October 7, 2005

Dr. David E. Moncton, Director
of Reactor Operations
Nuclear Reactor Laboratory
Massachusetts Institute of Technology
138 Albany Street
Cambridge, MA 02139

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-20/OL-05-01, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Dear Dr. Moncton:

During the week of September 5, 2005, the NRC administered initial examinations to employees of your facility who had applied for a license to operate your Massachusetts Institute of Technology Reactor. The examination was conducted in accordance with NUREG-1478, "Non-Power Reactor Operator Licensing Examiner Standards," Revision 1. Examination questions and preliminary findings were discussed with those members of your staff identified in the enclosed report at the conclusion of the examination.

In accordance with 10 CFR 2.390 of the Commission's regulations, a copy of this letter and the enclosures will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at (the Public Electronic Reading Room) http://www.nrc.gov/NRC/ADAMS/index.html. The NRC is forwarding the individual grades to you in a separate letter which will not be released publicly. Should you have any questions concerning this examination, please contact Mr. Phillip Young at 301-415-4094 or internet e-mail pty@nrc.gov.

Sincerely,

/RA/

Brian E. Thomas, Section Chief
Research and Test Reactors Section
New, Research and Test Reactors Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No. 50-20

Enclosures: 1. Initial Examination Report No. 50-20/OL-05-01
2. Facility comments with NRC resolution
3. Examination and answer key

cc w/encls: Please see next page

Massachusetts Institute of Technology

Docket No. 50-20

cc:

City Manager
City Hall
Cambridge, MA 02139

Department of Environmental Quality Engineering
100 Cambridge Street
Boston, MA 02202

Test, Research, and Training Reactor Newsletter
University of Florida
202 Nuclear Sciences Center
Gainesville, FL 32611

October 7, 2005

Dr. David E. Moncton, Director
of Reactor Operations
Nuclear Reactor Laboratory
Massachusetts Institute of Technology
138 Albany Street
Cambridge, MA 02139

SUBJECT: INITIAL EXAMINATION REPORT NO. 50-20/OL-05-01, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Dear Dr. Bernard:

During the week of September 5, 2005, the NRC administered initial examinations to employees of your facility who had applied for a license to operate your Massachusetts Institute of Technology Reactor. The examination was conducted in accordance with NUREG-1478, "Non-Power Reactor Operator Licensing Examiner Standards," Revision 1. Examination questions and preliminary findings were discussed with those members of your staff identified in the enclosed report at the conclusion of the examination.

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Brian E. Thomas, Section Chief
Research and Test Reactors Section
New, Research and Test Reactors Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No. 50-20
Enclosures: 1. Initial Examination Report No. 50-005/OL-05-01
2. Facility comments with NRC resolution
3. Examination and answer key
cc w/encls:
Please see next page

DISTRIBUTION:
PUBLIC RNRP/R&TR r/f BThomas PYoung
Facility File (EBarnhill)

ADAMS PACKAGE ACCESSION NO.: ML051810250
ADAMS REPORT ACCESSION NO.: ML052730191 **TEMPLATE #: NRR-074**

OFFICE	RNRP:CE		RNRP:E		IROB:LA		RNRP:SC	
NAME	PYoung:vmj		PDoyle		EBarnhill		BThomas	
DATE	09/ /2005		09/ /2004		09/ /2004		09/ /2004	

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U. S. NUCLEAR REGULATORY COMMISSION
OPERATOR LICENSING INITIAL EXAMINATION REPORT

REPORT NO.: 50-20/OL-05-01

FACILITY DOCKET NO.: 50-20

FACILITY LICENSE NO.: R-37

FACILITY: Massachusetts Institute of Technology

EXAMINATION DATES: September 5-8, 2005

SUBMITTED BY: _____ 10/ /2005
Phillip T. Young, Chief Examiner Date

SUMMARY:

During the week of September 5, 2005, the NRC administered operator licensing examinations to six Senior Reactor Operator (Upgrade) candidates, and six Reactor Operator candidates. All Senior Operator candidates and Reactor Operator candidates passed the examinations. NOTE: Due to reactor criticality issues, the requirement to have all RO and SRO-Instant candidates perform a reactor startup (NUREG-1478, *Non-Power Reactor Operator Licensing Examiner Standards*, Section ES-301N) was waived by the chief examiner.

REPORT DETAILS

1. Examiners:
   Phillip T. Young, Chief Examiner
   Paul Doyle, Examiner

2. Results:

	RO PASS/FAIL	SRO PASS/FAIL	TOTAL PASS/FAIL
Written	6/0	0/0	6/0
Operating Tests	6/0	6/0	12/0
Overall	6/0	6/0	12/0

3. Exit Meeting:
   Phillip T. Young, NRC, Chief Examiner
   Frank W. Warmsley, MITR, Training Supervisor
   Edward S. Lau, MITR, Reactor Superintendent

   The NRC thanked the facility staff for their assistance and cooperation during the examination. The facility staff presented the Chief Examiner with comments on the written examination. Generic weaknesses noted were minor, and were discussed with the facility staff.

Facility Comments with NRC Resolution

Question C.005:
Which of the following indications that will be automatically actuated outside of the control room when the 'trouble NW-12 gamma monitor' scam alarm actuates, and their location?

a. A red light and a bell at the reception area.
b. A blue light and a warning horn in operations office.
c. A siren and backlit signs in the containment building.
d. A horn in building NW12 and backlit signs at entrances.

Answer: C.005 a. Reference: PM 5.6.1, RSM 7.6

Facility Comment:
We suggest this question be removed because there is no correct answer provided. Answer (a) would have been correct if written as "A blue light and a bell at the reception area."

NRC Resolution:
Comment accepted. The question will be deleted and will not factor into the candidates grades. In the future the question will be modified accordingly.

Question C.010:
A rapid shift of cooling tower flow from the basins to spray may cause a reactor scram by causing a:

a. a temporary reduction in secondary flow.
b. rapid cooldown of the primary and secondary systems.
c. temporary lack of heat removal until spray becomes effective.
d. pressure pulse that is transmitted via the heat exchanger to the primary, where it appears as a loss of flow on MP-6/6A.

Answer: C.010 d. Reference: General knowledge of facility

Facility Comment:
We suggest this question be removed from both this exam and the question bank as it is no longer applicable to our facility operation. Answer (d) was correct for the reactor's previous cooling tower system. Since its replacement in 1999, the cooling towers do not send pressure pulses significant enough to have an effect on the MP-6/6A pressure sensors.

NRC Resolution:
Comment accepted. The question will be deleted and will not factor into the candidates grades.

U. S. NUCLEAR REGULATORY COMMISSION
NON-POWER INITIAL REACTOR LICENSE EXAMINATION

FACILITY: Massachusetts Institute of Technology

REACTOR TYPE: MITR-II

DATE ADMINISTERED: 09/05/05

CANDIDATE: _____

INSTRUCTIONS TO CANDIDATE:
Answers are to be written on the answer sheet provided. Attach the answer sheets to the examination. Points for each question are indicated in brackets for each question. A 70% in each section is required to pass the examination. Examinations will be picked up three (3) hours after the examination starts.

Category Value	% of Total	Candidates Score	% of Category Value	Category
20.00	33.3	_____	____	A. Reactor Theory, Thermodynamics and Facility Operating Characteristics
20.00	33.3	_____	____	B. Normal and Emergency Operating Procedures and Radiological Controls
20.00	33.3	_____	____	C. Facility and Radiation Monitoring Systems
60.00		_____	____%	TOTALS
			FINAL GRADE	

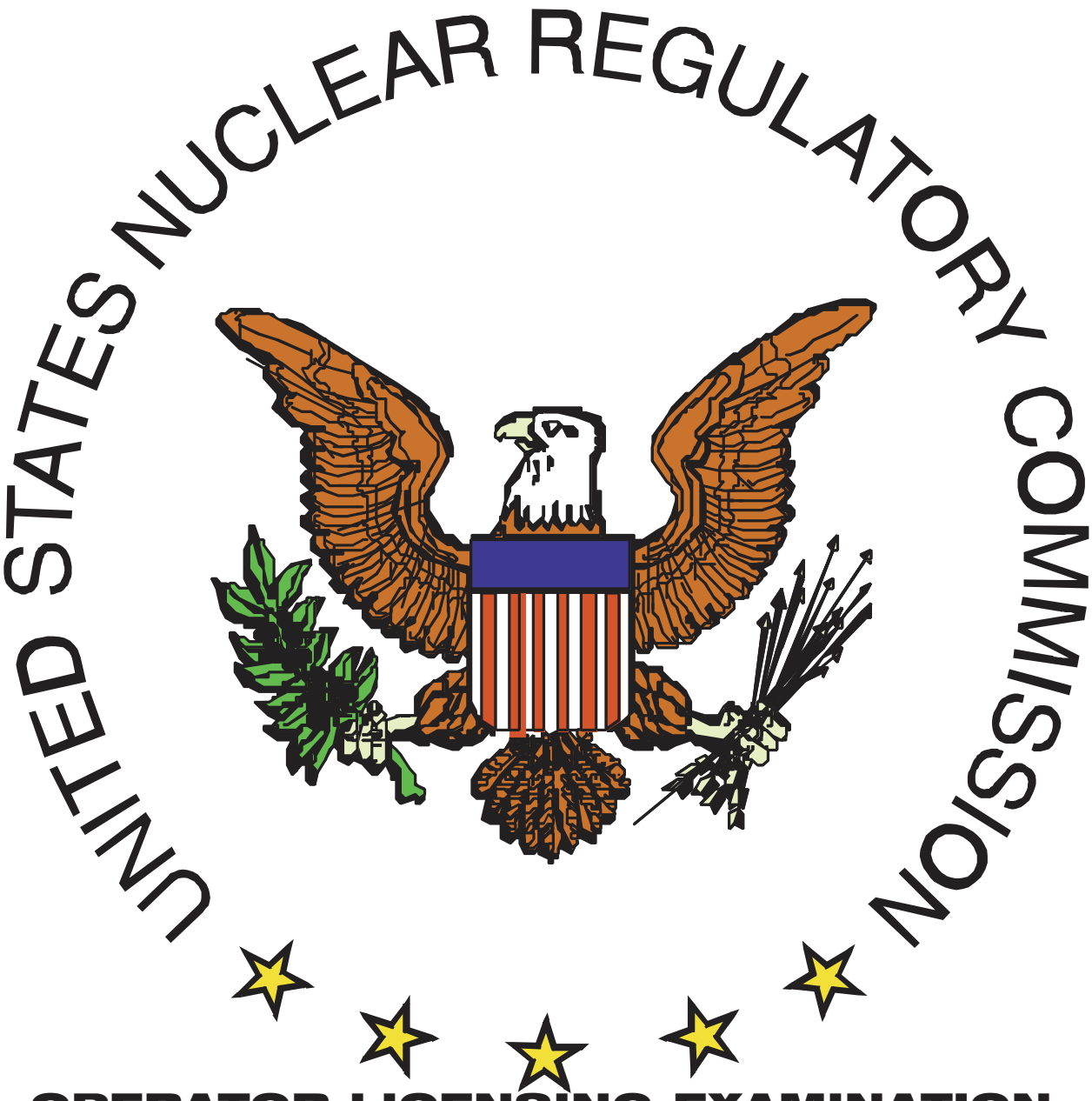
All work done on this examination is my own. I have neither given nor received aid.

_____
Candidate's Signature

ENCLOSURE 3

MIT

Written Examination and Answer Key



OPERATOR LICENSING EXAMINATION

September 6, 2005

Section A Rx Theory, Thermo & Fac. Operating Characteristics

QUESTION: A001 (1.00 point) [1.0]

Which ONE of the following factors is the most significant in determining the differential worth of a control rod?

a. The rod speed.

b. Reactor power.

c. The flux shape.

d. The amount of fuel in the core.

Answer: A.001 c.
Reference: MIT Reactor Physics Notes, Reactivity Feedback

QUESTION: A.002 (1.00 point) [2.0]

The major source of neutrons used for normal/routine startups of the MITR-II is from the:

a. Alpha decay of Uranium 238.

b. Antimony-Beryllium (Sb-Be) source.

c. Plutonium-Beryllium (Pu-Be) source.

d. Photo-neutrons produced by interaction of gamma rays with heavy water.

Answer: A.002 d.
Reference: MIT Reactor Physics Notes, Reactor Startup

QUESTION: A.003 (1.0 point) [3.0]

Why is the stable negative period following a scram always the same value, regardless of initial power level? The rate of power change is dependent on the:

A. constant decay rate of prompt neutrons.

B. mean lifetime of the longest lived delayed precursor.

C. mean lifetime of the shortest lived delayed neutron precursor.

D. constant decay rate of prompt gamma emitters.

Answer: A.003 b.
Reference: MITR II Reactor Physics Notes - Reactor Kinetics Section(e)

Section A Rx Theory, Thermo & Fac. Operating Characteristics

QUESTION: A.004 (1.00 point) [4.0]

Excess reactivity is the amount of reactivity:

a. associated with samples.

b. needed to achieve prompt criticality.

c. available above that which is required to make the reactor subcritical.

d. available above that which is required to keep the reactor critical.

Answer: A.004 d.
Reference: Glasstone and Sesonske, Nuclear Reactor Engineering, Chapter 5, Section 5.114

QUESTION: A.005 (1.00 point) [5.0]

The term "prompt jump" refers to:

a. the instantaneous change in power due to raising a control rod.

b. a reactor which has attained criticality on prompt neutrons alone.

c. a reactor which is critical using both prompt and delayed neutrons.

d. a negative reactivity insertion which is less than Beta-effective.

Answer: A.005 a.
Reference: MIT Reactor Physics Notes, Reactivity Feedback

QUESTION: A.006 (1.00 point) [6.0]

Which ONE of the following describe the difference between a moderator and reflector?

a. A reflector increases the fast non-leakage factor and a moderator increases the thermal utilization factor.

b. A reflector increases the neutron production factor and a moderator increases the fast fission factor.

c. A reflector decreases the thermal utilization factor and a moderator increases the fast fission factor.

d. A reflector decreases the neutron production factor and a moderator decreases the fast non-leakage factor.

Answer: A.006 a .
Reference: Glasstone & Sesonke, Nuclear Reactor Engineering, Chapter 1, Section 1.51 & 1.52

Section A ℞ Theory, Thermo & Fac. Operating Characteristics

QUESTION: A.007 (1.0 point)[7.0]

The following data was obtained during a reactor fuel load.

No. of Elements	Detector A (cps)
0	20
8	28
16	30
24	32
32	42
40	80

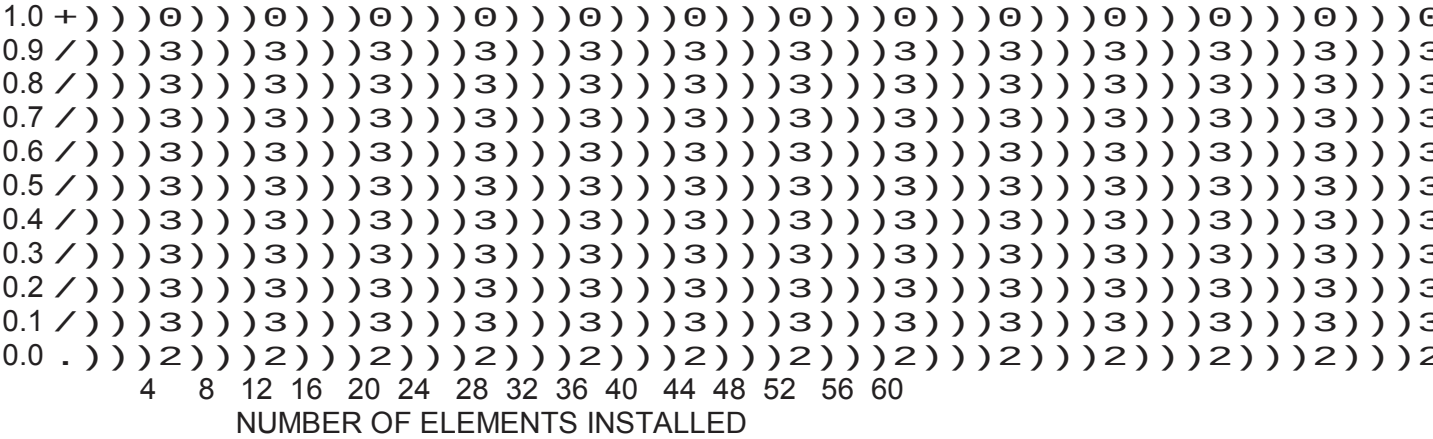
Which one of the following represents the number of fuel elements predicted to reach criticality?

a. 48

b. 52

c. 56

d. 60



Answer: A.007 a.

Reference Glasstone, S. and Sesonske, §§ 3.161 — 3,163, pp. 190 & 191.

Section A Rx Theory, Thermo & Fac. Operating Characteristics

QUESTION: A.008 (1.0 point) [8.0]

Select the statement that describes why neutron sources are used in reactor cores.

a. Increase the count rate by an amount equal to the source contribution.

b. Increase the count rate by 1/M (M = Subcritical Multiplication Factor).

c. Provide the source neutrons to initiate the chain reaction when first starting-up the reactor.

d. Provide a neutron level high enough to be monitored by source range instrumentation.

Answer: A.008 d.
Reference: Glasstone, S. and Sesonske , 1991, §§ 2.70 — 2.74, pp. 65 -- 66. And Section 5.286.

QUESTION: A.009 (1.0 point) [9.0]

Which one of the following figures most closely depicts the reactivity versus time plot for xenon for the following series of evolutions:

TIME	EVOLUTION
1	500 KW startup, clean core;
2	Operation at 500 KW for 24 hours;
3	Shutdown for 15 hours;
4	250 Kw for 12 hours.

a. figure a

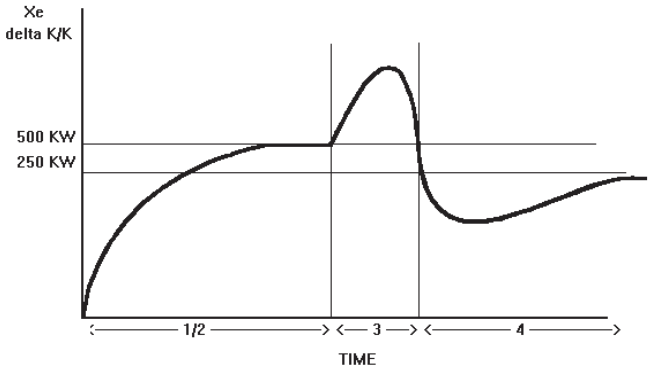
b. figure b

c. figure c

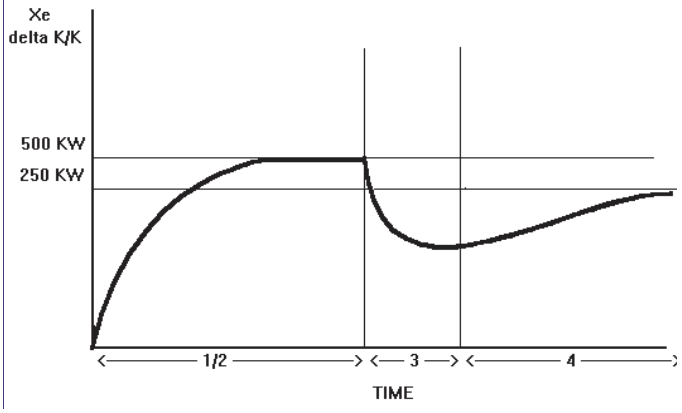
d. figure d

(See attached figures on following page for choice selections.)

Answer: A.009 a.
Reference: Glasstone, S. and Sesonske , 1991, §§ 5.56 — 5.80, pp. 250 — 260.


Xe
delta K/K
500 KW
250 KW
1/2
3
4
TIME

a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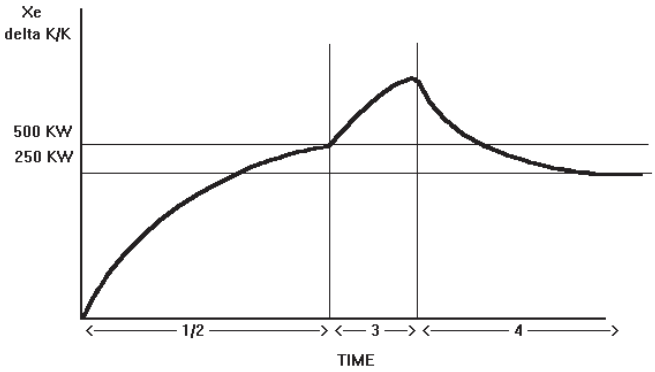
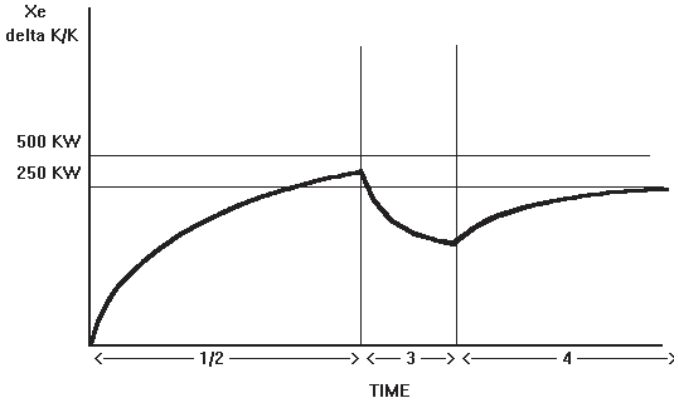
500 KW
250 KW
1/2
3
4
TIME

b


Xe
delta K/K
500 KW
250 KW
1/2
3
4
TIME

c


Xe
delta K/K
500 KW
250 KW
1/2
3
4
TIME

d

Section A Rx Theory, Thermo & Fac. Operating Characteristics

QUESTION: A.010 (1.00 point) [10.0]

Which of the following would occur if an in-core sample that is a neutron absorber and which is initially at the bottom of the in-core sample tube with the reactor critical were pulled up though the core and out?

a. Positive reactivity is added.
b. Negative reactivity is added.
c. Positive then negative reactivity is added.
d. Negative then positive reactivity is added.

Answer: A.010 d.
Reference: MIT RSM 10.1 on Axial flux profile and MIT Notes on Nuclear Instrumentation, p. 23

QUESTION: A.011 (1.00 point) [11.0]

The method for determining Calculated Thermal Power is described by:

a. Primary power plus reflector power plus shield power.
b. Primary power plus reflector power minus shield power.
c. Primary power plus shield power minus reflector power.
d. Primary power minus reflector power minus shield power.

Answer: A.011 a.
Reference: PM 2.4, p 5.

QUESTION: A.012 (1.00 point) [12.0]

As primary coolant temperature increases, control rod worth:

a. decreases due to lower reflector efficiency.
b. decreases due to higher neutron absorption in the moderator.
c. increases due to the increase in thermal diffusion length.
d. remains the same due to constant poison cross-section of the control rods..

Answer: A.012 c.
Reference: MIT Reactor Physics Notes, Reactivity Feedback, Section 5.

Section A Rx Theory, Thermo & Fac. Operating Characteristics

QUESTION: A.013 (1.00 point) [13.0]

For a doubling time of 25 seconds the corresponding reactor period is:

a. 25 seconds

b. 36 seconds

c. 50 seconds

d. 81 seconds

Answer: A.013 b.
Reference: MIT Reactor Physics Notes on Reactor Kinetics, pg. 18
Doubling Time = 0.693 x Period = 25 seconds, Period = 36 seconds

QUESTION: A.014 (1.00 point) [14.0]

In a subcritical reactor, K eff is increased from 0.861 to 0.946. Which ONE of the following is the amount of reactivity that was added to the reactor core?

a. 0.085 delta k/k

b. 0.104 delta k/k

c. 0.161 delta k/k

d. 0.218 delta k/k

Answer: A.014 b.
Reference: MIT Reactor Physics Notes on Reactor Kinetics, pg. 2 $\rho_1 = (0.861 - 1)/0.861 = -0.161\Delta k/k$; $\rho_2 = (0.946 - 1)/0.946 = -0.057\Delta k/k$ $\Delta\rho = \rho_2 - \rho_1 = -0.057 - (-0.161) = +0.104$ delta k/k

Section A Rx Theory, Thermo & Fac. Operating Characteristics

QUESTION: A.015 (1.00 point) [15.0]

Given the following:

Reactor operating at 5 MW,

scram setpoint at 6 MW,

scram delay time of 1 second,

reactor period of 12.5 seconds.

What will be the approximate reactor power at the time of the scram due to this reactivity excursion?

a. 6.1 MW
b. 6.5 MW
c. 7.2 MW
d. 12.5 MW

Answer: A.015 b.
Reference: MIT Exam Bank # 19

QUESTION: A.016 (1.00 point) [16.0]

As criticality is approached during a startup, blade withdrawal is made in smaller and smaller increments and with longer and longer intervals between withdrawals because:

a. as the reactor approaches criticality, the number of neutron generations required to attain equilibrium increases.
b. gamma rays begin to swamp the neutron signal in the nuclear detectors.
c. the fraction of delayed neutrons approaches zero as criticality is approached.
d. subcritical multiplication becomes less important.

Answer: A.016 a.
Reference: MIT Reactor Physics Notes on Subcritical Multiplication, pg. 10

Section A Rx Theory, Thermo & Fac. Operating Characteristics

QUESTION: A.017 (1.00 point) [17.0]

Coolant flows through a reactor core at a rate of 50 GPM, resulting in a coolant temperature increase of 6 degrees F. The power of the reactor is:

a. 5.3 kW.

b. 14.7 kW.

c. 44.0 kW.

d. 329.1 kW.

Answer: A.017 c.
Reference: MIT PM 2.4.2 Power = (Mass flow rate)(Specific heat)(temperature increase)
Power = (50 GPM)(8.34 lbs/gallon)(1 Btu/lb-deg F)(6 deg F)(60 min/hour)
Power = (150,120 Btu/hour)(1 kW/3413 Btu/hour) = 44.0 kW

QUESTION: A.018 (1.00 point) [18.0]

Of the approximately 200 Mev of energy released per fission event, the largest amount appears in the form of:

a. gamma radiation.

b. kinetic energy of prompt and delayed neutrons.

c. kinetic energy of fission fragments.

d. alpha and beta radiation.

Answer: A.018 c.
Reference: Glasstone, Section 1.52

QUESTION: A.019 (1.00 point) [19.0]

The MITR-II is normally refueled when the xenon-equilibrium shim bank height is 16-17 inches, in order to:

a. avoid burnup of the upper portion of each element, thereby minimizing power peaking at the top of the core.

b. avoid blade withdrawal above the 18 inch height of the regulating rod.

c. avoid the possibility of being xenon-precluded should a restart following a scram be necessary.

d. maintain a uniform axial flux profile for the 3GV irradiation facilities.

Answer: A.019 c.
Reference: Examination of MITR-II Shim Bank and Xenon Reactivity Worth Curves

Section A Rx Theory, Thermo & Fac. Operating Characteristics

QUESTION: A.020 (1.00 point) [20.0]

The fuel temperature coefficient of reactivity is -1.25E-4 delta k/k/deg.F. When a control rod with an average rod worth of 0.1% delta k/k/inch is withdrawn 10 inches, reactor power increases and becomes stable at a higher level. At this point, (ignoring any other temperature effects) the fuel temperature has:

a. increased by 80 deg.F.

b. decreased by 80 deg.F.

c. increased by 8 deg.F.

d. decreased by 8 deg.F.

Answer: A.020 a.
Reference: Glasstone, Section 5.96
Reactivity added by control rod = +(0.001 Δk/k/inch)((10 inches) = 0.01 delta k/k
Fuel temperature change = - reactivity of rod/fuel temp. coeff. =
(- 0.01 delta k/k)/(- 1.25E-4 delta k/k/deg. F) = 80 deg. F

(*** End of Section A ***)

Section B Normal/Emerg. Procedures & Rad Con

QUESTION: B.001 (1.00 point) [1.0]

What action should always be taken to maximize effectiveness of the emergency plan for radiological emergencies?

5. Minor scram .
6. Shut down the reactor; Isolate containment.
7. Shut down the reactor; Leave ventilation on.
8. Lower shim blades to subcritical; Isolate containment.

Answer: B.001 b.
Reference: E-Plan Sect. 4.3.1.2.1

QUESTION: B.002 (1.0 point) [2.0]

What must be done in order to continue operation if a single plenum radiation monitor becomes inoperative due to a plugged flow line and the containment isolates?

a. Bypass by selecting a different plenum channel and restart ventilation.
b. Bypass affected channel using key switch and restart ventilation.
c. Replace plugged flow line and restart ventilation.
d. Operation is not allowed.

Answer: B.002 b.
Reference: AOP 5.6.3

QUESTION: B.003 (1.0 point)[3.0]

Administrative controls for rabbit irradiations state that all samples after irradiation must be handled by tongs at least 6" long. There must be no direct contact with fingers on the irradiated container or samples because of the probable:

a. of contamination
b. high beta radiation
c. high gamma radiation
d. high surface temperature of polyethylene container.

Answer: B.003 b.
Reference: PM 1.10.8.1.1 req #11, p. 10

Section B Normal/Emerg. Procedures & Rad Con

QUESTION: B.004 (1.0 point) [4.0]

Based on 10CFR55, which one of the following is the MINIMUM requirement that must be met to retain an "active" license?

a. Must perform license duties at least 4 hours per calendar quarter.

b. Must perform license duties a minimum of 8 hours per month.

c. Must perform license duties a minimum of 5 eight-hour shifts per calendar quarter.

d. Must perform license duties at least 40 hours per calendar year.

Answer: B.004 a.
Reference: 10CFR55.53(e)

QUESTION: B.005 (1.0 point) [5.0]

A 4 inch thickness of steel reduces a gamma radiation dose rate from 60 mrem/hr to 6 mrem/hr. What is the dose rate if an additional 1 inch thickness of steel is added?

a. 0.56 mrem/hr

b. 1.50 mrem/hr

c. 2.62 mrem/hr

d. 3.37 mrem/hr

Answer: B. 5 d.
Reference: 4 inches = 1/10 (6/60) shielding value layer. 1 inch = 10E (-0.25) = .56 shielding value layer
OR: I/Io = e (-ux) Shielded dose = 6 mrem/hr X .56 = 3.37 mrem/hr

QUESTION: B.006 (1.0 point) [6.0]

A reactor containment evacuation is required. The Reactor Operator performs the Immediate Actions necessary to evacuate personnel from Containment. If the radiation level in the control room is 150 mrem/hr, what is the Reactor Operator's MAXIMUM stay time?

a. 40 minutes

b. 3.2 hours

c. 6.7 hours

d. 13.3 hours

Answer: B.006 c.
Reference: PM 4.4.4.12, p. 2 1000mr/150mr/hr = 6.7 hrs

Section B Normal/Emerg. Procedures & Rad Con

QUESTION: B.007 (1.0 point) [7.0]

Which one of the following statements is NOT a violation of Technical Specifications?

a. Operating with one inoperable shim blade fully inserted.

b. Reactor power is 2 MW, one primary pump in service, and the total coolant flow rate is 1000 gpm.

c. Reactor power is 150 kW with the emergency cooling system inoperable.

d. Reactor power is 100 kW and emergency power is not available.

Answer: B.007 b.
Reference: T.S. p. 2-5 (LSSS)

QUESTION: B.008 (1.0 point) [8.0]

Per Technical Specifications, what is the maximum allowed power level if a Pu-Be source is in the core?

a. 100 W

b. 500 W

c. 100 kW

d. 250 kW

Answer: B.008 b.
Reference: T.S. 3.11.3

QUESTION: B.009 (1.0 point) [9.0]

Which one of the following statements is a requirement when performing maintenance on a system that could jeopardize personnel safety?

a. Circuit breakers should be padlocked open and the person who will be performing the work shall retain the key to the padlock on his person until completion of the work.

b. Tags may be removed by any member of the NRL/RPO staff. If there is doubt as to whether the tag should be cleared, the Operator-in-Charge should be consulted.

c. The on-duty console operator or a licensed operator shall observe the performance of the system lock out and verify that the system is in a safe condition.

d. Any member of the NRL/RPO staff including electronics and maintenance may remove lockouts when under the direction of a licensed senior operator.

Answer: B.009 a.
Reference: PM 1.14 pg 9 of 9

Section B Normal/Emerg. Procedures & Rad Con

QUESTION: B.010 (1.0 point) [10.0]

Which ONE of the following statements specifies a condition which satisfies Technical Specification Shutdown Margin requirements?

a. With the most reactive blade and regulating rod fully withdrawn the reactor can be made at least 1% ΔK/K subcritical from the cold Xenon equilibrium critical condition.

b. No less than five shim blades are operable and the inoperable blade is at the operating position or higher.

c. Variable reactivity effects (samples) shall be in their most negative reactive state.

d. The reflector dump time must be at least twice the initial measured value.

Answer: B.010 b.
Reference: TS 3.9

QUESTION: B.011 (1.0 point) [11.0]

Containment integrity is required whenever:

a. the H_2 concentration in the air space above the core exceeds 1.0 volume percent.

b. maintenance is being performed on the rod control system.

c. the emergency cooling system is not operable.

d. the reactor is not secured.

Answer: B.011 d.
Reference: TS 3.5.1

QUESTION: B.012 (1.0 point) [12.0]

Safety Limits are …

a. limits on variables associated with core thermal and hydraulic performance which are established to protect the integrity of the fuel clad.

b. settings for automatic protective devices related to those variable having significant safety functions.

c. settings for ANSI 15.8 suggested reactor scrams and/or alarms which form the protective system for the reactor or provide information which requires manual protective action to be initiated.

d. the lowest functional capability or performance levels of equipment required for safe operation of the reactor.

Answer: B.012 a.
Reference: TS 2.1

Section B Normal/Emerg. Procedures & Rad Con

QUESTION: B.013 (1.0 point) [13.0]

While responding to low pressure condition in the D_2O Helium System and monitoring the recombiner, the gasholder level decreases rapidly. The primary concern associated with this condition is:

a. a buildup of Argon-41 in containment.

b. an oil spill from a ruptured blow-out patch.

c. a release of Tritium to the equipment room.

d. the loss of loop seal overpressure protection for the recombiner.

Answer: B.013 c.
Reference: PM 5.5.13

QUESTION: B.014 (1.0 point) [14.0]

What is the maximum power level allowed if the reactor top shield is NOT in place?

a. 100 W

b. 500 W

c. 100 kW

d. 250 kW

Answer: B.014 c.
Reference: TS 3.11.2.d

QUESTION: B.015 (1.0 point) [15.0]

Which ONE of the following is NOT a concern on loss of compressed air?

a. Operability of the pneumatic tube sample ejection system.

b. Capability to monitor dump tank level remotely.

c. Position of the dump valve.

d. Containment integrity.

Answer: B.015 a.
Reference: MIT Reactor Systems Manual, Section 2.5 and 8.6

Section B Normal/Emerg. Procedures & Rad Con

QUESTION: B.016 (1.0 point) [16.0]

A declared "non-routine" reactor startup is performed **to insure that** :

a. a thermal power calibration is completed at 1 KW.

b. power level scrams are properly set prior to attaining full power.

c. the actual critical position is within the limits of the extrapolated ECP.

d. axial power distribution shifts are plotted on an experiment free core.

Answer: B.016 b.
Reference: PM 2.3.2 & PM 3.1.4

QUESTION: B.017 (1.0 point) [17.0]

During a normal reactor startup the reactor attains criticality before reaching the 0.5" below ECP position. The required action is to:

a. establish/maintain an infinite period and recalculate the ECP.

b. limit power to 100 kW until the cause has been determined.

c. lower the shim bank at least 1.0" and determine the cause.

d. drive all rods in and recalculate the ECP.

Answer: B.017 c.
Reference: PM 2.3, Step 11, p 2.

QUESTION: B.018 (1.0 point) [18.0]

Shim blade withdrawal motion is limited to four inches by the "subcritical position" interlock circuit. Which ONE of the following is **NOT** a reason for incorporating the subcritical interlock into the shim blade circuit?

a. To maintain the shim blade bank at a uniform height during final approach to criticality.

b. To establish a level, below the critical position, to which the shim blades may be individually withdrawn in one step.

c. To maintain the shim blade bank at a uniform height sufficient to maintain subcritical multiplication on the startup channels.

d. To provide a convenient reference point at which the operator can pause to make a complete instrument check before bringing the reactor to criticality.

Answer: B.018 c.
Reference: RSM 4.2.

Section B Normal/Emerg. Procedures & Rad Con

QUESTION: B.019 (1.0 point) [19.0]

If the Technical Specification limit for Tritium in the secondary coolant system is exceeded, all of the following actions must be performed EXCEPT:

a. Secure the secondary system water discharge flow.
b. Stop the reactor building ventilation system.
c. Isolate the reflector heat exchanger.
d. Shut down the cooling tower spray.

Answer: B.019 b.
Reference: TS 3.8.1

QUESTION: B.020 (1.0 point) [20.0]

Which ONE of the following is the reason for the irradiation time limit associated with the use of rabbits?

a. prevent swelling of containers.
b. maintain internal container size.
c. prevent embrittlement of the polyethelyene containers.
d. limit radioactive gas release in the event of a container failure.

Answer: B.020 c.
Reference: PM 1.10.8.1.1, Step 9, p 10.

(*** End of Section B ***)

Section C Plant and Rad Monitoring Systems

QUESTION: C.001 (1.0 point) [1.0]

With a nominal battery load of 72 amps, the Emergency Power Distribution System batteries have the capacity to supply power to selected instruments and pumps for approximately (___) following the loss of both external electrical power feeders.

a. 1 hour

b. 3 hours

c. 6 hours

d. 8 hours

Answer: C.001 d.
Reference: RSM - 8.35

QUESTION: C.002 (1.0 point)[2.0]

Which of the following is the method by which gamma-ray compensation is accomplished in the nuclear instrumentation compensated ion chambers.
Gamma-ray compensation is accomplished by:

a. varying the pressure of the detector Argon charge gas in conjunction with a low boron concentration coating the inside walls of the outer chamber.

b. the comparison of the currents generated in two concentric chambers in the detector, one sensitive only to gammas and one sensitive to neutrons and gammas.

c. a pulse height discriminator that eliminates (or discriminates) the pulses from the low energy gammas and allows only the higher energy neutron signals through.

d. varying the amount and concentration of the boron trifluoride gas in the compensated ion chamber thus reducing the detector's sensitivity to gamma induced ionizations.

Answer: C.002 b.
Reference: RSM-5.2.2

QUESTION: C.003 (1.0 point) [3.0]

Which of the following sensors does NOT use a flow orifice?

e. Primary flow MF-1.

f. Reflector flow DF-1.

g. Shield flow PF-1.

h. Secondary flow HF-1A.

Answer: C.003 a.
Reference: RSM-6.4.1 and 6.4.2

Section C Plant and Rad Monitoring Systems

QUESTION: C.004 (1.0 point) [4.0]

Which ONE of the following describes an automatic response of the ventilation system?

a. If temperature of the outside air drops below approximately 35EF the intake fan will trip.

b. If the main intake damper fails to close within 10 seconds of a trip signal, then the intake fan will trip.

c. If the auxiliary intake damper fails to close within 10 seconds of a trip signal, then the main damper will close.

d. In the "weekend-open" position, if activity is detected by the plenum monitors, the inlet dampers and intake fan will trip.

Answer: C.004 a.
Reference: RSM-8.3.1

DELETED PER FACILITY REQUEST ~~QUESTION: C.005 (1.0 point) [5.0]~~
~~Which of the following indications that will be automatically actuated outside of the control room when the 'trouble NW-12 gamma monitor' scam alarm actuates, and their location?~~
~~b. A red light and a bell at the reception area.~~
~~c. A blue light and a warning horn in operations office.~~
~~d. A siren and backlit signs in the containment building.~~
~~e. A horn in building NW12 and backlit signs at entrances.~~
~~Answer: C.005 a.~~
~~Reference: PM 5.6.1, RSM 7.6~~

QUESTION: C.006 (1.0 point) [6.0]

A CO_2 purge is maintained to the Vertical Thimbles during reactor operation. Which ONE of the following is the reason for maintaining this purge?

a. To maintain a positive pressure in the thimbles to prevent filling with water in the event of a seal leak.

b. To limit the amount of tritium produced during reactor operation.

c. To provide cooling to the samples during irradiation.

d. To reduce the production of Argon-41 and prevent formation of Nitric acid.

Answer: C.006 d.
Reference: RSM 2.4

Section C Plant and Rad Monitoring Systems

QUESTION: C.007 (1.0 point) [7.0]

Which ONE of the following describes the expected response in the event both door gaskets are deflated simultaneously on the Main Personnel Basement Air Lock?

a. The reactor will automatically scram.
b. Campus Patrol receives an "INTRUSION" alarm.
c. The Backup bottle of compressed air automatically supplies the door gaskets.
d. A "LOW PRESSURE AIR" alarm is received in the control room and reception area.

Answer: C.007 a.
Reference: RSM-8.10, Section 8.2.3

QUESTION: C.008 (1.0 point) [8.0]

If the normal heat removal path is NOT available for the Shutdown Cooling System, alternative cooling can be obtained from the:

a. fire protection system.
b. secondary cooling system.
c. city water supply to HE-2.
d. H2O medical shutter cooling system.

Answer: C.008 c.
Reference: RSM-3.4, Section 3.2.6; PM 5.2.8, Step B.2

QUESTION: C.009 (1.0 point) [9.0]

Which ONE of the following actions should be performed to determine if the ion column resin is exhausted?

a. Measure the inlet and outlet ion column conductivities, if both are increasing then the ion column is exhausted.
b. Measure the differential pressure drop across the ion column, if normal then the ion column resin is not exhausted.
c. Determine if the temperature of the ion column has reached 53 degrees-C, if so then the ion column is exhausted.
d. Bypass the ion column flow and if the primary coolant conductance increases then the ion column is not exhausted.

Answer: C.009 a.
Reference: PM 5.2.12

Section C Plant and Rad Monitoring Systems

DELETED PER FACILITY REQUEST ~~QUESTION: C.010 (1.0 point) [10.0]~~
~~A rapid shift of cooling tower flow from the basins to spray may cause a reactor scram by causing a:~~
~~a. a temporary reduction in secondary flow.~~
~~b. rapid cooldown of the primary and secondary systems.~~
~~c. temporary lack of heat removal until spray becomes effective.~~
~~d. pressure pulse that is transmitted via the heat exchanger to the primary, where it appears as a loss of flow on MP-6/6A.~~
~~Answer: C.010 d.~~
~~Reference: General knowledge of facility~~

QUESTION: C.011 (1.0 point) [11.0]

The voltage scrams associated with the nuclear instruments are set to trip if:

a. console power is lost.

b. compensating voltage is lost.

c. the voltage becomes too high, driving the detector into the continuous discharge region.

d. the voltage drops below the value required to maintain the detector in the ion chamber plateau region.

Answer: C.011 d.
Reference: PM 5.1.5 and MIT Notes on Nuclear Instrumentation, Sections 5.3, 5.4

QUESTION: C.012 (1.0 point) [12.0]

Which ONE of the following statements is NOT TRUE?

a. A "low air pressure cooling tower sprinkler" alarm means that either a fire exists or the cooling tower fire system's compressor has failed.

b. The "cooling tower sprinkler on" alarm means that a sprinkler head has either melted or cracked, thereby causing sprinkler flow.

c. The cooling tower fire alarm annunciates in the control room and MIT Physical Plant's control room.

d. The cooling tower fire alarm annunciates only in the reactor control room.

Answer: C.012 d.
Reference: PM 5.7.6 and 5.7.7, MIT Reactor Systems Manual, Section 8.9

Section C Plant and Rad Monitoring Systems

QUESTION: C.013 (1.0 point) [13.0]

Which of the following statements is correct regarding radiation monitoring:

a. When the reactor is operating a secondary water radiation monitor that alarms in the control room shall be inservice.

b. When secondary cooling water is flowing through the D2O heat exchangers, the secondary tritium monitor shall be in service.

c. Whenever containment is not isolated or not required, one plenum monitor shall be in service, capable of closing the dampers.

d. Whenever the reactor floor is occupied, five normal area monitors, shall be in service, capable of warning personnel of high radiation levels. If one of the monitors becomes inoperative, a portable instrument shall be used.

Answer: C.013 c, also accepted answer a.
Reference: Tech. Spec. 3.8.2, 3.8.3, 3.8.4 & 3.8.5

QUESTION: C.014 (1.0 point) [14.0]

At what building pressure should the containment pressure relief system be placed on line?

a. 3 psi

b. 2 psi

c. 2.5 psi

d. 1 psi

Answer: C.014 b.
Reference: Reactor Systems Manual 8.4, AOP PM 5.5.7

QUESTION: C.015 (1.0 point) [15.0]

Which ONE of the following alarm conditions will result in an automatic scram?

a. Low Level Dump Tank.

b. Low Flow Shield Coolant.

c. High Pressure Reactor Inlet.

d. High Level Linear Flux Channel.

Answer: C.015 b.
Reference: Reactor Systems Manual, Section 9.3.1

Section C Plant and Rad Monitoring Systems

QUESTION: C.016 (1.0 point) [16.0]

Which ONE of the following is NOT a purpose of the shield coolant system?

a. Remove heat deposited by gamma rays from the shield.
b. Cool spectrometer magnets if spectrometers are operational.
c. Remove heat from the H_2O shutter tank.
d. Cool 3GV facility samples.

Answer: C.016 c.
Reference: RSM Section 3.5.1

QUESTION: C.017 (1.0 point) [17.0]

The automatic action associated with the Sewer radiation monitor high alarm during NORMAL system operation is:

a. the Sump pumps trip.
b. the Sewer pump trips.
c. the inlet City Water solenoid valve closes.
d. the isolation valve closes to secure flow to the sewer.

Answer: C.017 a.
Reference: Reactor Systems Manual, Pages 7.7, 8.19; SAR Rev 36, Sec 12.2; SR#-0-88-11, p 2.

QUESTION: C.018 (1.0 point) [18.0]

Which ONE of the following actions should the console operator perform immediately, if during rabbit irradiation the rabbit station radiation monitor alarms?

a. Eject the sample into the hot cell using the "Abort Auto Transfer" pushbutton on the console.
b. Depress and hold the radiation alarm reset pushbutton to allow for the automatic transfer of the sample.
c. Shutdown the reactor and when radiation levels are less than the permissible limit, use the 1PH1 "Eject" pushbutton to remove the sample.
d. Perform a normal reactor shutdown, allow the radiation level to decay to the less than permissible level, then depress the OPERATE RESET pushbutton.

Answer: C.018 a.
Reference: PM 1.10, Step 4.14B, p 14.

Section C Plant and Rad Monitoring Systems

QUESTION: C.019 (1.0 point)[19.0]

Which ONE of the following is the reason for shutting down the reactor if the compressed air system pressure is less than 60 psig?

a. Personnel airlock cannot be operated.
b. Eventual loss of containment integrity.
c. Loss of ability to dump the reflector.
d. Prevent trip on low secondary flow indication.

Answer: C.019 b.
Reference: PM 5.5.4 & 5.5.17

QUESTION: C. 020 (1.0 point) [20.0]

The primary concern associated with the pressure relief system charcoal filters becoming submersed during a large leak of primary coolant is:

a. loss of efficiency in removing particulates.
b. possible spontaneous combustion during dryout.
c. reduction in relief flow capability to relieve pressure.
d. possible spread of contamination from leaks in the filter housing.

Answer: C.020 b.
Reference: PM 5.2.14

(*** End of Section C ***)