Nat Circ}}$

$K_{eff} = 1/(1 - \rho)$

$\rho = (K_{eff} - 1)/K_{eff}$

$SUR = 26.06/\tau$

$$\tau = \frac{\bar{\beta}_{eff} - \rho}{\lambda_{eff}\,\rho}$$

$$\rho = \frac{\ell^*}{\tau} + \frac{\bar{\beta}_{eff}}{1 + \lambda_{eff}\,\tau}$$

$\ell^* = 1.0 \times 10^{-4}$ sec

$\lambda_{eff} = 0.1\ \text{sec}^{-1}$ (for small positive ρ)

$DRW \propto \varphi^2_{tip} / \varphi^2_{avg}$

$P = P_o e^{t/\tau}$

$P = P_o 10^{SUR(t)}$

$A = A_o e^{-\lambda t}$

$N = S/(1 - K_{eff})$

$CR_1(1 - K_{eff_1}) = CR_2(1 - K_{eff_2})$

$1/M = CR_1/CR_x$

$A = \pi r^2$

$F = PA$

$\dot{m} = \rho A\vec{v}$

$\dot{W}_{Pump} = \dot{m}\Delta P\upsilon$

$P = I^2R$

$P = IE$

$P_A = \sqrt{3}IE$

$P_T = \sqrt{3}IEpf$

$P_R = \sqrt{3}IE\sin\theta$

Thermal Efficiency = Net Work Out/Energy In

$$\frac{g(z_2 - z_1)}{g_c} + \frac{(\vec{v}_2^2 - \vec{v}_1^2)}{2g_c} + \upsilon(P_2 - P_1) + (u_2 - u_1) + (q - w) = 0$$

$g = 32.2\ \text{ft/sec}^2$

$g_c = 32.2$ lbm-ft/lbf-sec^2

CONVERSIONS

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1 MW $= 3.41 \times 10^6$ Btu/hr

1 hp $= 2.54 \times 10^3$ Btu/hr

1 Btu $= 778$ ft-lbf

°C $= (5/9)(°F - 32)$

°F $= (9/5)(°C) + 32$

1 kg $= 2.21$ lbm

1 ft^3_{water} $= 7.48$ gal

1 gal_{water} $= 8.35$ lbm

1 Curie $= 3.7 \times 10^{10}$ dps

QUESTION: 1

A completely full water storage tank is being hydrostatically tested to 200 psig using a positive displacement pump (PDP) with a smooth and constant discharge flow rate of 6 gpm. The tank is protected by two relief valves that discharge to the atmosphere. The relief valves have the following characteristics:

- Relief valve A opening setpoint is 200 psig with an accumulation of 3.0 percent.
- Relief valve B opening setpoint is 200 psig with an accumulation of 1.5 percent.
- Each valve has linear flow rate characteristics and a maximum discharge flow rate of 9 gpm.

The PDP is inadvertently left running when tank pressure reaches 200 psig.

With the PDP running continuously, what will be the discharge flow rates of the relief valves when tank pressure stabilizes?

	Relief Valve A	Relief Valve B
A.	2 gpm	4 gpm
B.	3 gpm	6 gpm
C.	4 gpm	2 gpm
D.	6 gpm	3 gpm

QUESTION: 2

To verify a manual valve in an operating system is closed, the operator should observe valve position indication and operate the valve handwheel in the...

A. open direction at least one full rotation, then close the valve using normal force.

B. open direction until system flow is observed, then close the valve using normal force.

C. close direction using normal force and verify there is no substantial handwheel movement.

D. close direction using normal force, then operate the valve handwheel an additional one-quarter turn in the close direction.

QUESTION: 3

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.

QUESTION: 4

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.

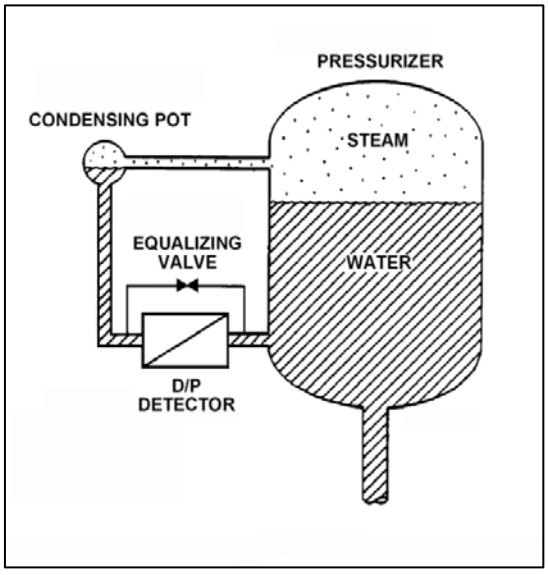
When the plant is returned to normal operating conditions, pressurizer level will indicate _____ than actual level because a given pressurizer level at normal operating conditions produces a _____ D/P compared to cold shutdown conditions.

A. higher; smaller

B. higher; larger

C. lower; smaller

D. lower; larger



QUESTION: 5

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

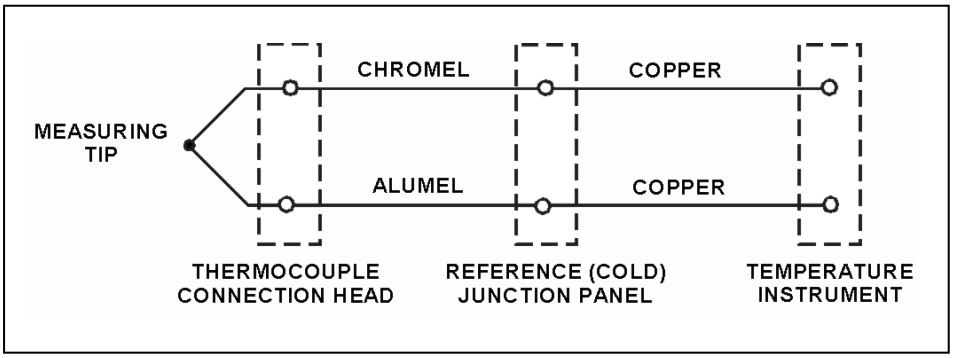
What is the effect on the thermocouple reference junctions if the chromel and alumel extension wires from the thermocouple connection head to the reference junction panel are replaced with copper wires?

A. There will no longer be any reference junctions.

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

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

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



QUESTION: 6

A Geiger-Mueller detector with a "pancake" probe (often called a frisker) is being used to monitor personnel leaving a radiologically controlled area. The probe is equipped with a mica window.

Two individuals have radioactive skin contamination—one individual with only alpha emitters, and the other with only beta emitters. Both types of radiation are being emitted at the same rate. The same percentage of each type of radiation enters the probe's detection chamber and causes ionization.

Which one of the following describes the detector's count rate response to the alpha and beta radiation?

A. The count rate will be higher for the alpha radiation.

B. The count rate will be higher for the beta radiation.

C. The count rate will be the same for both types of radiation.

D. Cannot be determined without knowing the energy levels of the radiation.

QUESTION: 7

Refer to the drawing of a lube oil temperature control system (see figure below).

Given:

- The lube oil temperature controller setpoint is 90EF.
- The heat exchanger lube oil outlet temperature is stable at 93EF.
- The temperature control valve is currently 60 percent open.
- The temperature control system uses a direct-acting proportional controller with a 20°F proportional band.

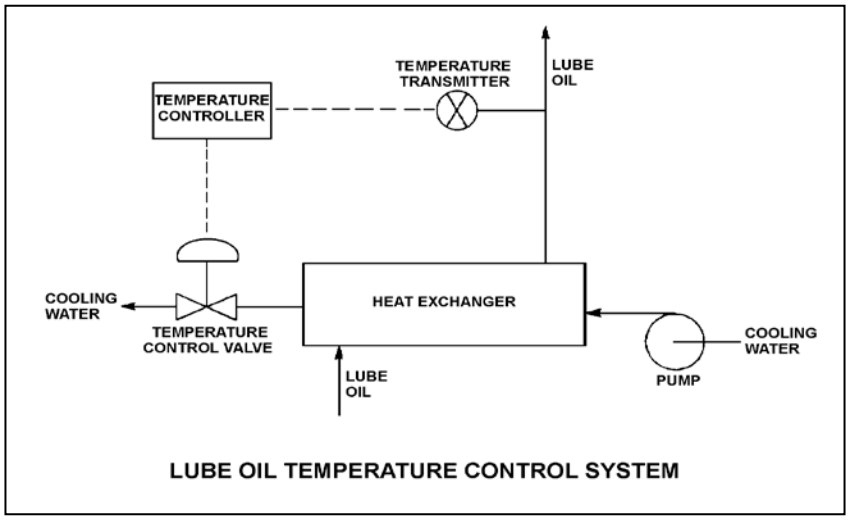
If the controller's proportional band is changed to 30°F, the heat exchanger lube oil outlet temperature will stabilize _____ than 93°F; and the controller output needed to position the temperature control valve to 60 percent open will be _____.

A. lower; the same

B. lower; greater

C. higher; the same

D. higher; greater



LUBE OIL TEMPERATURE CONTROL SYSTEM

QUESTION: 8

The level in a drain collection tank is being controlled by an automatic level controller, and is initially stable at the controller setpoint. Flow rate into the tank increases, slowly at first, and then faster until a stable higher flow rate is attained.

As tank level begins to increase, the level controller slowly opens a tank drain valve. The level controller output signal increases both as the tank level increases and as the rate of tank level change quickens. After a few minutes, tank level returns to, and remains at, the original level with the drain flow rate equal to the supply flow rate.

The controller in this system uses _____ control.

A. proportional only

B. proportional plus derivative only

C. proportional plus integral only

D. proportional plus integral plus derivative

QUESTION: 9

Given:

- A direct-acting proportional pneumatic controller will be used to maintain level in a water storage tank by positioning an air-operated flow control valve in the tank's makeup water supply line.
- The controller's input will vary directly with tank level.

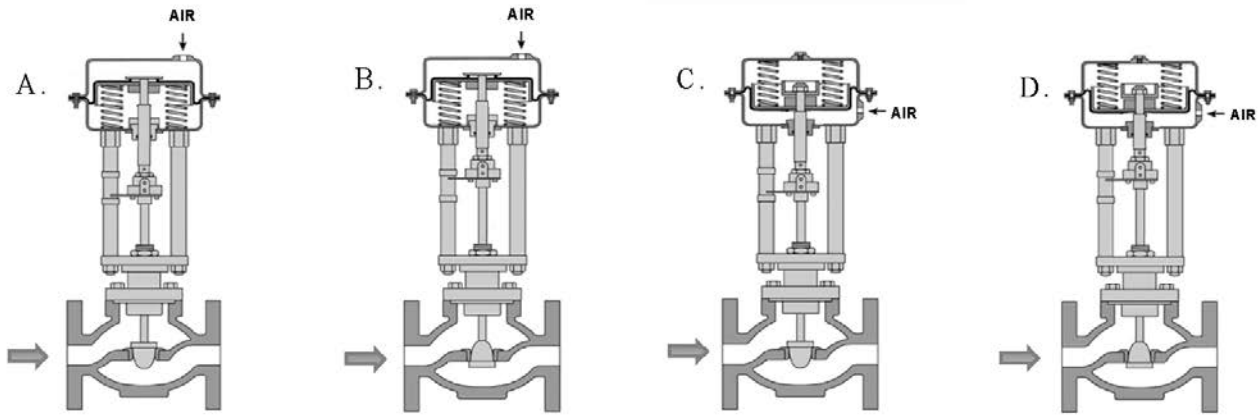
Which pair of flow control valves shown below will be compatible with the controller in the above application?

A. A and B

B. B and C

C. C and D

D. D and A



QUESTION: 10

Refer to the drawing of a centrifugal pump with a recirculation line (see figure below).

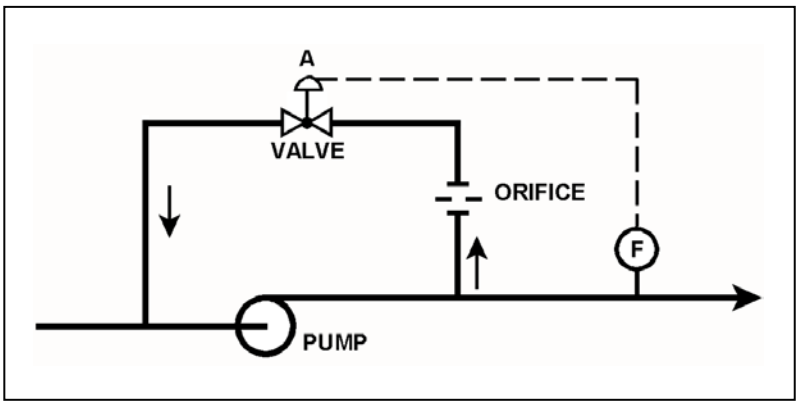
The flowpath through valve A is designed to...

A. prevent pump runout by creating a recirculation flowpath.

B. provide a small flow rate through the pump during shutoff head conditions.

C. direct a small amount of water to the pump suction to raise available net positive suction head.

D. prevent the discharge piping from exceeding design pressure during no-flow conditions.



QUESTION: 11

The discharge valve for a radial-flow centrifugal cooling water pump is closed in preparation for starting the pump.

After the pump is started, the pump suction and discharge pressures stabilize as follows:

Pump suction pressure = 5 psig
Pump discharge pressure = 35 psig

With the discharge valve still closed, if the pump speed is doubled, what will be the new stable pump discharge pressure?

A. 65 psig

B. 120 psig

C. 125 psig

D. 140 psig

QUESTION: 12

In response to a loss of coolant accident, an emergency core cooling pump is taking suction from the bottom of a vented water storage tank and discharging to the downcomer region of a reactor vessel. Which one of the following will cause the pump to operate closer to cavitation?

A. The pressure in the reactor vessel increases.

B. The level of the water in the reactor vessel increases.

C. The temperature of the water in the water storage tank increases.

D. The ambient pressure surrounding the water storage tank increases.

QUESTION: 13

What is the purpose of the relief valve located between the pump outlet and the discharge isolation valve of many positive displacement pumps?

A. Protect the pump and suction piping from overpressure if the discharge valve is open during system startup.

B. Protect the pump and suction piping from overpressure if the suction valve is closed during pump operation.

C. Protect the pump and discharge piping from overpressure if the discharge valve is closed during pump operation.

D. Protect the pump and discharge piping from overpressure due to thermal expansion of pump contents when the pump is stopped with its suction valve closed.

QUESTION: 14

DELETED

QUESTION: 15

The starting current in a typical AC induction motor is usually much higher than the full-load running current because...

A. starting torque is lower than full-load running torque.

B. starting torque is higher than full-load running torque.

C. rotor speed during start is too low to generate significant counter electromotive force in the stator.

D. rotor current during start is too low to generate significant counter electromotive force in the stator.

QUESTION: 16

The rate of heat transfer between two liquids in a heat exchanger will <u>increase</u> if the: (Assume single-phase conditions and a constant specific heat for each liquid.)

A. inlet temperatures of both liquids decrease by 20°F.

B. inlet temperatures of both liquids increase by 20°F.

C. flow rate of the colder liquid decreases by 10 percent.

D. flow rate of the hotter liquid increases by 10 percent.

QUESTION: 17

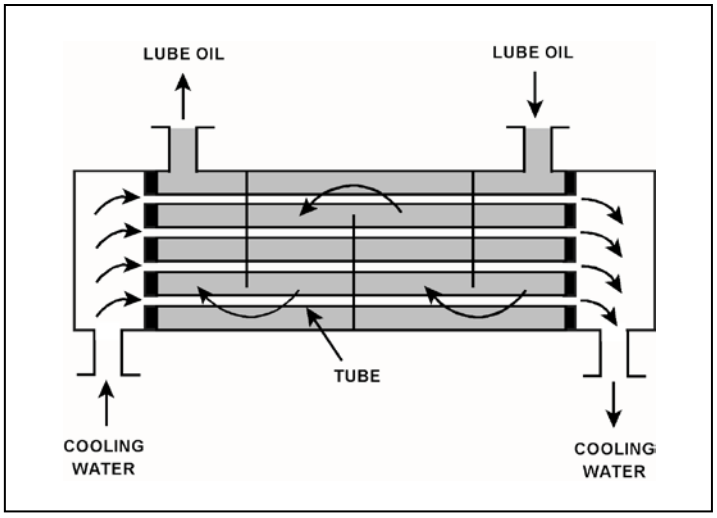
Refer to the drawing of a lube oil heat exchanger (see figure below).

The lube oil heat exchanger is in service with the following inlet temperatures:

Lube oil inlet temperature = 130°F
Cooling water inlet temperature = 70°F

Assume that cooling water mass flow rate is less than lube oil mass flow rate, and that both fluids have the same specific heat. Which one of the following pairs of heat exchanger outlet temperatures is <u>not</u> possible?

	Lube Oil Outlet Temp	Cooling Water Outlet Temp
A.	100°F	105°F
B.	105°F	105°F
C.	110°F	90°F
D.	115°F	90°F



QUESTION: 18

If water containing negatively charged ionic impurities passes through a mixed-bed ion exchanger, the negatively charged ionic impurities will be removed by the _____ exchange resin, with the corresponding release of _____ ions into the water.

A. anion; negative

B. anion; positive

C. cation; negative

D. cation; positive

QUESTION: 19

A nuclear power plant is operating at 70 percent steady-state power level when the temperature of the reactor coolant letdown passing through a boron-saturated mixed-bed ion exchanger decreases by 20°F.

As a result, the boron concentration in the effluent of the ion exchanger will _____ because the ability of the ion exchanger to remove boron atoms has _____.

A. decrease; increased

B. decrease; decreased

C. increase; increased

D. increase; decreased

QUESTION: 20

Refer to the drawing of a valve motor control circuit (see figure below).

Note: Limit switch (LS) contacts are shown open regardless of valve position, but relay contacts are shown open/closed according to the standard convention for control circuit drawings.

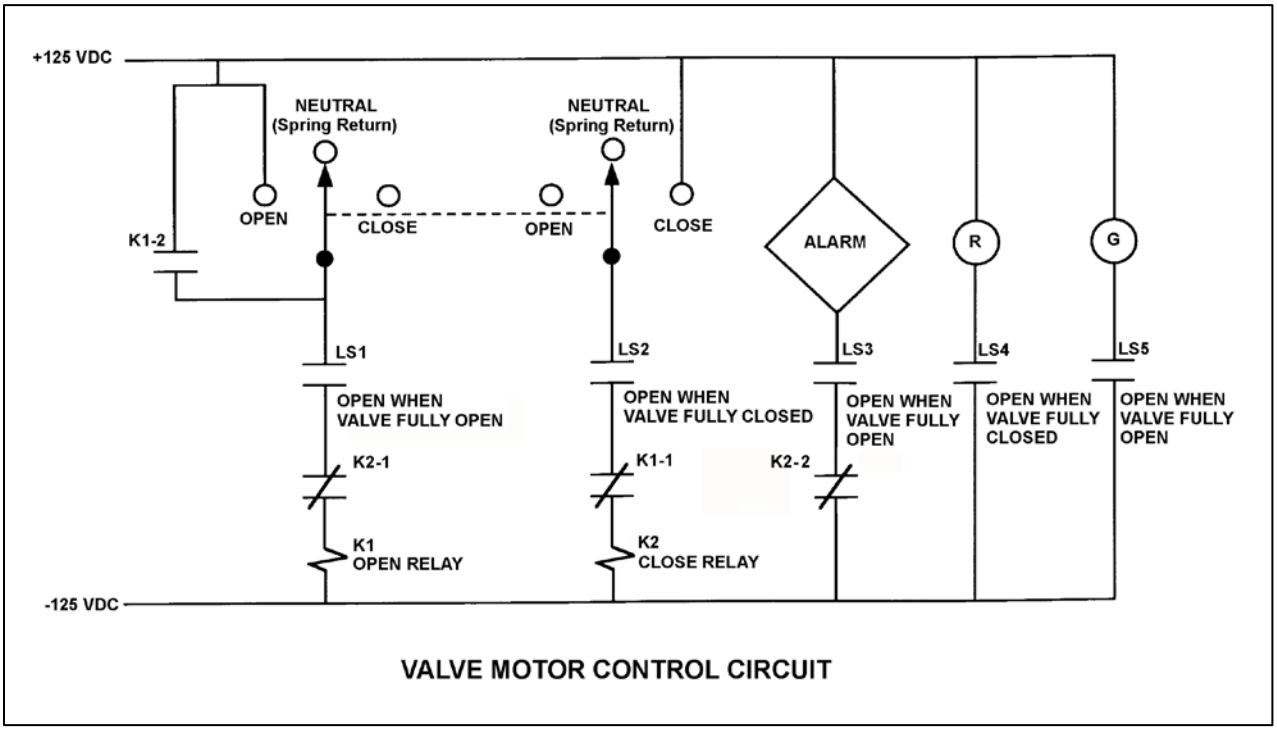
Which one of the following will actuate the alarm?

A. With the valve partially closed, the control switch is taken to the CLOSE position.

B. With the valve partially closed, the control switch is taken to the OPEN position.

C. With the valve fully open, the control switch is taken to the CLOSE position.

D. With the valve fully open, the control switch is taken to the OPEN position.



VALVE MOTOR CONTROL CIRCUIT

QUESTION: 21

Which one of the following is an unsafe practice if performed while working on or near energized electrical equipment?

A. Use insulated tools to prevent inadvertent contact with adjacent equipment.

B. Cover exposed energized circuits with insulating material to prevent inadvertent contact.

C. Attach a metal strap from your body to a nearby neutral ground to ensure that you are grounded.

D. Have a person standing by with the ability to remove you from the equipment in the event of an emergency.

QUESTION: 22

Given the following indications for an open 4,160 VAC breaker:

The local OPEN/CLOSED mechanical flag indicates OPEN.
A breaker overcurrent trip flag is actuated on one phase.
The line-side voltmeter indicates 4,160 VAC.
The load-side voltmeter indicates 0 VAC.

Assuming no operator actions were taken since the breaker opened, which one of the following could have caused the breaker to open?

A. A ground fault caused an automatic breaker trip.

B. A loss of control power caused an automatic breaker trip.

C. An operator opened the breaker locally.

D. An operator opened the breaker from a remote location.

QUESTION: 23

Which one of the following is the process that produces the majority of prompt neutrons in an operating nuclear power plant reactor?

A. A thermal neutron is absorbed by a fuel nucleus. Almost immediately, the nucleus fissions and emits one or more prompt neutrons.

B. A thermal neutron is absorbed by a fuel nucleus. Almost immediately, the fuel nucleus fissions and produces fission products. During the decay of the fission products, one or more prompt neutrons are emitted.

C. A fast neutron is absorbed by a fuel nucleus. Almost immediately, the nucleus fissions and emits one or more prompt neutrons.

D. A fast neutron is absorbed by a fuel nucleus. Almost immediately, the fuel nucleus fissions and produces fission products. During the decay of the fission products, one or more prompt neutrons are emitted.

QUESTION: 24

A nuclear reactor is shut down with the reactor vessel head removed for refueling. The core is covered by 23 feet of refueling water at 100EF with a boron concentration of 2,000 ppm. Source range count rate indicates 100 cps.

How will the source range count rate be affected if refueling water temperature increases to 120EF?

A. The count rate will increase, because the positive effect of increased core neutron leakage more than offsets the negative effect of a smaller K_{eff}.

B. The count rate will increase, because the positive effect of increased core neutron leakage adds to the positive effect of a greater K_{eff}.

C. The count rate will decrease, because the negative effect of decreased core neutron leakage more than offsets the positive effect of a greater K_{eff}.

D. The count rate will decrease, because the negative effect of decreased core neutron leakage adds to the negative effect of a smaller K_{eff}.

QUESTION: 25

Which one of the following describes a condition in which a reactor is prompt critical?

A. A very long reactor period makes reactor control very sluggish and unresponsive.

B. Fissions are occurring so rapidly that the effective delayed neutron fraction approaches zero.

C. Any increase in reactor power requires a reactivity addition equal to the fraction of prompt neutrons in the core.

D. The net positive reactivity in the core is greater than or equal to the magnitude of the effective delayed neutron fraction.

QUESTION: 26

Which one of the following 10 percent reactor power level changes produces the largest amount of negative reactivity from the fuel temperature coefficient? (Assume that each power level change produces the same increase/decrease in fuel temperature.)

A. 30 percent to 40 percent

B. 30 percent to 20 percent

C. 80 percent to 90 percent

D. 80 percent to 70 percent

QUESTION: 27

Given the following initial parameters:

Power coefficient	=	-0.020 %ΔK/K/percent
Differential boron worth	=	-0.010 %ΔK/K/ppm
Differential rod worth	=	-0.025 %ΔK/K/inch
Reactor coolant boron concentration	=	500 ppm

Which one of the following is the final reactor coolant boron concentration required to support decreasing reactor power from 100 percent to 30 percent by boration/dilution with 20 inches of inward control rod motion? (Ignore any change in fission product poison reactivity.)

A. 410 ppm

B. 425 ppm

C. 575 ppm

D. 590 ppm

QUESTION: 28

A reactor startup is in progress from a cold shutdown condition. During the reactor coolant heatup phase of the startup, differential control rod worth becomes _____ negative; and during the complete withdrawal of the initial bank of control rods, differential control rod worth becomes _____.

A. more; more negative initially and then less negative

B. more; less negative initially and then more negative

C. less; more negative during the entire withdrawal

D. less; less negative during the entire withdrawal

QUESTION: 29

After a control rod is fully inserted (from the fully withdrawn position), the effect on the axial flux shape is minimal. This is because...

A. the differential rod worth is constant along the length of the control rod.

B. the fully inserted control rod is an axially uniform poison.

C. a control rod only has reactivity worth if it is moving.

D. a variable poison distribution exists throughout the length of the control rod.

QUESTION: 30

A reactor was operating at 50 percent power for one week when power was ramped to 100 percent. Which one of the following describes the equilibrium xenon-135 concentration at 100 percent power?

A. Twice the 50 percent power concentration.

B. Less than twice the 50 percent power concentration.

C. More than twice the 50 percent power concentration.

D. Remains the same, because it is independent of power.

QUESTION: 31

Initially, a nuclear power plant was operating at 100 percent power with equilibrium xenon-135. Then, power was decreased to 75 percent over a one-hour period. The operator is currently adjusting control rod position as necessary to maintain average reactor coolant temperature constant.

What will the control rod position and directional trend be 30 hours after power reached 75 percent?

A. Above the initial 75 percent power position and inserting slowly.

B. Above the initial 75 percent power position and withdrawing slowly.

C. Below the initial 75 percent power position and inserting slowly.

D. Below the initial 75 percent power position and withdrawing slowly.

QUESTION: 32

Just prior to a refueling outage, the reactor coolant boron concentration at 100 percent power was 50 ppm. Burnable poisons were installed during the outage. Immediately following the outage, the boron concentration at 100 percent power was 1,000 ppm.

Which one of the following contributes to the need for a much higher 100 percent power reactor coolant boron concentration after the outage?

A. The negative reactivity from burnable poisons after the outage is greater than before the outage.

B. The negative reactivity from fission product poisons after the outage is smaller than before the outage.

C. The positive reactivity from the fuel in the core after the outage is smaller than before the outage.

D. The positive reactivity from a unit withdrawal of a typical control rod after the outage is greater than before the outage.

QUESTION: 33

A reactor startup is in progress. The reactor is slightly subcritical with a constant startup rate of 0.0 dpm. A short control rod insertion will cause the reactor startup rate indication to initially become negative, and then...

A. gradually become less negative and return to 0.0 dpm.

B. gradually become more negative until source neutrons become the only significant contributor to the neutron population, and then return to 0.0 dpm.

C. stabilize until source neutrons become the only significant contributor to the neutron population, and then return to 0.0 dpm.

D. stabilize at -1/3 dpm until fission neutrons are no longer a significant contributor to the neutron population, and then return to 0.0 dpm.

QUESTION: 34

Which one of the following indicates that a reactor has achieved criticality during a normal reactor startup?

A. Constant positive startup rate during rod withdrawal.

B. Increasing positive startup rate during rod withdrawal.

C. Constant positive startup rate with no rod motion.

D. Increasing positive startup rate with no rod motion.

QUESTION: 35

Initially, a reactor is stable at the point of adding heat (POAH) during a reactor startup with the average reactor coolant temperature at 550°F. Control rods are manually withdrawn a few inches to increase steam generator steaming rate.

When the reactor stabilizes, reactor power will be _____ the POAH, and average reactor coolant temperature will be _____ 550°F.

A. greater than; equal to

B. greater than; greater than

C. equal to; equal to

D. equal to; greater than

QUESTION: 36

A reactor was operating for several months at steady-state 100 percent power when a reactor trip occurred. Which one of the following lists the two factors most responsible for the value of the core neutron flux level one hour after the trip?

A. K_{eff} and the rate of source neutron production.

B. K_{eff} and the effective delayed neutron fraction.

C. The decay rates of the delayed neutron precursors and the rate of source neutron production.

D. The decay rates of the delayed neutron precursors and the effective delayed neutron fraction.

QUESTION: 37

Refer to the drawing of two water storage tanks with four differential pressure (D/P) level detectors (see figure below).

The tanks are identical and are being maintained at 17 psia and 70 percent water level (calibration conditions). They are located in a building that is currently at atmospheric pressure.

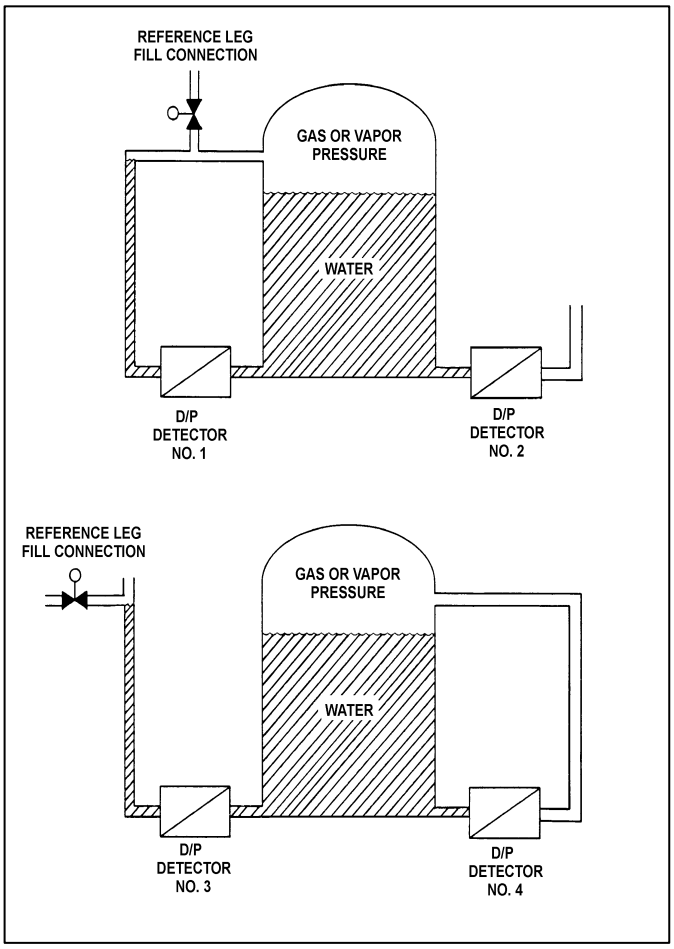
If the building ventilation system creates a vacuum in the building, which level detectors will provide the lowest level indications?

A. 1 and 3

B. 1 and 4

C. 2 and 3

D. 2 and 4



QUESTION: 38

A reactor is operating normally at 100 percent power. Reactor coolant enters the reactor vessel at a temperature of 556°F and a total flow rate of 320,000 gpm. The reactor coolant leaves the reactor vessel at 612°F.

What is the approximate flow rate of the reactor coolant leaving the reactor vessel?

A. 320,000 gpm

B. 330,000 to 339,000 gpm

C. 340,000 to 349,000 gpm

D. 350,000 to 359,000 gpm

QUESTION: 39

Given the following initial conditions for a spent fuel pool:

Spent fuel decay heat rate = 6.0 MW
Spent fuel pool water temperature = 90°F
Spent fuel pool water mass = 2.5×10^6 lbm
Spent fuel pool water specific heat = 1.0 Btu/lbm-°F

If a complete loss of spent fuel pool cooling occurs, approximately how long will it take for spent fuel pool water temperature to reach 212°F? (Assume the spent fuel pool remains in thermal equilibrium, and there is no heat removal from the spent fuel pool.)

A. 6 hours

B. 15 hours

C. 26 hours

D. 51 hours

QUESTION: 40

A pressurizer safety valve is leaking by, allowing dry saturated steam from the pressurizer to enter the discharge pipe, which remains at a constant pressure of 30 psig. Initial safety valve discharge pipe temperature is elevated but stable. Assume no heat loss from the safety valve discharge pipe.

Upon discovery of the leak, the reactor is shut down and a plant cooldown and depressurization are commenced. Throughout the cooldown and depressurization, dry saturated steam continues to leak through the pressurizer safety valve.

As pressurizer pressure decreases from 2,000 psig to 1,800 psig, the safety valve discharge pipe temperature will...

A. decrease, because the entropy of the safety valve discharge fluid will decrease as the pressurizer pressure decreases in this pressure range.

B. decrease, because the enthalpy of the safety valve discharge fluid will decrease as the pressurizer pressure decreases in this pressure range.

C. increase, because the safety valve discharge fluid will become more superheated as the pressurizer pressure decreases in this pressure range.

D. remain the same, because the safety valve discharge fluid will remain a saturated steam-water mixture at 30 psig in this pressure range.

QUESTION: 41

Feedwater heating increases overall nuclear power plant thermal efficiency because...

A. the average temperature at which heat is transferred in the steam generators is increased.

B. less steam flow passes through the turbine, thereby increasing turbine efficiency.

C. increased feedwater temperature lowers the temperature at which heat is rejected in the condenser.

D. less power is required by the feedwater pumps to pump the warmer feedwater.

QUESTION: 42

A heat exchanger has the following initial cooling water inlet temperature and differential pressure (ΔP) parameters:

Inlet Temperature = 70°F
Heat Exchanger ΔP = 10 psi

Six hours later, the current heat exchanger cooling water parameters are:

Inlet Temperature = 85°F
Heat Exchanger ΔP = 10 psi

In comparison to the initial cooling water mass flow rate, the current mass flow rate is...

A. lower, because the density of the cooling water has decreased.

B. higher, because the velocity of the cooling water has increased.

C. the same, because the changes in cooling water velocity and density offset.

D. the same, because the heat exchanger cooling water ΔP is the same.

QUESTION: 43

An operating centrifugal water pump has a 26-inch diameter suction nozzle and a 24-inch diameter discharge nozzle. For this pump, the discharge water velocity is _____ the suction water velocity; and the discharge water volumetric flow rate is _____ the suction water volumetric flow rate. (Assume water is incompressible and the suction and discharge water temperatures are the same.)

A. greater than; greater than

B. greater than; equal to

C. less than; greater than

D. less than; equal to

QUESTION: 44

A nuclear power plant is operating at 60 percent power. Which one of the following is the primary method of heat transfer from the outer surface of the steam generator tubes to the bulk feedwater?

A. Radiolysis

B. Radiation

C. Conduction

D. Convection

QUESTION: 45

Subcooled water enters the bottom of an operating reactor core. As the water flows upward past the fuel assemblies, steam bubbles form on the surface of a few fuel rods and are swept away.

If the coolant at the surface of the affected fuel rods had remained subcooled, average fuel temperature in the affected fuel rods would have been _____ because single-phase convection is a _____ efficient method of heat transfer than boiling.

A. higher; more

B. higher; less

C. lower; more

D. lower; less

QUESTION: 46

A nuclear power plant is operating with the following initial steady-state conditions:

- Reactor power is 45 percent in the middle of a fuel cycle.
- Axial and radial power distributions are peaked in the center of the core.

Which one of the following will decrease the steady-state departure from nucleate boiling ratio?

A. A reactor trip occurs and one control rod remains fully withdrawn from the core.

B. A pressurizer malfunction increases reactor coolant system pressure by 20 psig with no control rod motion.

C. The operator decreases reactor coolant boron concentration by 5 ppm with no control rod motion.

D. Core xenon-135 builds up in proportion to the axial and radial power distribution with automatic rod control.

QUESTION: 47

Assume that a 30°F subcooling margin is maintained in the reactor coolant system (RCS) hot legs during each of the following cooldown operations for a shutdown reactor. Which one of the following will maintain the greatest subcooling margin in the reactor vessel head?

A. Performing a 25°F/hr RCS cooldown with natural circulation using one steam generator.

B. Performing a 25°F/hr RCS cooldown with all reactor coolant pumps running.

C. Performing a 100°F/hr RCS cooldown with natural circulation using all steam generators.

D. Performing a 100°F/hr RCS cooldown with one reactor coolant pump running.

QUESTION: 48

A reactor had been operating at 100 percent power for 3 months when a loss of offsite power occurred, causing a reactor trip and a loss of forced reactor coolant flow. If forced reactor coolant flow is not restored, which one of the following describes the relationship between reactor coolant hot leg and cold leg temperatures one hour after the reactor trip?

A. Hot leg temperature will be greater than cold leg temperature because natural circulation cooling flow occurs in the same direction as forced reactor coolant flow.

B. Hot leg temperature will be less than cold leg temperature because natural circulation cooling flow occurs in the opposite direction as forced reactor coolant flow.

C. Hot leg temperature will be approximately the same as cold leg temperature because only the density of the reactor coolant changes during natural circulation cooling.

D. Hot leg temperature will be approximately the same as cold leg temperature because the reactor does not produce a significant amount of heat one hour after a reactor trip.

QUESTION: 49

A reactor is operating at 3,300 MW thermal power. The core linear power density limit is 12.4 kW/ft.

Given:

- The reactor core contains 198 fuel assemblies.
- Each fuel assembly contains 262 fuel rods, each with an active length of 12 feet.
- The highest total peaking factors measured in the core are as follows:

  Location A: 2.5
  Location B: 2.4
  Location C: 2.3
  Location D: 2.2

Which one of the following describes the operating conditions in the core relative to the linear power density limit?

A. All locations in the core are operating below the linear power density limit.

B. Location A has exceeded the linear power density limit while locations B, C, and D are operating below the limit.

C. Locations A and B have exceeded the linear power density limit while locations C and D are operating below the limit.

D. Locations A, B, and C have exceeded the linear power density limit while location D is operating below the limit.

QUESTION: 50

Two identical reactors have been in operation for the last 10 years. Reactor A has experienced 30 heatup/cooldown cycles and has an average capacity factor of 60 percent. Reactor B has experienced 40 heatup/cooldown cycles and has an average capacity factor of 50 percent.

Which reactor will have the higher reactor vessel nil-ductility transition temperature, and why?

A. Reactor A, due to the fewer number of heatup/cooldown cycles.

B. Reactor A, due to the higher average capacity factor.

C. Reactor B, due to the greater number of heatup/cooldown cycles.

D. Reactor B, due to the lower average capacity factor.

***** FINAL ANSWER KEY *****

MARCH 2017 GENERIC FUNDAMENTALS EXAMINATION
PRESSURIZED WATER REACTOR - ANSWER KEY

FORM A	FORM B	ANS.	FORM A	FORM B	ANS.
1	15	A	26	40	A
2	16	C	27	41	D
3	17	D	28	42	A
4	18	D	29	43	B
5	19	D	30	44	B
6	20	C	31	45	C
7	21	C	32	46	B
8	22	D	33	47	A
9	23	D	34	48	C
10	24	B	35	49	B
11	25	C	36	50	A
12	26	C	37	1	B
13	27	C	38	2	D
14	28	Deleted	39	3	B
15	29	C	40	4	D
16	30	D	41	5	A
17	31	C	42	6	A
18	32	A	43	7	B
19	33	A	44	8	D
20	34	B	45	9	B
21	35	C	46	10	C
22	36	A	47	11	B
23	37	A	48	12	A
24	38	B	49	13	C
25	39	D	50	14	B