

**UNITED STATES NUCLEAR REGULATORY COMMISSION
BOILING WATER REACTOR GENERIC FUNDAMENTALS EXAMINATION
MARCH 2006--FORM A**

Please Print

Name: _____

Docket No.: _____

Facility: _____

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 your individual docket number.
3. Fill in the name of your facility.
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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$A = \pi r^2$$

$$F = PA$$

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

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

$$E = IR$$

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

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

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

CONVERSIONS

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

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

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

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

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

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

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

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

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

**USNRC GENERIC FUNDAMENTALS EXAMINATION
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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 8 gpm. The tank is protected by a relief valve and a safety valve; both valves discharge to the atmosphere. Each valve has an opening setpoint of 205 psig and a maximum rated discharge flow rate of 6 gpm. The PDP is inadvertently left running when tank pressure reaches 200 psig.

With the PDP still running, when conditions stabilize the relief valve will be _____ open; and the safety valve will be discharging approximately _____ to atmosphere.

- A. partially; 6 gpm
- B. partially; 2 gpm
- C. fully; 6 gpm
- D. fully; 2 gpm

QUESTION: 2

In a comparison of butterfly valves with ball valves, _____ valves are generally more leak tight in high pressure applications; and _____ valves generally exhibit the lower system pressure drop when fully open.

- A. ball; ball
- B. ball; butterfly
- C. butterfly; ball
- D. butterfly; butterfly

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QUESTION: 3

When comparing a 3-inch gate valve to a 3-inch globe valve in the same application in an operating cooling water system, if both valves are fully open, the globe valve produces the _____ head loss and the _____ flow rate.

- A. larger; larger
- B. larger; smaller
- C. smaller; larger
- D. smaller; smaller

QUESTION: 4

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% 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

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QUESTION: 5

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.

QUESTION: 6

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. increase to 120 psig.
- B. increase by a small, but indeterminate amount.
- C. decrease by a small, but indeterminate amount.
- D. decrease to 80 psig.

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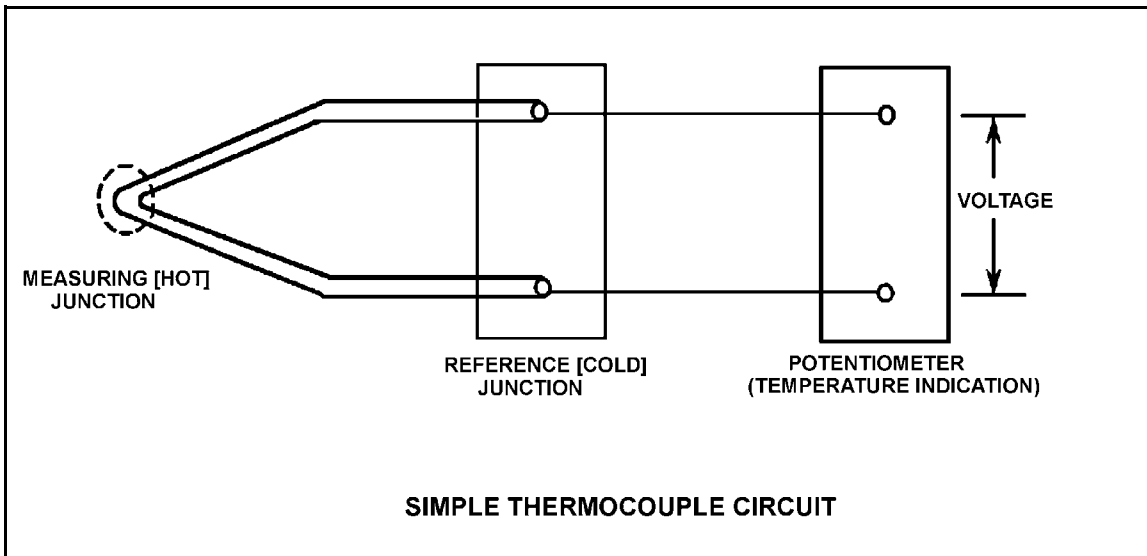
QUESTION: 7

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

Thermocouple temperature indication is currently 150°F. Reference junction temperature is currently 90°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)



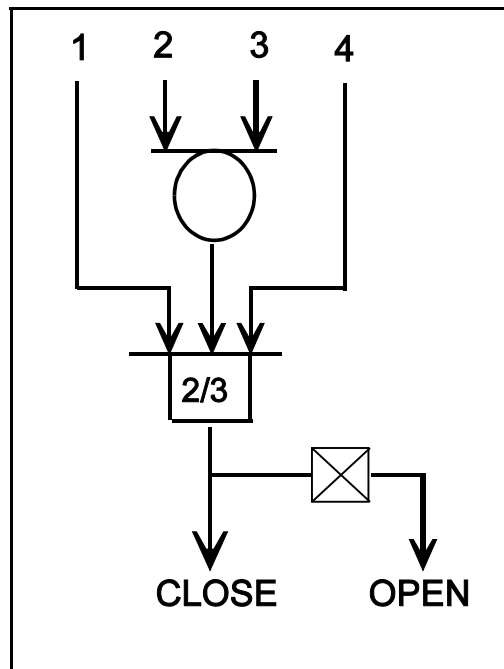
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QUESTION: 8

Refer to the following valve controller logic diagram (see figure below).

Which one of the following combinations of inputs will result in the valve receiving an open signal?

	INPUTS			
	1.	2.	3.	4.
A.	ON	OFF	OFF	ON
B.	OFF	ON	ON	OFF
C.	ON	OFF	ON	OFF
D.	OFF	ON	OFF	ON



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QUESTION: 9

An air-operated isolation valve requires 2,800 pounds-force (lbf) from its diaphragm actuator and 4 inches of stem travel for proper operation. The valve positioner can supply a nominal 117 psig of air pressure to the actuator.

What is the minimum surface area of the actuator diaphragm required for proper valve operation? (Answer options are rounded to the nearest square inch.)

- A. 24 square inches
- B. 48 square inches
- C. 94 square inches
- D. 138 square inches

QUESTION: 10

A motor-driven centrifugal cooling water pump is operating in an open system with its discharge valve fully open. If the discharge valve is repositioned to 50% open, the pump's available net positive suction head (NPSH) will _____ and the pump's required NPSH will _____.

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

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QUESTION: 11

A centrifugal fire water pump takes a suction on an open storage tank and discharges through a fire hose. Which one of the following will cause the pump to operate at shutoff head?

- A. A firefighter inadvertently severs the fire hose.
- B. The fire hose becomes completely crimped in a fire door.
- C. Fire water storage tank level drops below the pump suction tap.
- D. A firefighter adjusts the fire hose nozzle spray pattern from “deluge” to “fog.”

QUESTION: 12

Which one of the following describes a reason for designing centrifugal pumps with suction nozzles that are larger than their discharge nozzles?

- A. Increases total pump head by increasing the velocity head at the suction of the pump.
- B. Increases the differential pressure across the pump by decreasing pump head loss.
- C. Increases pump available net positive suction head by decreasing head loss at the pump suction.
- D. Increases pump capacity by decreasing turbulence at the suction of the pump.

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QUESTION: 13

A positive displacement pump should be started with its suction valve _____ and its discharge valve _____.

- A. closed; closed
- B. closed; open
- C. open; closed
- D. open; open

QUESTION: 14

A nuclear power plant startup is in progress. The main generator has just been connected to the power grid with the following generator indications:

10 MW
0 MVAR
288 amps
20,000 volts

The operator suspects that the main generator is operating under reverse power conditions and attempts to increase generator load (MW) normally. If the main generator is operating under reverse power conditions when the operator attempts to increase generator load, generator MW will initially _____; and generator amps will initially _____.

- A. decrease; decrease
- B. decrease; increase
- C. increase; decrease
- D. increase; increase

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QUESTION: 15

A 4160 Vac diesel generator (D/G) is loaded to 2850 KW with a 0.85 power factor. What is the approximate KVAR load on the D/G?

- A. 503 KVAR
- B. 1,766 KVAR
- C. 2,850 KVAR
- D. 3,353 KVAR

QUESTION: 16

Which one of the following will reduce the rate of heat transfer between two liquids in a heat exchanger? (Assume single-phase conditions and a constant specific heat for both liquids.)

- A. The inlet temperatures of both liquids are decreased by 20°F.
- B. The inlet temperatures of both liquids are increased by 20°F.
- C. The inlet temperature of the hotter liquid is increased by 20°F.
- D. The inlet temperature of the colder liquid is increased by 20°F.

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QUESTION: 17

Which one of the following is the approximate condenser vacuum (inches Hg vacuum) when condenser pressure is 16 inches Hg absolute?

- A. 4 inches Hg vacuum
- B. 8 inches Hg vacuum
- C. 12 inches Hg vacuum
- D. 14 inches Hg vacuum

QUESTION: 18

A nuclear power plant is operating at steady-state conditions with the main generator supplying 1,000 MW to the power grid. Assume main generator load remains constant.

If 1% of the tubes in the main condenser become plugged, condenser absolute pressure will _____; and condenser hotwell temperature will _____.

- A. increase; increase
- B. decrease; increase
- C. increase; decrease
- D. decrease; decrease

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QUESTION: 19

What percentage of ionic impurities is being removed from the water passing through an ion exchanger if the ion exchanger has a decontamination factor of 1.0?

- A. 100%
- B. 99%
- C. 1%
- D. 0%

QUESTION: 20

A condensate demineralizer differential pressure (D/P) gauge indicates 4.0 psid at 50% flow rate. Which one of the following combinations of condensate flow and demineralizer D/P observed at various power levels indicates an increase in the accumulation of insoluble corrosion products in the demineralizer?

	<u>CONDENSATE FLOW</u>	<u>DEMINERALIZER D/P (PSID)</u>
A.	25%	0.9
B.	60%	6.3
C.	75%	8.7
D.	100%	15.6

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QUESTION: 21

Which one of the following will provide the first motor protection against electrical damage caused by gradual bearing degradation?

- A. Thermal overload device
- B. Overcurrent trip relay
- C. Underfrequency relay
- D. Undervoltage device

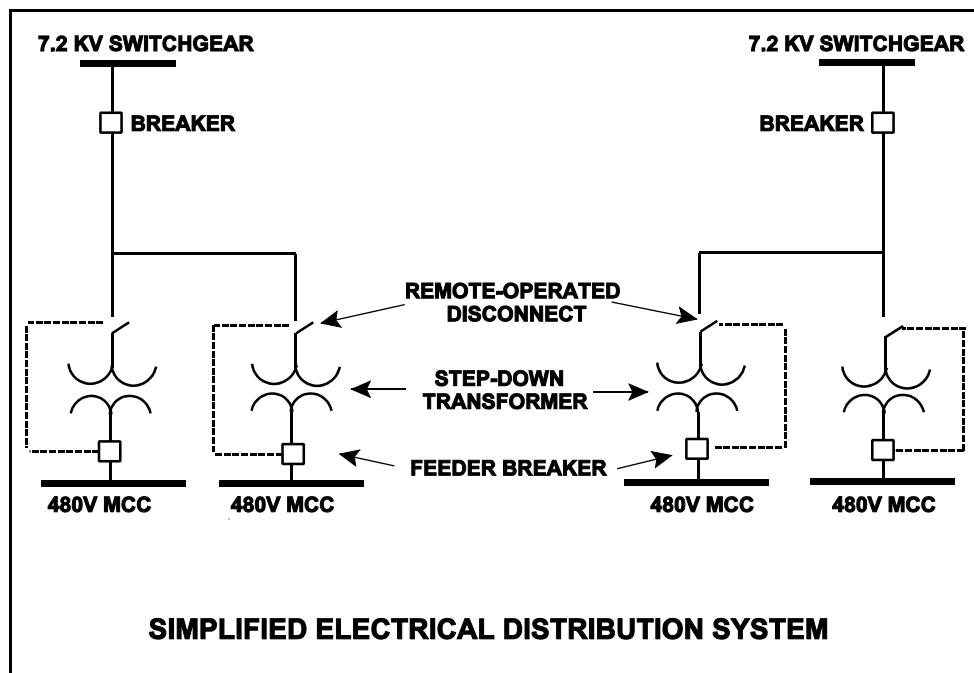
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QUESTION: 22

Refer to the simplified drawing of an electrical distribution system showing 7.2 KV switchgear, step-down transformers, and 480 V motor control centers (MCCs) (see figure below). The high voltage side of each step-down transformer has a remote-operated disconnect. The control circuit for each disconnect is position-interlocked with the associated MCC feeder breaker.

Which one of the following describes the interlock operating scheme that will provide the greatest protection for the disconnect?

- A. Permits opening the feeder breaker only if the disconnect is closed.
- B. Permits opening the feeder breaker only if the disconnect is open.
- C. Permits opening the disconnect only if the feeder breaker is closed.
- D. Permits opening the disconnect only if the feeder breaker is open.



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QUESTION: 23

In a comparison between a delayed neutron and a prompt neutron born from the same fission event, the prompt neutron is more likely to...

- A. cause fast fission of a U-238 nucleus.
- B. be captured by a U-238 nucleus at a resonance energy between 1 eV and 1000 eV.
- C. be captured by a Xe-135 nucleus.
- D. cause thermal fission of a U-235 nucleus.

QUESTION: 24

In a subcritical reactor, K_{eff} was increased from 0.85 to 0.95 by rod withdrawal. Which one of the following is the approximate amount of reactivity that was added to the core?

- A. 0.099 $\Delta K/K$
- B. 0.124 $\Delta K/K$
- C. 0.176 $\Delta K/K$
- D. 0.229 $\Delta K/K$

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QUESTION: 25

Nuclear reactors A and B are identical except that the reactor cores are operating at different times in core life. The reactor A effective delayed neutron fraction is 0.007, and the reactor B effective delayed neutron fraction is 0.005. Both reactors are currently subcritical with neutron flux level stable in the source range.

Given:

$$\text{Reactor A } K_{\text{eff}} = 0.999$$

$$\text{Reactor B } K_{\text{eff}} = 0.998$$

If positive 0.003 $\Delta K/K$ is suddenly added to each reactor, how will the resulting stable periods compare? (Consider only the reactor response while power is below the point of adding heat.)

- A. Reactor A stable period will be shorter because it will have the higher positive reactivity in the core.
- B. Reactor B stable period will be shorter because it has the smaller effective delayed neutron fraction.
- C. Reactors A and B will have the same stable period because both reactors will remain subcritical.
- D. Reactors A and B will have the same stable period because both reactors received the same amount of positive reactivity.

QUESTION: 26

Which one of the following describes the net reactivity effect of a moderator temperature increase in an overmoderated nuclear reactor core?

- A. Negative reactivity will be added because more neutron leakage will occur.
- B. Negative reactivity will be added because more neutrons will be captured by the moderator.
- C. Positive reactivity will be added because less neutron leakage will occur.
- D. Positive reactivity will be added because fewer neutrons will be captured by the moderator.

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QUESTION: 27

Which one of the following will cause the void coefficient to become less negative? (Consider only the direct effects of the indicated changes.)

- A. Core void fraction increases.
- B. Fuel temperature decreases.
- C. Gadolinium burns out.
- D. Control rods are partially inserted.

QUESTION: 28

A nuclear reactor is critical below the point of adding heat. If control rods are manually inserted for 5 seconds, reactor power will decrease...

- A. to a shutdown power level determined by subcritical multiplication.
- B. temporarily, then return to the original value due to the resulting decrease in moderator temperature.
- C. until inherent positive reactivity feedback causes the reactor to become critical at a lower neutron level.
- D. temporarily, then return to the original value due to subcritical multiplication.

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QUESTION: 29

Which one of the following conditions will cause the associated individual control rod worth(s) to become more negative? (Consider only the direct effect of the indicated changes.)

- A. During a small power change, fuel temperature increases.
- B. With the reactor shut down, reactor coolant temperature increases from 100°F to 200°F.
- C. During a small power change, the percentage of voids increases.
- D. During a control pattern adjust, the local thermal neutron flux surrounding a control rod decreases while the core average thermal neutron flux remains the same.

QUESTION: 30

Nuclear reactors A and B are operating at steady-state 100% power with equilibrium core Xe-135. The reactors are identical except that reactor A is operating at end of core life (EOL) and reactor B is operating at beginning of core life (BOL).

Which reactor has the smaller concentration of equilibrium core Xe-135?

- A. Reactor A (EOL) due to the smaller 100% power thermal neutron flux
- B. Reactor A (EOL) due to the larger 100% power thermal neutron flux
- C. Reactor B (BOL) due to the smaller 100% power thermal neutron flux
- D. Reactor B (BOL) due to the larger 100% power thermal neutron flux

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QUESTION: 31

A nuclear power plant has been operating at 100% power for several months. Which one of the following describes the relative contributions of beta decay and neutron capture to Xe-135 removal from the reactor core?

- A. Primary - neutron capture; secondary - beta decay.
- B. Primary - beta decay; secondary - neutron capture.
- C. Beta decay and neutron capture contribute equally.
- D. Not enough information is given to make a comparison.

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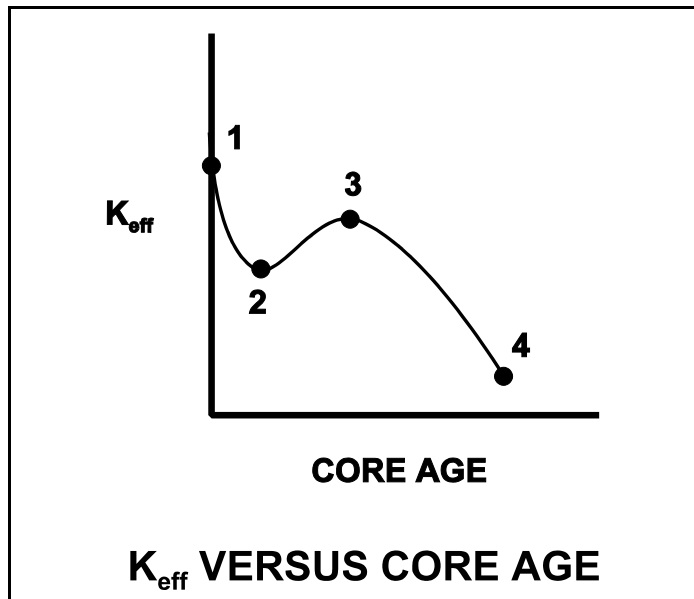
QUESTION: 32

Refer to the curve of K_{eff} versus core age for an operating nuclear reactor (see figure below).

The reactor has been operating at 100% power for several weeks and is currently operating between points 2 and 3 on the curve.

Assuming reactor recirculation flow rate remains the same, what general control rod operation will be necessary to maintain the reactor operating at 100% power until point 3 is reached?

- A. Withdrawal for the entire period.
- B. Withdrawal at first, then insertion.
- C. Insertion for the entire period.
- D. Insertion at first, then withdrawal.



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QUESTION: 33

A nuclear reactor is being started up with a stable positive 100-second period, and power is entering the intermediate range. Assuming no operator action, which one of the following describes the future response of reactor period?

- A. Prior to reaching the point of adding heat, the fuel temperature increase will add negative reactivity and reactor period will approach infinity.
- B. As heat production in the reactor exceeds ambient heat losses, the temperature of the fuel and moderator will increase, adding negative reactivity, and reactor period will approach infinity.
- C. The heat produced by the reactor when operating in the intermediate range is insufficient to raise the fuel or moderator temperatures, and reactor period remains nearly constant throughout the entire intermediate range.
- D. As heat production in the reactor exceeds ambient losses, positive reactivity added by the fuel temperature increase counteracts the negative reactivity added by the moderator temperature increase, and reactor period remains nearly constant throughout the entire intermediate range.

QUESTION: 34

A nuclear reactor startup is in progress and criticality has just been achieved. After recording the critical rod heights, the operator withdraws a control rod for 20 seconds to establish a stable positive 60-second reactor period. One minute later (prior to reaching the point of adding heat), the operator inserts the same control rod for 25 seconds.

During the insertion, when will the reactor period become negative?

- A. Immediately when the control rod insertion is initiated.
- B. After the control rod passes through the critical rod height.
- C. Just as the control rod passes through the critical rod height.
- D. Prior to the control rod passing through the critical rod height.

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QUESTION: 35

A nuclear power plant is initially operating at steady-state 60% power when a main steamline break develops that continuously releases 5% of rated main steam flow. The plant stabilizes as follows:

- No operator or protective actions occur.
- Automatic pressure control returns reactor pressure to its initial value.
- Ignore any reactivity effects from feedwater injection temperature changes..

Compared to the initial operating conditions, current reactor power is approximately _____; and current turbine power is approximately _____.

- A. 5% higher; the same
- B. 5% higher; 5% lower
- C. the same; the same
- D. the same; 5% lower

QUESTION: 36

Nuclear reactors A and B are identical and have operated at 100% power for six months when a reactor scram occurs simultaneously on both reactors. All reactor A control rods fully insert. One reactor B control rod remains fully withdrawn.

After ten minutes, when compared to reactor A, the core fission rate in reactor B will be _____, and the reactor period in reactor B will be _____.

- A. higher; longer
- B. higher; the same
- C. the same; longer
- D. the same; the same

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QUESTION: 37

A water storage tank is vented to atmosphere. The tank is located at sea level and contains 100,000 gallons of 80°F water. A pressure gauge at the bottom of the tank reads 5.6 psig. What is the approximate water level in the tank?

- A. 13 feet
- B. 17 feet
- C. 21 feet
- D. 25 feet

QUESTION: 38

Consider a 100 lbm quantity of a steam-water mixture at standard atmospheric pressure. The mixture has a quality of 70 percent. Assume that pressure remains constant and there is no heat loss from the mixture.

Which one of the following is the approximate heat addition needed to increase the quality of the mixture to 100 percent?

- A. 5,400 Btu
- B. 12,600 Btu
- C. 29,100 Btu
- D. 67,900 Btu

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QUESTION: 39

The lowest pressure in a liquid jet pump exists in the...

- A. throat.
- B. diffuser.
- C. rams head.
- D. impeller eye.

QUESTION: 40

The location in a main turbine that experiences the greatest amount of blade erosion is in the _____ stage of the _____ pressure turbine.

- A. last; high
- B. last; low
- C. first; high
- D. first; low

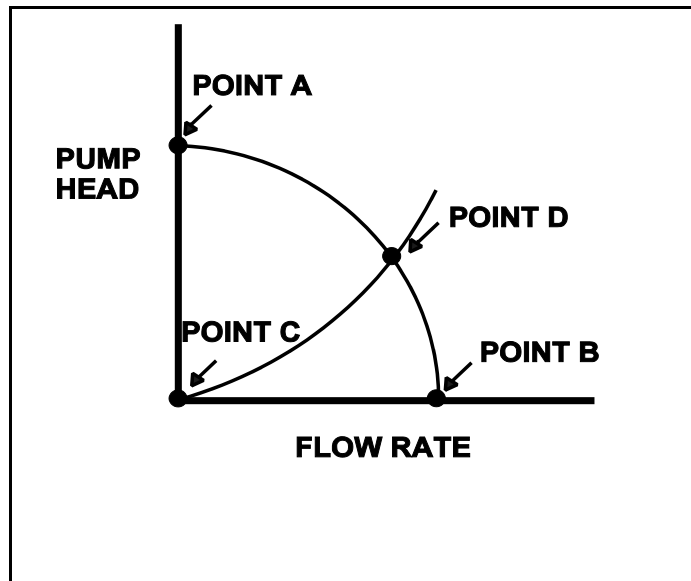
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QUESTION: 41

Refer to the drawing of a centrifugal pump operating curve and system curve (see figure below).

Which one of the following determines the general shape of the curve from point C to point D?

- A. The pump flow losses due to the decrease in available net positive suction head as the system flow rate increases.
- B. The pump flow losses due to back leakage through the clearances between the pump impeller and casing as the D/P across the pump increases.
- C. The frictional and throttling losses in the piping system as the system flow rate increases.
- D. The frictional losses between the pump impeller and its casing as the differential pressure (D/P) across the pump increases.



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QUESTION: 42

An ideal positive displacement pump is pumping to a system operating at 100 psig. Assume pump speed is constant, zero pump slip, and pump backpressure remains within normal pump operating limits.

If system pressure increases to 200 psig, the pump head will _____; and pump flow rate will _____.

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

QUESTION: 43

Excessive amounts of entrained gases passing through a single-phase (liquid) heat exchanger are undesirable because...

- A. flow blockage can occur in the heat exchanger.
- B. the laminar layer will increase in the heat exchanger.
- C. the heat exchanger heat transfer coefficient will increase.
- D. the temperature difference across the heat exchanger tubes will decrease.

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QUESTION: 44

The order of heat-transfer mechanisms occurring in the core (inlet-to-outlet) is...

- A. nucleate boiling, single-phase convection, slug flow, annular flow.
- B. nucleate boiling, single-phase convection, annular flow, slug flow.
- C. single-phase convection, nucleate boiling, slug flow, annular flow.
- D. single-phase convection, nucleate boiling, annular flow, slug flow.

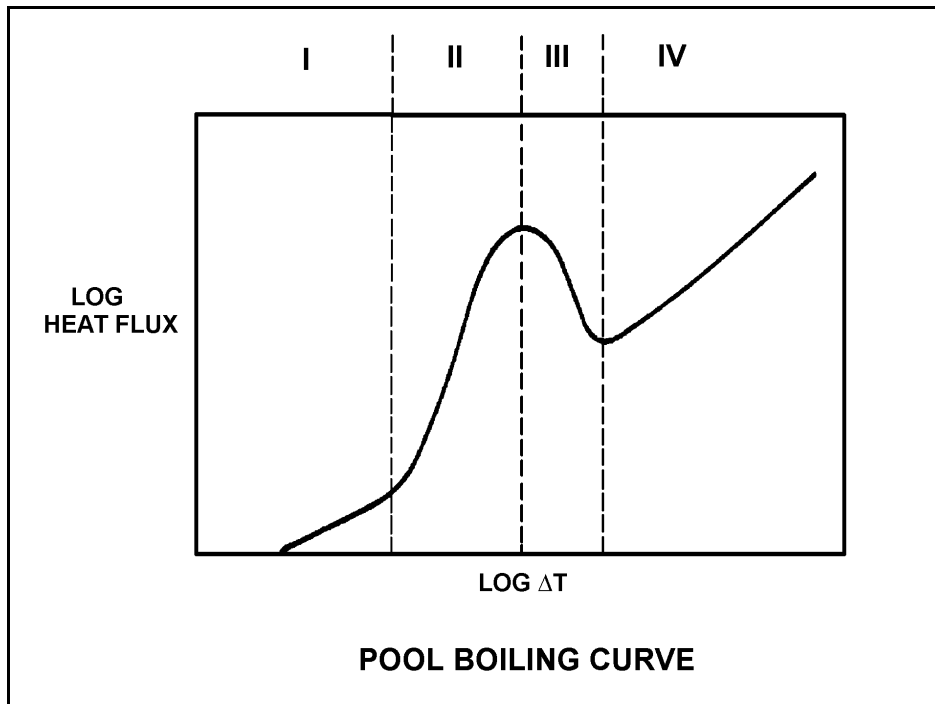
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QUESTION: 45

Refer to the drawing of a pool boiling curve (see figure below).

Which one of the following describes the conditions in a fuel channel that is experiencing region IV heat transfer?

- A. Complete steam blanketing of the fuel rod surface
- B. Alternate wetting and drying of the fuel rod surface
- C. Saturated nucleate boiling
- D. Subcooled nucleate boiling



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MARCH 2006 BWR--FORM A**

QUESTION: 46

Nuclear reactors A and B are identical. Reactor A is operating at 75% power and reactor B is operating at 50% power with neutron flux radially and axially peaked in the center of each core. Recirculation mass flow rate through each core is the same.

Compared to the center fuel bundle in reactor A, the center fuel bundle in reactor B has the _____ critical power and the _____ coolant flow rate.

- A. lower; lower
- B. lower; higher
- C. higher; lower
- D. higher; higher

QUESTION: 47

At high core exposures, the maximum average planar linear heat generation rate (MAPLHGR) limit decreases with increasing core exposure. What is the reason for this decrease?

- A. Cracking of fuel pellets at higher core exposures permits additional volume for fission product gases.
- B. Zirconium-steam chemical reaction in cladding requires higher temperatures at higher core exposures.
- C. Fission product decay heat level decreases at higher core exposures.
- D. Fission product gases lower the overall heat transfer coefficient of the fuel rod fill gas.

**USNRC GENERIC FUNDAMENTALS EXAMINATION
MARCH 2006 BWR--FORM A**

QUESTION: 48

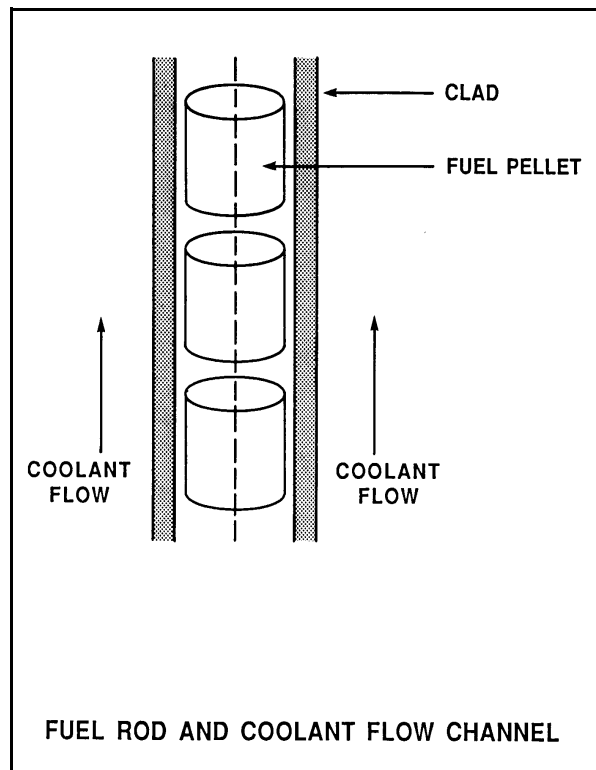
Refer to the drawing of a fuel rod and coolant flow channel at the beginning of core life (see figure below).

Given the following initial core parameters:

Reactor power	= 50%
T_{coolant}	= 550°F
$T_{\text{fuel centerline}}$	= 2,750°F

What will the fuel centerline temperature be if, over core life, the total fuel-to-coolant thermal conductivity doubles? (Assume reactor power is constant.)

- A. 1,100°F
- B. 1,375°F
- C. 1,525°F
- D. 1,650°F



**USNRC GENERIC FUNDAMENTALS EXAMINATION
MARCH 2006 BWR--FORM A**

QUESTION: 49

A nuclear power plant is operating at 90% power at the end of core life when a signal error causes the turbine control system to open the turbine control valves an additional 5 percent. Assuming the reactor does not scram, the critical power ratio will initially...

- A. increase, because reactor power initially increases.
- B. decrease, because reactor power initially decreases.
- C. increase, because the reactor coolant latent heat of vaporization initially increases.
- D. decrease, because the reactor coolant latent heat of vaporization initially decreases.

QUESTION: 50

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

Which reactor will have the lowest reactor vessel nil-ductility transition temperature?

- A. Reactor A due to the higher average power capacity
- B. Reactor A due to the fewer number of heatup/cooldown cycles
- C. Reactor B due to the lower average power capacity
- D. Reactor B due to the greater number of heatup/cooldown cycles

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

**MARCH 2006 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	A	26	40	D
2	16	A	27	41	B
3	17	B	28	42	A
4	18	C	29	43	B
5	19	B	30	44	B
6	20	D	31	45	A
7	21	A	32	46	C
8	22	B	33	47	B
9	23	A	34	48	D
10	24	C	35	49	D
11	25	B	36	50	B
12	26	C	37	1	A
13	27	D	38	2	C
14	28	A	39	3	A
15	29	B	40	4	B
16	30	D	41	5	C
17	31	D	42	6	A
18	32	A	43	7	A
19	33	D	44	8	C
20	34	B	45	9	A
21	35	A	46	10	D
22	36	D	47	11	D
23	37	A	48	12	D
24	38	B	49	13	C
25	39	A	50	14	C