

**UNITED STATES NUCLEAR REGULATORY COMMISSION
BOILING WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
JUNE 2005--FORM A**

Please Print

Name: _____

Facility: _____

Docket No.: _____

Start Time: _____ Stop Time: _____

INSTRUCTIONS TO APPLICANT

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% is required to pass this portion of the NRC operator licensing written examination. All examination papers will be collected 3.0 hours after the examination starts. This examination applies to a typical boiling water reactor (BWR) 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.

Applicant's Signature

**RULES AND GUIDELINES FOR THE NRC
GENERIC FUNDAMENTALS EXAMINATION**

During the administration of this examination the following rules apply:

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

1. Print your name in the blank provided on the cover sheet of the examination.
2. Fill in the name of your facility.
3. Fill in your individual docket number.
4. Fill in your start and stop times at the appropriate time.
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 of 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.
11. Turn in your examination materials, answer sheet on top, followed by the examination booklet, then examination aids - steam table booklets, handouts, and scrap paper used during the examination.
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 HANDOUT SHEET

EQUATIONS

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

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

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

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

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

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

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

$$\text{SUR} = 26.06/\tau$$

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

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

$$\ell^* = 1 \times 10^{-4} \text{ sec}$$

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

$$\text{DRW} \propto \phi_{\text{tip}}^2 / \phi_{\text{avg}}^2$$

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

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

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

$$\text{CR}_{\text{S/D}} = S/(1 - K_{\text{eff}})$$

$$\text{CR}_1(1 - K_{\text{eff}1}) = \text{CR}_2(1 - K_{\text{eff}2})$$

$$1/M = \text{CR}_1/\text{CR}_x$$

$$A = \pi r^2$$

$$F = PA$$

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

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

$$E = IR$$

$$\text{Eff.} = \text{Net Work Out/Energy In}$$

$$v(P_2 - P_1) + \frac{(\bar{v}_2^2 - \bar{v}_1^2)}{2g_c} + \frac{g(z_2 - z_1)}{g_c} = 0$$

$$g_c = 32.2 \text{ lbm-ft/lbf-sec}^2$$

CONVERSIONS

$$1 \text{ Mw} = 3.41 \times 10^6 \text{ Btu/hr}$$

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

$$1 \text{ Btu} = 778 \text{ ft-lbf}$$

$$^\circ\text{C} = (5/9)(^\circ\text{F} - 32)$$

$$^\circ\text{F} = (9/5)(^\circ\text{C}) + 32$$

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

$$1 \text{ kg} = 2.21 \text{ lbm}$$

$$1 \text{ gal}_{\text{water}} = 8.35 \text{ lbm}$$

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

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QUESTION: 1

Given the following pressure specifications for a main steam safety valve (MSSV):

Setpoint pressure (MSSV will start to open): 1,200 psia
Maximum pressure (MSSV will be fully open): 1,242 psia
Reseat pressure (MSSV will be fully closed): 1,152 psia

Which one of the following is the percent accumulation for this MSSV?

- A. 2.5%
- B. 3.0%
- C. 3.5%
- D. 4.0%

QUESTION: 2

When transferring a valve controller from the manual mode to the automatic mode, the automatic valve controller output signal should be _____ the manual valve controller output signal at the time of transfer.

- A. equal to
- B. greater than
- C. less than
- D. increasing with

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QUESTION: 3

An operator attempts to close a fully-open upright manual gate valve to isolate a pump in a cooling water system that has been cooled down for maintenance. However, the operator is unable to rotate the handwheel in the close direction.

Which one of the following could cause this condition?

- A. A hydraulic lock has developed under the valve disk.
- B. A hydraulic lock has developed in the valve bonnet between the valve disk and the packing gland.
- C. The two halves of the valve disk have expanded and are jammed against the valve seats.
- D. The valve disk has jammed against its backseat by the difference in the thermal contraction of the stem and the bonnet.

QUESTION: 4

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.

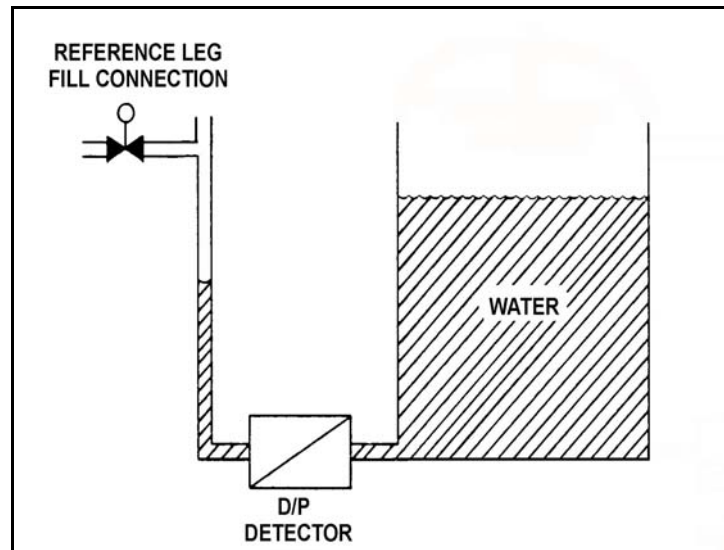
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QUESTION: 5

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. read less than the actual level.
- D. read greater than the actual level.



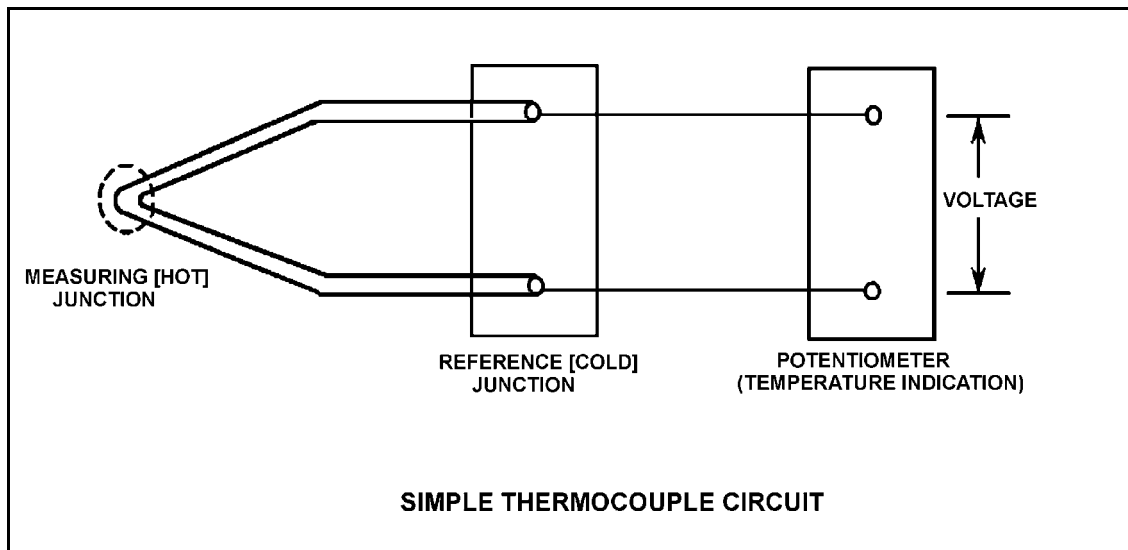
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QUESTION: 6

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.



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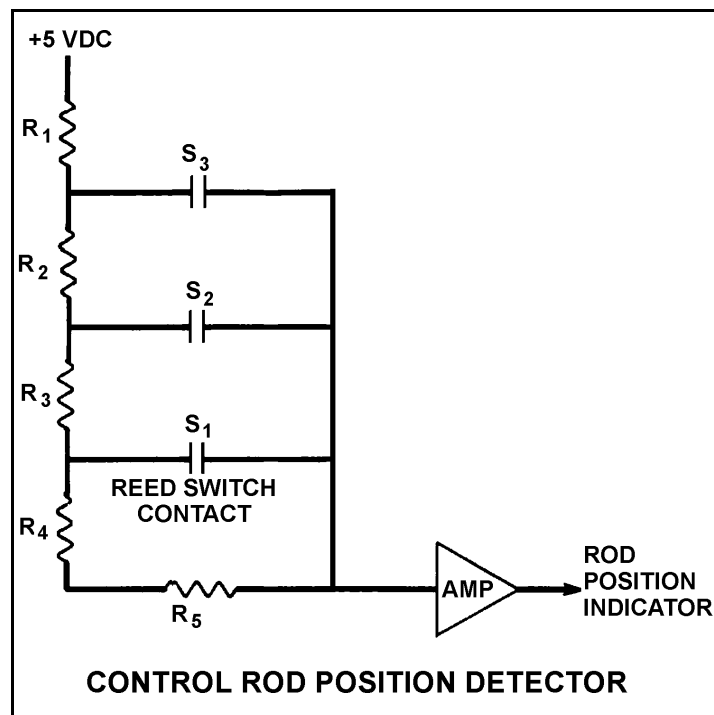
QUESTION: 7

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



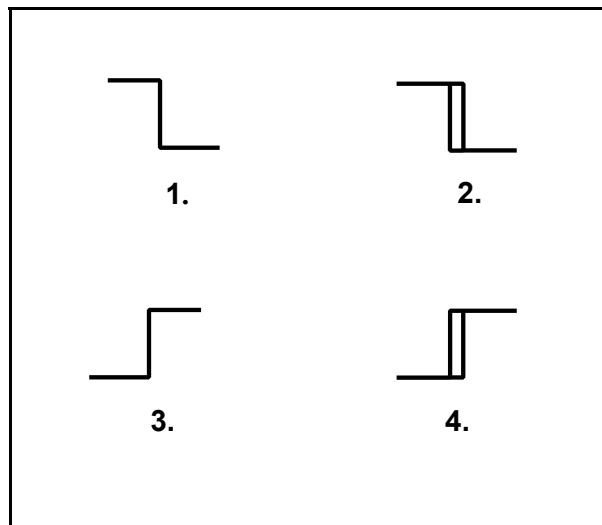
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QUESTION: 8

The water level in a drain collection tank is being controlled by an automatic bistable level controller. When tank level increases to 70%, the controller bistable turns on to fully open a tank drain valve. When tank level decreases to 60%, the controller bistable turns off to close the drain valve.

Which one of the following bistable symbols indicates the characteristics of the bistable used in the level controller?

- A. 1.
- B. 2.
- C. 3.
- D. 4.



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QUESTION: 9

A diesel generator (DG) is supplying an isolated electrical bus with the DG governor operating in the speed droop mode. Assuming the DG does not trip, if a large electrical bus load trips, bus frequency will initially...

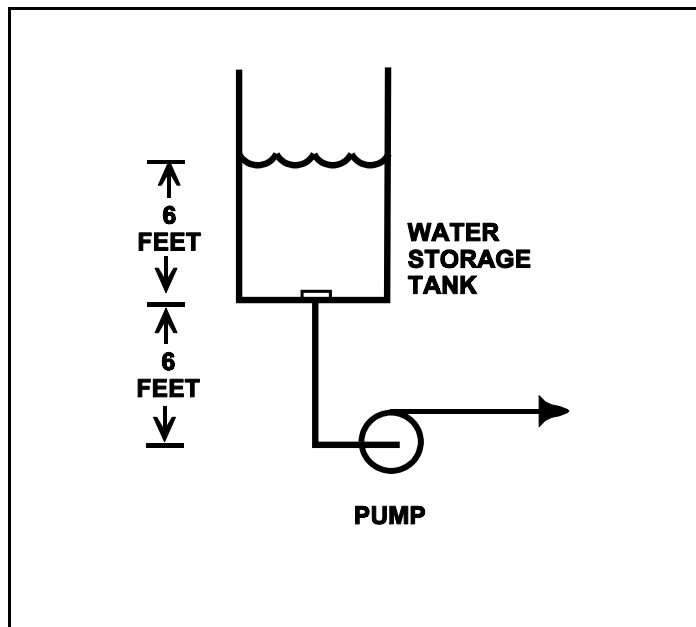
- A. increase, then decrease and stabilize below the initial value.
- B. increase, then decrease and stabilize above the initial value.
- C. decrease, then increase and stabilize below the initial value.
- D. decrease, then increase and stabilize above the initial value.

QUESTION: 10

Refer to the drawing below of a centrifugal pump taking suction from the bottom of an open storage tank containing water at 66°F. Pump and water level elevations are indicated in the figure. Assume standard atmospheric pressure.

Assuming that pump suction fluid velocity head loss is negligible, what is the approximate value of net positive suction head available to the pump.

- A. 6 feet
- B. 12 feet
- C. 39 feet
- D. 45 feet



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QUESTION: 11

Some large centrifugal pumps are interlocked so that the pump will not start unless its discharge valve is at least 90% fully closed. This interlock is provided to minimize...

- A. pump discharge pressure.
- B. heating of the pumped fluid.
- C. the potential for cavitation at the pump suction.
- D. the duration of the pump motor starting current.

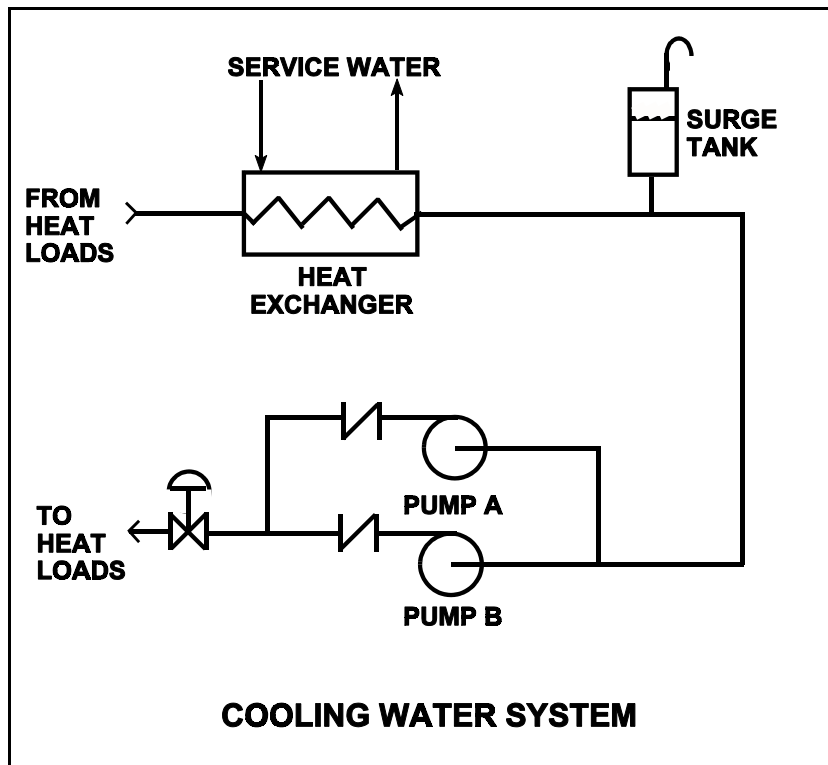
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QUESTION: 12

Refer to the drawing of a cooling water system in which only centrifugal pump A is operating and the common pump discharge valve is currently 90% open (see figure below).

An abnormal total heat load on the cooling water system is causing pump A to approach operation at runout conditions. Which one of the following will cause pump A to operate farther away from runout conditions? (Assume that satisfactory net positive suction head is available at all times.)

- A. Starting pump B.
- B. Positioning the discharge valve to 100% open.
- C. Raising the water level in the surge tank by 2 feet.
- D. Decreasing heat exchanger service water flow rate by 10%.



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QUESTION: 13

Which one of the following components of a centrifugal pump has the specific primary function of increasing the kinetic energy of a fluid?

- A. Volute
- B. Impeller
- C. Diffuser
- D. Discharge nozzle

QUESTION: 14

A main generator that is connected to an infinite power grid has the following initial indications:

100 MWe
0 MVAR
2,900 amps
20,000 Vac

If main generator excitation is reduced slightly, amps will _____ and MWe will _____.

- A. increase; decrease
- B. decrease; decrease
- C. increase; remain the same
- D. decrease; remain the same

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QUESTION: 15

A main generator is supplying 300 MVAR to the power grid with a 0.85 power factor. What is the approximate MW load on the main generator?

- A. 186 MW
- B. 353 MW
- C. 484 MW
- D. 569 MW

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QUESTION: 16

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

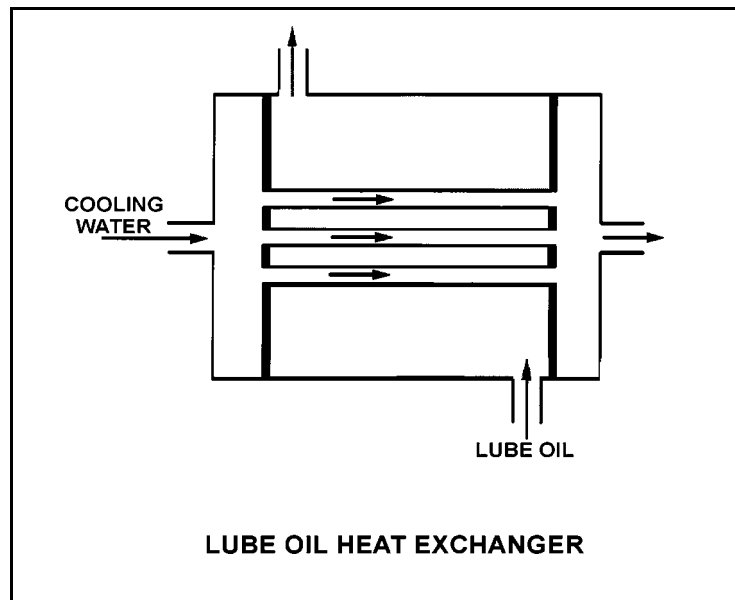
The lube oil heat exchanger is in service with the following inlet temperatures:

Lube oil inlet temperature: 120°F

Cooling water inlet temperature: 60°F

Assuming cooling water flow rate is greater than lube oil flow rate, which one of the following sets of heat exchanger outlet temperatures is possible? (Neglect any difference between fluid specific heats.)

	<u>Lube Oil Outlet Temp</u>	<u>Cooling Water Outlet Temp</u>
A.	90°F	100°F
B.	90°F	85°F
C.	95°F	100°F
D.	95°F	85°F



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QUESTION: 17

Which one of the following is the approximate condenser vacuum when condenser pressure is 7 inches Hg absolute?

- A. 0 inches Hg vacuum
- B. 7 inches Hg vacuum
- C. 23 inches Hg vacuum
- D. 30 inches Hg vacuum

QUESTION: 18

A nuclear reactor is shut down at 400 psia during a maintenance outage when all forced core coolant flow is lost. Which one of the following will enhance natural circulation within the reactor vessel?

- A. Increase reactor vessel pressure to 500 psia.
- B. Increase reactor vessel water level above the steam separators.
- C. Decrease reactor vessel pressure to 300 psia.
- D. Decrease reactor vessel water level to just above the top of the core.

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QUESTION: 19

High differential pressure in a demineralizer could be caused by all of the following except...

- A. resin exhaustion.
- B. resin overheating.
- C. crud buildup.
- D. high flow rate.

QUESTION: 20

The temperature of the water passing through a demineralizer must be controlled because excessively hot water will...

- A. increase the ion exchange rate for hydronium ions, thereby changing effluent pH.
- B. degrade the corrosion inhibitor applied to the inner wall of the demineralizer.
- C. result in excessive demineralizer retention element thermal expansion, thereby releasing resin.
- D. reduce the affinity of the demineralizer resin for ion exchange.

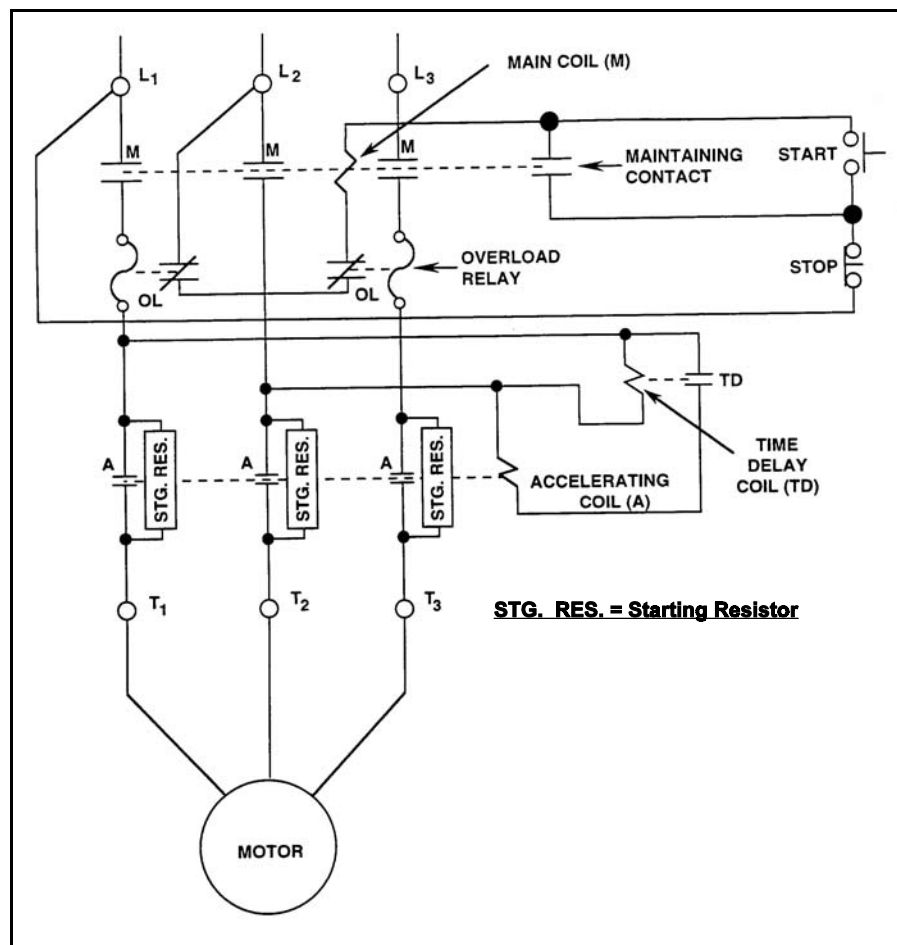
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QUESTION: 21

Refer to the drawing of a motor and its control circuit (see figure below). (Note: The relay contacts shown follow the standard convention for control circuit drawings.)

The motor has been operating for several hours when it is decided to stop the motor. What is the status of the starting resistors before and after the motor STOP button is depressed?

- A. Initially inserted in the motor circuit; bypassed immediately after the STOP button is depressed.
- B. Initially inserted in the motor circuit; bypassed following a preset time delay after the STOP button is depressed.
- C. Initially bypassed; bypass is removed immediately after the STOP button is depressed.
- D. Initially bypassed; bypass is removed following a preset time delay after the STOP button is depressed.



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QUESTION: 22

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

- A. Using two hands for balance and to prevent dropping tools onto energized equipment.
- B. Standing on insulating rubber material to increase the electrical resistance of the body to ground.
- C. Having a person stand by to deenergize the equipment in the event of an emergency.
- D. Covering exposed energized circuits with insulating material to prevent inadvertent contact.

QUESTION: 23

Which one of the following will decrease the ability of the coolant to moderate neutrons in a nuclear reactor operating at saturated conditions?

- A. Decreasing moderator temperature.
- B. Decreasing feedwater inlet temperature.
- C. Decreasing reactor vessel pressure.
- D. Increasing reactor recirculation system flow rate.

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QUESTION: 24

Which one of the following is a benefit of installing excess reactivity (K_{excess}) in a nuclear reactor core?

- A. Ensures that sufficient control rod negative reactivity is available to shut down the reactor.
- B. Ensures that the reactor can be made critical during a peak xenon condition after a reactor scram.
- C. Ensures that positive reactivity additions result in controllable reactor power responses.
- D. Ensures that the U-235 fuel enrichment is the same at the beginning and the end of a fuel cycle..

QUESTION: 25

The following data is given for the fuel in an operating nuclear reactor core:

<u>Nuclide</u>	<u>Delayed Neutron Fraction</u>	<u>Fraction of Total Fuel Composition</u>	<u>Fraction of Total Fission Rate</u>
U-235	0.0065	0.03	0.73
U-238	0.0148	0.96	0.07
Pu-239	0.0021	0.01	0.20

What is the approximate core average delayed neutron fraction for this reactor?

- A. 0.0052
- B. 0.0054
- C. 0.0062
- D. 0.0068

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QUESTION: 26

Which one of the following describes how and why the void coefficient of reactivity changes as void fraction increases during a control rod withdrawal at power?

- A. Becomes less negative due to the increased absorption of neutrons by U-238.
- B. Becomes less negative due to a greater fraction of neutrons lost to leakage from the core.
- C. Becomes more negative due to the reduction in the fast fission contribution to the neutron population.
- D. Becomes more negative due to a greater fractional loss of moderator for a 1% void increase at higher void fractions.

QUESTION: 27

Which one of the following lists the moderator temperature coefficient (MTC), fuel temperature coefficient (FTC), and void coefficient (VC) in typical order of magnitude from most negative to least negative for a nuclear reactor at 50% power in the middle of a fuel cycle?

- A. FTC, VC, MTC
- B. FTC, MTC, VC
- C. VC, FTC, MTC
- D. VC, MTC, FTC

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QUESTION: 28

A group of control rods, initially at position 06 are withdrawn three notches. After withdrawal, this group of rods is classified as _____ rods; and the blade tips for this group of rods are positioned 36 inches from the _____ of the reactor core.

- A. deep; top
- B. deep; bottom
- C. shallow; top
- D. shallow; bottom

QUESTION: 29

A nuclear reactor is operating at 50% power at the beginning of a fuel cycle. Assuming the reactor does not scram, which one of the following compares the effects of dropping a deep control rod out of the core to the effects of dropping the same control rod if it is shallow?

- A. Dropping a deep control rod causes a greater change in shutdown margin.
- B. Dropping a deep control rod causes a smaller change in shutdown margin.
- C. Dropping a deep control rod causes a greater change in axial power distribution.
- D. Dropping a deep control rod causes a greater change in radial power distribution.

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QUESTION: 30

A reactor scram occurred from steady state 100% power and a reactor startup is currently in progress. Which one of the following sets of initial startup conditions will require the smallest amount of control rod withdrawal to achieve criticality? (BOC = beginning of fuel cycle; EOC = end of fuel cycle.)

	<u>CORE AGE</u>	<u>TIME SINCE REACTOR SCRAM</u>
A.	BOC	12 hours
B.	BOC	40 hours
C.	EOC	12 hours
D.	EOC	40 hours

QUESTION: 31

A nuclear reactor has been operating at full power for 10 weeks when a scram occurs. The reactor is made critical 24 hours later, and power level is maintained low in the intermediate range.

To maintain a constant power level for the next several hours, control rods must be...

- A. inserted, because xenon burnout will cause increased neutron flux peaking near the periphery of the core.
- B. maintained at the present height as xenon establishes its equilibrium value for this power level.
- C. inserted, because xenon will approximately follow its normal decay curve.
- D. withdrawn, because xenon concentration is increasing toward equilibrium.

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QUESTION: 32

Gadolinium (Gd-155 and -157) is used instead of boron (B-10) as the _____ material; when compared to gadolinium, boron has a much _____ cross section for absorbing thermal neutrons.

- A. control rod; larger
- B. burnable poison; larger
- C. control rod; smaller
- D. burnable poison; smaller

QUESTION: 33

A nuclear reactor startup is in progress and criticality has just been achieved. After recording critical rod height, the operator withdraws control rods for 20 seconds to establish a positive 30-second reactor period. One minute later (prior to the point of adding heat) the operator inserts the same control rods for 25 seconds. (Assume the control rod withdrawal and insertion rates are the same.)

During the rod insertion, the reactor period will become...

- A. negative during the entire period of control rod insertion.
- B. negative shortly after the control rods pass through the critical rod height.
- C. negative just as the control rods pass through the critical rod height.
- D. negative shortly before the control rods pass through the critical rod height.

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QUESTION: 34

During a nuclear reactor startup, reactor pressure is increased from 5 psig to 50 psig in a 2-hour period. What was the average heat-up rate?

- A. 35°F/hr
- B. 60°F/hr
- C. 70°F/hr
- D. 120°F/hr

QUESTION: 35

A nuclear power plant is operating at 80% of rated power near the end of a fuel cycle. Which one of the following lists the typical method(s) used to add positive reactivity during a normal power increase to 100%?

- A. Withdrawal of deep control rods and increasing recirculation flow rate
- B. Withdrawal of deep control rods only
- C. Withdrawal of shallow control rods and increasing recirculation flow rate
- D. Withdrawal of shallow control rods only

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QUESTION: 36

A nuclear power plant is operating normally at 50% of rated power when a main steamline break occurs that continuously releases 5% of rated steam flow. Assume no operator or protective actions occur, automatic pressure control returns reactor pressure to its initial value, and feedwater injection temperature remains the same.

How will turbine power respond to the main steamline break?

- A. Decrease and stabilize at a lower power level.
- B. Increase and stabilize at a higher power level.
- C. Initially decrease, then increase and stabilize at the previous power level.
- D. Initially increase, then decrease and stabilize at the previous power level.

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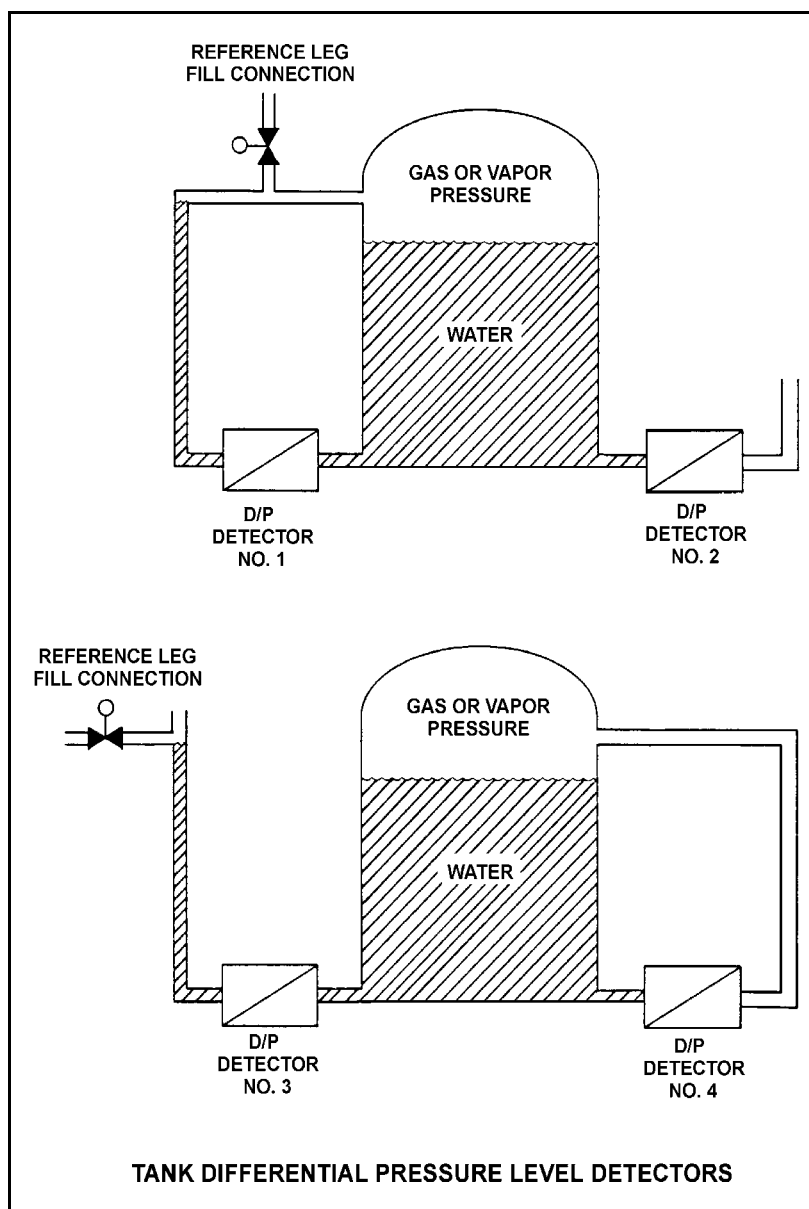
QUESTION: 37

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

The tanks are identical and they are presently at 2 psig overpressure, 60°F, and the same constant water level. They are located within a sealed containment structure that is being maintained at atmospheric pressure. All level detectors have been calibrated and are producing the same level indication. A ventilation malfunction causes containment structure pressure to decrease to 12 psia.

Which level detectors will produce the lowest level indication?

- A. 1 and 2
- B. 3 and 4
- C. 1 and 4
- D. 2 and 3



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QUESTION: 38

Saturated steam undergoes an ideal expansion process in an ideal turbine from 1,000 psia to 28 inches Hg vacuum. Approximately how much specific work is being performed by the turbine?

- A. 1,189 Btu/lbm
- B. 775 Btu/lbm
- C. 414 Btu/lbm
- D. 388 Btu/lbm

QUESTION: 39

A nuclear power plant is operating normally at 80% power. Which one of the following will result in the most rapid initial loss of condenser vacuum?

- A. All feed and condensate pumps are stopped.
- B. All condenser cooling water flow is stopped.
- C. All air ejectors are isolated from the main condenser.
- D. All condenser hotwell makeup water flow is stopped.

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QUESTION: 40

A nuclear power plant is operating at 80% of rated power with 10°F of condensate subcooling. Which one of the following initially will increase plant thermodynamic efficiency? (Assume main condenser vacuum does not change unless otherwise stated.)

- A. Isolating heating steam to a feedwater heater
- B. Decreasing circulating water flow rate
- C. Decreasing circulating water temperature
- D. Decreasing main condenser vacuum (increasing pressure)

QUESTION: 41

Increasing the flow rate from a centrifugal pump by throttling open the discharge valve will cause pump head to...

- A. increase and stabilize at a higher value.
- B. decrease and stabilize at a lower value.
- C. remain constant because pump head is a design parameter.
- D. increase, then decrease following the pump's efficiency curve.

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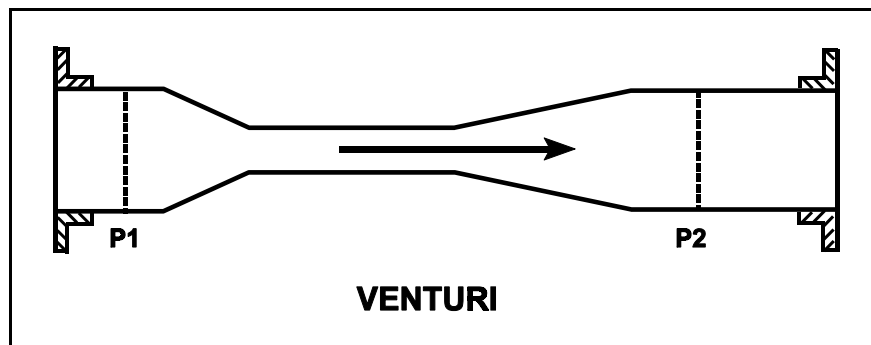
QUESTION: 42

Refer to the drawing of a venturi in a main steamline (see figure below). The venturi inlet and outlet pipe diameters are equal.

A main steamline break downstream of the venturi causes the main steam mass flow rate through the venturi to increase. Soon, the steam reaches sonic velocity in the throat of the venturi.

How will the main steam mass flow rate through the venturi be affected as the steam pressure downstream of the venturi continues to decrease?

- A. It will continue to increase at a rate that is dependent on the steam velocity in the throat of the venturi.
- B. It will continue to increase at a rate that is dependent on the differential pressure ($P1 - P2$) across the venturi.
- C. It will not continue to increase because the steam velocity cannot increase above sonic velocity in the throat of the venturi.
- D. It will not continue to increase because the differential pressure ($P1 - P2$) across the venturi cannot increase further once the steam reaches sonic velocity in the throat of the venturi.



**USNRC GENERIC FUNDAMENTALS EXAMINATION
JUNE 2005 BWR--FORM A**

QUESTION: 43

Which one of the following pairs of fluids undergoing heat transfer in typical cross-flow design heat exchangers will yield the greatest heat exchanger overall heat transfer coefficient? (Assume comparable heat exchanger sizes and fluid flow rates.)

- A. Oil to water in a lube oil cooler
- B. Steam to water in a feedwater heater
- C. Water to air in a ventilation heating unit
- D. Water to water in a cooling water heat exchanger

QUESTION: 44

How does the convective heat transfer coefficient vary from the bottom to the top of a fuel rod if subcooled reactor coolant enters the coolant channel and exits as superheated steam?

- A. Increases continuously.
- B. Increases, then decreases.
- C. Decreases continuously.
- D. Decreases, then increases.

**USNRC GENERIC FUNDAMENTALS EXAMINATION
JUNE 2005 BWR--FORM A**

QUESTION: 45

If ΔT is the temperature difference between the fuel rod clad surface and the coolant, which one of the following describes the heat transfer from a fuel rod experiencing departure from nucleate boiling?

- A. Steam bubbles begin to blanket the fuel rod clad, causing a rapid increase in the ΔT for a given heat flux.
- B. Steam bubbles completely blanket the fuel rod clad, causing a rapid decrease in the ΔT for a given heat flux.
- C. Steam bubbles begin to form on the fuel rod clad, causing a rapid decrease in the heat flux from the fuel rod for a given ΔT .
- D. Steam bubbles completely blanket the fuel rod clad, causing a rapid increase in the heat flux from the fuel rod for a given ΔT .

QUESTION: 46

A nuclear reactor is operating at steady-state 70% power. Recirculation flow rate is increased by 5%.

Which one of the following statements describes the initial response of the boiling boundary within the core?

- A. It physically moves upward, because each pound mass of coolant must travel farther through a fuel bundle before vaporizing.
- B. It physically moves upward, because each pound mass of coolant enters the core with a larger subcooled margin.
- C. It physically moves downward, because each pound mass of coolant will vaporize sooner as it travels through a fuel bundle.
- D. It physically moves downward, because each pound mass of coolant enters the core with a smaller subcooled margin.

**USNRC GENERIC FUNDAMENTALS EXAMINATION
JUNE 2005 BWR--FORM A**

QUESTION: 47

A nuclear reactor is operating at its licensed limit of 2,200 MWt. The linear heat generation rate (LHGR) limit is 13.0 kW/ft.

Given:

- The reactor core contains 560 fuel bundles.
- Each bundle contains 62 fuel rods, each with an active length of 12.5 feet
- The highest total peaking factors are at the following core locations:

Location A: 2.9

Location B: 2.7

Location C: 2.5

Location D: 2.3

Which one of the following describes the operating condition of the core relative to the LHGR limit?

- A. All locations in the core are operating below the LHGR limit.
- B. Only location A has exceeded the LHGR limit while the remainder of the core is operating below the limit.
- C. Locations A and B have exceeded the LHGR limit while the remainder of the core is operating below the limit.
- D. Locations A, B, and C have exceeded the LHGR limit while the remainder of the core is operating below the limit.

**USNRC GENERIC FUNDAMENTALS EXAMINATION
JUNE 2005 BWR--FORM A**

QUESTION: 48

For what operational condition does the flow biasing correction factor (K_f) adjust the minimum critical power ratio?

- A. Operation at less than rated core flow.
- B. Operation at less than rated steam flow.
- C. Operation at greater than rated core flow.
- D. Operation at greater than rated steam flow.

QUESTION: 49

A step increase in reactor power results in a fuel cladding surface temperature increase from 550°F to 580°F at steady-state conditions. The fuel thermal time constant is 6 seconds.

Which one of the following is the approximate fuel cladding surface temperature 6 seconds after the power change?

- A. 571°F
- B. 569°F
- C. 565°F
- D. 561°F

**USNRC GENERIC FUNDAMENTALS EXAMINATION
JUNE 2005 BWR--FORM A**

QUESTION: 50

A nuclear reactor is shut down for refueling. During the shutdown, a reactor vessel metal specimen is removed from the reactor vessel for testing. The specimen was last tested six years ago. During the subsequent six years, the reactor has completed several 18-month fuel cycles with an average power level of 85%.

The test determines that the nil-ductility transition (NDT) temperature of the specimen has remained unchanged at 44°F since it was last tested. Which one of the following conclusions is warranted?

- A. The test results are credible, however, the reactor vessel is more susceptible to brittle fracture now than six years ago.
- B. The test results are credible, however, the reactor vessel is less susceptible to brittle fracture now than six years ago.
- C. The test results are questionable because the specimen NDT temperature should have increased since it was last tested.
- D. The test results are questionable because the specimen NDT temperature should have decreased since it was last tested.

*** FINAL ANSWER KEY ***

JUNE 2005 NRC GENERIC FUNDAMENTALS EXAMINATION
BOILING WATER REACTOR - ANSWER KEY

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