



# Psychometric Analysis

By

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# Presentation Goals



- To increase your understanding of the significance and importance of writing written examination questions free of psychometric flaws.
- To enable you to prepare a psychometrically sound question related to the subject KA.

# What is a psychometric flaw?



- A flaw where an applicant can use deductive reasoning to answer a question without knowing technical matter relevant to the question.
- It creates an undesirable misperception.
- This reminds me of a story.

# What is "Psychometric Analysis?"



The *process* of applying sound qualitative processes to mental measurements which utilize deductive reasoning to answer a question without knowing technical matter relevant to the question.



# *Brief review of NUREG guidance*

ES-401 and Appendix B contain copious amounts of information, guidance, and examples concerning psychometric flaws and pitfalls.

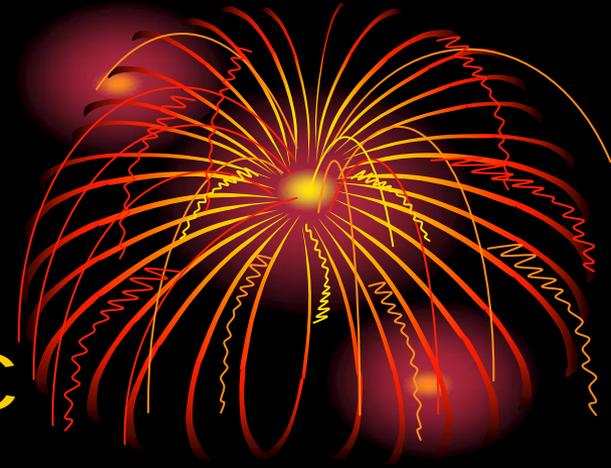
# ES-401, D.2.b



Ensure that each question is technically accurate *and free of the following psychometric flaws* that could diminish the validity of the examination:

- implausible distractors
- confusing or ambiguous language
- confusing or inappropriate negatives
- a collection of true/false statements
- backward logic
- specific determiners

# Backward-logic



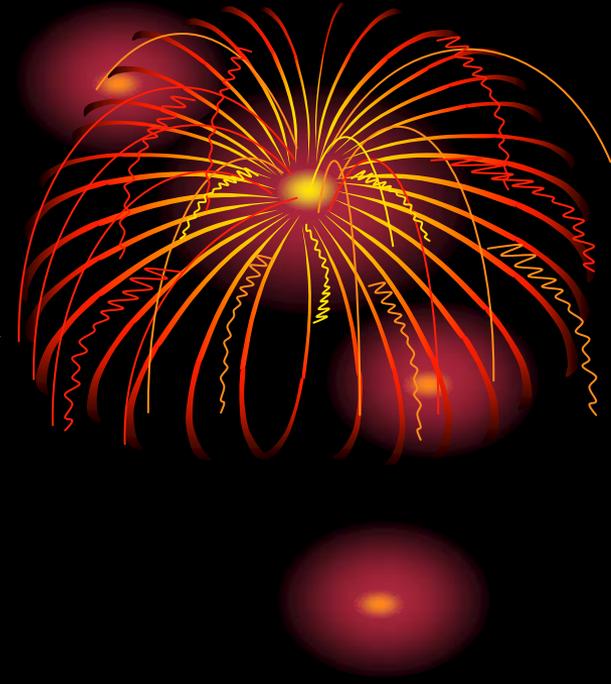
Backward-logic questions provide operators with information they normally have to produce, while asking them for information they normally receive.

# Backward Logic Item



*If the shutdown margin is 5.5 %, how long has the unit been shut down?*

A better way



*The unit has been shut down for 6 hours. Which one of the following is the correct shutdown margin?*

# specific determiners



Specific determiners give clues as to the correct answer.

During 100% normal power operation, a single steam flow element in the steam generator feedwater control system fails high. This will cause:



- a. the feedwater valves to increase steam generator level slightly before returning the level to normal.
- b. before returning the level to slightly above normal, the feedwater valves to increase the steam generator level significantly.
- c. the feedwater valves to increase the steam generator level to the level of a reactor trip
- d. the feedwater valves to increase the steam generator level lightly and maintain the increased level

## Improved distractor “b”

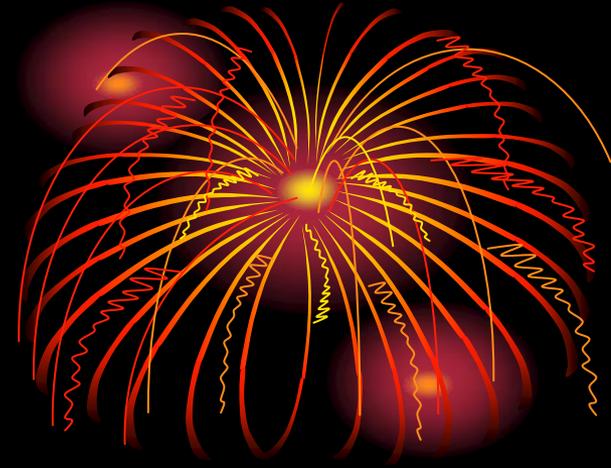
During 100% normal power operation, a single steam flow element in the steam generator feedwater control system fails high. This will cause:

- b. the feedwater valves to significantly increase the steam generator level before returning the level to slightly above normal.





- The following Psychometrically Flawed examples are actual examples lifted off of various written examinations.
- These examples are then followed by suggestions to replace these Psychometrically Flawed questions.



# Example 1



With Unit 2 at 100% power, the following conditions exist:



- B Train equipment is in operation.
- The 2B1 Component Cooling Pump trips on over-current and remains unavailable.
- The operator implements the appropriate response procedures and restores the Component Cooling System to normal operation.

Which ONE (1) of the following identifies the electrical power source(s) supplying the operating Component Cooling Pump(s)?



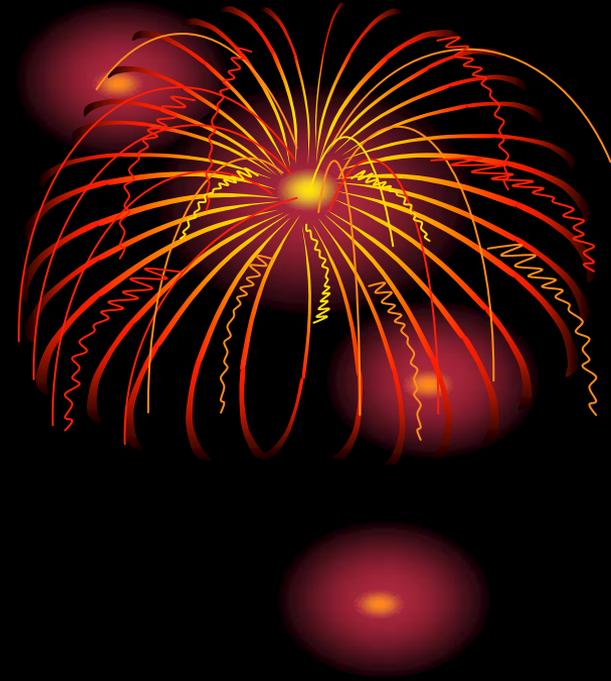
- A. 2ELXA and 2ELXB.
- B. 2ETA and 2ETB.
- C. 2ELXA.
- D. *2ETA.*

- If A was correct, C would be also.
- If B was correct, D would be also.

# Example 1 answers revised



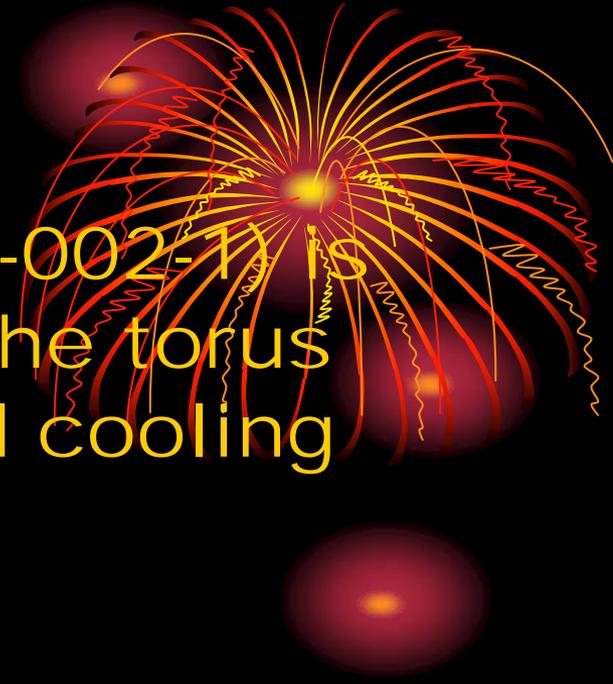
- A. 2ELXA and 2ELXB.
- B. 2ETA and 2ETB.
- C. 2ELXA ONLY.
- D. 2ETA ONLY.*



# Example 2

The HPCI Pump Operability surveillance test (34SV-E41-002-1) is in progress. The status of the torus temperature monitoring and cooling systems is:

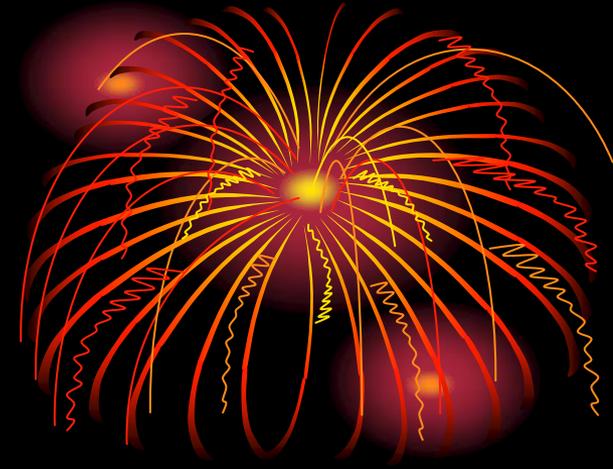
- 1T47-R611..... Operable
- 1T47-R612..... Operable
- 1T48-R647..... INOPERABLE
- SPDS..... Unavailable
- "A" Loop RHR in torus cooling
- Initial temperature just before the test was 80 °F





Given this instrumentation status, which ONE of the following is the correct criteria to determine when HPCI must be stopped to minimize heating of the suppression pool water?

- A. HPCI must be stopped at the time when  $[(\text{Avg of upper region sensors}) + (\text{Avg of lower region sensors})]/2$  reaches 95 °F.
  - B. HPCI must be stopped at the time when  $[(\text{Avg of upper region sensors}) + (\text{Avg of lower region sensors})]/2$  reaches 105 °F.
  - C. HPCI must be stopped when the run time reaches 20 minutes.
  - D. *HPCI must be stopped when the run time reaches 30 minutes.*
- If "A" was correct, "B" would be also.
  - If "C" was the correct answer, "D" would be also.



Example 2 revised



The Unit 1 HPCI Pump Operability surveillance test (34SV-E41-002-1) is in progress with the following conditions:

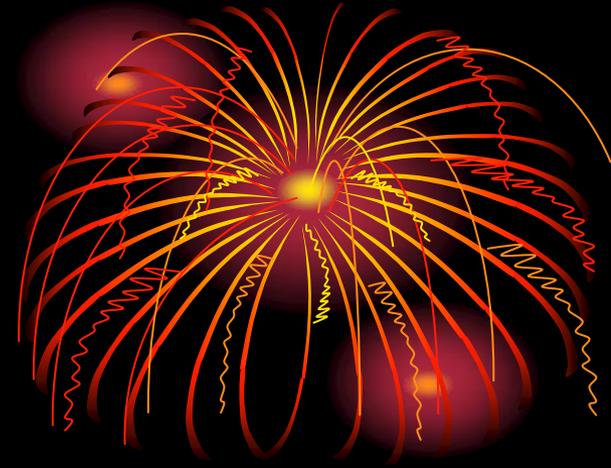
- Torus temperature is 92°F and increasing at 0.5°F/min
- Engineering has requested that the run be extended for 30 minutes to complete the system walk down
- The current time is: 1400

Given these conditions, SELECT the time that HPCI MUST be stopped to minimize heating of the suppression pool water and the required actions that the crew must perform?

HPCI is required to be stopped at time \_\_\_\_\_

Following HPCI termination, \_\_\_\_\_ of RHR in suppression pool cooling is/are required to be in service in accordance with procedures.

- A. 1416  
Only One loop
- B. 1426  
Only One loop
- C. 1416  
Both loops
- D. 1426  
*Both loops*



# Example 3





Unit 2 scrambled due to a loss of offsite power.

- All D/Gs start and tie to the 4kv Shutdown Bds.
- 480v Shutdown Bd 2B Normal feeder tripped when D D/G Output Breaker closed.
- RCIC is in operation for level control.
- A valid RCIC Rupture Disc High Pressure isolation signal is received.



Which ONE of the following is correct regarding the RCIC steam isolation valves?

- A. 71-2 will remain open & 71-3 will remain open.
- B. *71-2 will remain open & 71-3 will go closed.*
- C. 71-2 will go closed & 71-3 will remain open.
- D. 71-2 will go closed & 71-3 will go closed.

# The Problem



- "A" and "D" distractors are not plausible because of the way they are written.
- You would not say: Johnny, you left your bathroom light on and Johnny, you left your bedroom light on.
- You would say Johnny, you left both your bathroom and your bedroom lights on.
- If I didn't have a clue what the correct answer was, I would immediately dump "A" and "D." Now I have a 50/50 chance.

## Example 3 answers revised



- A. BOTH 71-2 and 71-3 will remain open.
- B. *71-2 will remain open & 71-3 will go closed.*
- C. 71-2 will go closed & 71-3 will remain open.
- D. BOTH 71-2 and 71-3 will go closed.

# Conclusion

## Psychometric flaws

- reduce the discriminatory value of the question.
- open up the potential for unnecessary post exam comments.
- can render the question unsat that could cause the exam to be unsat if the total number of unsat questions exceed 20%.



# Be very clear in what you want.



- A hopeful suitor dropped into a computer-dating center and registered his qualifications.
- He wanted someone who enjoyed water sports, liked company, favored formal attire, and was very small.
- The computer operated faultlessly.
- It sent him a penguin.



Questions?