

MEASURING COMPLEX REASONING



WORKSHOP GOALS

By end of class be able to

- ◆ Identify text suitable for writing complex reasoning items, such as policies, procedures, and regulations
- ◆ Identify the logic within the text
- ◆ Write test items based on the text that measure the ability to interpret and apply complex systems of rules to a case

What is Complex Reasoning?

- The test items we are going to look at now are intended to measure the coordinated use of multiple cognitive processes.
- In our previous test items, we were measuring relatively discrete mental processes: the ability to draw correct inferences based either on the deductive or inductive rules of inference.
- Our earlier test items do involve a degree of reading comprehension and interpretation. But now we want to measure these abilities more explicitly.
- The real life task that these exercises most closely resemble is the ability to read, interpret, and apply complex rules and regulation. For example, applying personnel rules or accounting standards.

What's Special about Complex Reasoning Items?

Complex reasoning tests are realistic and holistic

- Require the exercise of a number of different mental skills in order to break the problem down, and still others to finally solve it
- More closely approximates real world problem solving
- Much in common with math word problems: break down a complex problem into several simpler problem solving exercises
- Also resembles reading comprehension problems. But distinguished in several important respects:
 - Reading comprehension measures the ability to grasp content
 - In complex reasoning questions, grasping the content is just the beginning of the series of mental exercises required

COMPLEX REASONING FROM OUR PAST

READING COMPREHENSION

Fascinating historic sites await you in historical Hyde Park, New York. In addition to the F.D. Roosevelt Home and Eleanor Roosevelt's Val-Kill Estate, the Little Red School House and stately mansions of the Vanderbilt and Mill families can delight any visitor.

Recreation of all kinds and ability levels is available at the town's parks, and golf courses. Hyde Park also boasts a roller-skating rink, a drive in movie theatre and local diners.

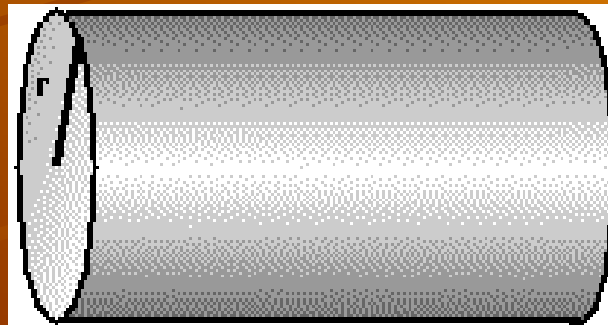
1. What was Eleanor Roosevelt's home called?

- A. Val Kil
- B. Eleanor's Inn
- C. Stony Kill
- D. Roosevelt Estate

COMPLEX REASONING FROM OUR PAST

MATHEMATICAL WORD PROBLEMS

- Suppose a water tank in the shape of a right circular cylinder is thirty feet long and eight feet in diameter.
- How much sheet metal was used in its construction?



COMPLEX REASONING FROM OUR PAST

MATHEMATICAL WORD PROBLEMS

- An executive drove from home at an average speed of 30 mph to an airport where a helicopter was waiting. The executive boarded the helicopter and flew to the corporate offices at an average speed of 60 mph. The entire distance was 150 miles; the entire trip took three hours.
- Find the distance from the airport to the corporate offices.



The Complex Steps of **COMPLEX REASONING**

- ◆ Read and comprehend the text
- ◆ Identify rules within the text
- ◆ “Abstract” those rules from the text
- ◆ Apply the rules to a particular case
- ◆ Draw inferences based on application of multiple rules

EXAMPLE TEST QUESTION

TEXT

Section 5108. Registration PERSONS REQUIRED TO FILE:

- (1) If a person has a class C license, that person must file a registration statement with the Secretary of Transportation if the person is transporting in commerce any of the following:
 - (A) radioactive material.
 - (B) shipment of a class A or B explosive in a motor vehicle, rail car, or transport container if that shipment is more than 25 kilograms.
 - (C) more than one liter of a hazardous material designated as extremely toxic by inhalation.
 - (D) hazardous material in a bulk packaging, container, or tank, if the bulk packaging, container, or tank has a capacity of at least 3,500 gallons or more than 468 cubic feet.
 - (E) a shipment of a class of hazardous material for which placarding of a vehicle, rail car, or freight container is required, if that shipment is of at least 5,000 pounds.
- (2) If radioactive material is being transported it must be transported in type A-3 tanks. If a type A-1, A-2, or A-3 tanks is carrying in excess of 1000 lbs cargo, that cargo must be registered with the Department of the Interior."

EXAMPLE TEST QUESTION

Question

1. We can infer from the above passage that:
 - A. Some persons transporting radioactive material in commerce need not file a registration statement with the Secretary of Transportation.
 - B. All persons transporting less than 25 kilograms of a class A or B explosive in a motor vehicle must file a registration statement with the Secretary of Transportation.
 - C. All persons transporting in commerce a package of more than 1 liter of hazardous material designated as extremely toxic by inhalation must file a registration statement with the Secretary of Transportation.
 - D. No transportation of class A explosives require filing a registration statement with the Secretary of Transportation.

EXAMPLE TEST QUESTION

Question

2. We can infer from the above passage that:
- A. If transporting hazardous material in bulk packaging with a capacity of 1000 gallons, a registration statement with the Secretary of Transportation must be filed.
 - B. All radioactive materials being transported must be registered with the Department of the Interior.
 - C. Only type A-3 tanks carrying in excess of 1000 lbs must be registered with the Department of the Interior.
 - D. If transporting in excess of 1000 lbs of radioactive material, the cargo must be registered with the Department of the Interior.

EXAMPLE TEST QUESTION

Question

1. We can infer from the above passage that:
 - A. Some persons transporting radioactive material in commerce need not file a registration statement with the Secretary of Transportation.
 - B. All persons transporting less than 25 kilograms of a class A or B explosive in a motor vehicle must file a registration statement with the Secretary of Transportation.
 - C. All persons transporting in commerce a package of more than 1 liter of hazardous material designated as extremely toxic by inhalation must file a registration statement with the Secretary of Transportation.
 - D. No transportation of class A explosives require filing a registration statement with the Secretary of Transportation.

EXAMPLE TEST QUESTION

Question

2. We can infer from the above passage that:
- A. If transporting hazardous material in bulk packaging with a capacity of 1000 gallons, a registration statement with the Secretary of Transportation must be filed.
 - B. All radioactive materials being transported must be registered with the Department of the Interior.
 - C. Only type A-3 tanks carrying in excess of 1000 lbs must be registered with the Department of the Interior.
 - D. If transporting in excess of 1000 lbs of radioactive material, the cargo must be registered with the Department of the Interior.

DESIGNING TEST QUESTIONS



Designing Test Questions

The Process

Identifying the logic

- Find the logical connective, such as *If...Then, Or, And*
- Identify the propositions based on logical connectives
- Select three connectives, at least two of them conditionals, that will form the basis of your test questions



IDENTIFYING THE LOGIC

After September 30, 1993, a corporation may transport crude oil only if that corporation has a current business plan that:

- Sets forth the manner of response to discharges that may occur during transportation, *and*
- Takes into account the maximum potential discharge of the contents from the packaging, *and*
- Identifies the appropriate persons and agencies to be contacted in the event of such a discharge.

After February 18, 1993, a corporation may transport crude oil in a quantity greater than 1,000 barrels (42,000 gallons) only if that corporation has a current business plan that:

- Identifies the qualified individual having full authority to implement removal actions

IDENTIFYING THE LOGIC

After September 30, 1993, a corporation may transport crude oil only if that corporation has a current business plan that:



IDENTIFYING THE LOGIC

If after September 30, 1993, then a corporation may transport crude oil only if that corporation has a current business plan that:

Sets forth the manner of response to discharges that may occur during transportation, and

Takes into account the maximum potential discharge of the contents from the packaging, and

Identifies the appropriate persons and agencies to be contacted in the event of such a discharge.

IDENTIFYING THE LOGIC

If after September 30, 1993, then a corporation may transport crude oil only if that corporation has a current business plan that:

- Sets forth the manner of response to discharges that may occur during transportation, *and*
- Takes into account the maximum potential discharge of the contents from the packaging, *and*
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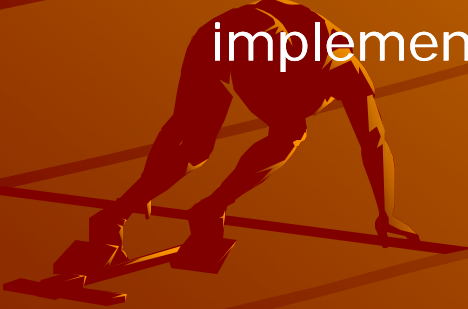
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IDENTIFYING THE LOGIC

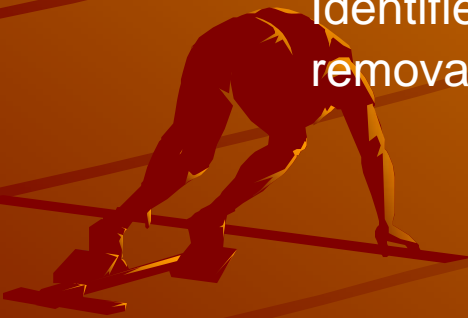
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IDENTIFYING THE LOGIC

If after February 18, 1993, then a corporation may transport crude oil in a quantity greater than 1,000 barrels (42,000 gallons) only if that corporation has a current business plan that:

Identifies the qualified individual having full authority to implement removal actions



Selecting Connectives

If after **September 30, 1993**, then a corporation may transport crude oil **only if** that corporation has a current business plan that:

- Sets forth the manner of response to discharges that may occur during transportation, *and*
- Takes into account the maximum potential discharge of the contents from the packaging, *and*
- Identifies the appropriate persons and agencies to be contacted in the event of such a discharge.

If after **February 18, 1993**, then a corporation may transport crude oil in a quantity greater than 1,000 barrels (42,000 gallons) **only if** that corporation has a current business plan that:

- Identifies the qualified individual having full authority to implement removal actions

Selecting Connectives

Corporation Q has a **current business plan** that

identifies the qualified individual having full authority to implement removal actions,

but that = and that

does not Set forth the manner of response to discharges that may occur during transportation.

CREATING A TEST QUESTION

Corporation Q has a current business plan that identifies the qualified individual having full authority to implement removal actions, but that does not set forth the manner of response to discharges that may occur during transportation.

From this we may infer that:

- A. Q may transport crude oil only if it is less than 1000 barrels
- B. Q may transport over 1500 barrels of crude oil on October 30 1993
- C. Q may transport 1500 barrels of crude oil on March 30 1993
- D. Q may transport 900 barrels of crude oil on October 30 1993