

Diagrammatic reasoning: transformations, flows, and rule diagrams: open practice pack

100 untimed questions across 10 authored sections.

Detail	Value
Pack	cognitive-skills-diagrammatic-reasoning
Source	cognitive-skills
Pack version	v1
Worksheet items	100
Authored hints	0
Worked explanations	100

This is untimed educational practice for one cognitive skill. It is not a clinical, diagnostic, employment, or professionally recognized assessment, and it does not produce an IQ score or credential.

The answer key and worked explanations in this file belong only to this public, untimed educational practice source. No active aptitude suite or Novus Reasoning Challenge answer key is ever included in any download.

Learner worksheet

One hundred untimed self-check items across ten sections, moving from single-box flows to integrated multi-stage systems. Every diagram is described in words and every rule you need appears in the prompt. No outside knowledge required.

Choose one answer for each item. For a delayed-recall item, read its study text, cover it, and then answer without looking back.

Reading single-step flow diagrams

Each item describes one operation box. Apply its rule exactly as stated.

1. diagrammatic-reasoning-s01-q01

A flow diagram shows a single box labelled 'Add 4'. The number 9 enters the box. What number comes out?

- A. 5
- B. 12
- C. 13
- D. 36

Your answer: _____

2. diagrammatic-reasoning-s01-q02

A box labelled 'Double' receives the number 7. What is the output?

- A. 9
- B. 14
- C. 21
- D. 49

Your answer: _____

3. diagrammatic-reasoning-s01-q03

A box labelled 'Reverse' receives the letter sequence P-Q-R. What sequence comes out?

- A. P-Q-R
- B. Q-P-R
- C. R-Q-P
- D. R-P-Q

Your answer: _____

4. diagrammatic-reasoning-s01-q04

A box labelled 'Remove the last item' receives the list: apple, pear, plum. What list comes out?

- A. apple, pear
- B. pear, plum
- C. apple, plum
- D. apple, pear, plum

Your answer: _____

5. diagrammatic-reasoning-s01-q05

A box labelled 'Rotate 90° clockwise' receives a printed arrow pointing straight up. Which way does the arrow point on the way out?

- A. Up
- B. Down
- C. Left
- D. Right

Your answer: _____

6. diagrammatic-reasoning-s01-q06

A box labelled 'Swap the first and last symbols' receives the sequence ? ? ? ?. What comes out?

- A. ? ? ? ?
- B. ? ? ? ?
- C. ? ? ? ?
- D. ? ? ? ?

Your answer: _____

7. diagrammatic-reasoning-s01-q07

A box labelled 'Halve' receives the number 26. What is the output?

- A. 12
- B. 13
- C. 24
- D. 52

Your answer: _____

8. diagrammatic-reasoning-s01-q08

A box labelled 'Toggle shading' turns white figures black and black figures white without changing the shape. A white triangle enters. What comes out?

- A. A white triangle
- B. A black square
- C. A white circle
- D. A black triangle

Your answer: _____

9. diagrammatic-reasoning-s01-q09

A box labelled 'Repeat the whole sequence twice' receives the sequence A-B. What comes out?

- A. A-A-B-B
- B. A-B-A-B
- C. A-B-B-A
- D. B-A-B-A

Your answer: _____

10. diagrammatic-reasoning-s01-q10

A box labelled 'Subtract 6' receives the number 6. What is the output?

- A. 0
- B. 1
- C. 6
- D. 12

Your answer: _____

Two-step operator chains

Apply the two boxes strictly in the order shown, left to right.

11. diagrammatic-reasoning-s02-q01

The number 5 enters [Add 3] and the result enters [Double]. What is the output?

- A. 13
- B. 16
- C. 11
- D. 10

Your answer: _____

12. diagrammatic-reasoning-s02-q02

The number 12 enters [Halve] and the result enters [Subtract 2]. What is the output?

- A. 4

- B. 5
- C. 8
- D. 10

Your answer: _____

13. diagrammatic-reasoning-s02-q03

The letters C-A-T enter [Reverse] and the result enters [Remove the last letter]. What comes out?

- A. A-T
- B. C-A
- C. T-C
- D. T-A

Your answer: _____

14. diagrammatic-reasoning-s02-q04

An arrow pointing north enters [Rotate 90° clockwise] and the result enters [Rotate 180°]. Which way does it finally point?

- A. North
- B. East
- C. West
- D. South

Your answer: _____

15. diagrammatic-reasoning-s02-q05

The list 2, 4, 6, 8 enters [Remove the first item] and the result enters [Reverse]. What comes out?

- A. 8, 6, 4, 2
- B. 8, 6, 4
- C. 4, 6, 8
- D. 6, 4, 2

Your answer: _____

16. diagrammatic-reasoning-s02-q06

The number 3 enters [Square] and the result enters [Add 1]. What is the output?

- A. 16
- B. 7
- C. 9
- D. 10

Your answer: _____

17. diagrammatic-reasoning-s02-q07

A white circle enters [Toggle shading] and the result enters [Rotate 90° clockwise]. What comes out?

- A. A black circle

- B. A white circle
- C. A black square
- D. A white square

Your answer: _____

18. diagrammatic-reasoning-s02-q08

The word STAR enters [Swap the first and last letters] and the result enters [Reverse]. What comes out?

- A. RATS
- B. RTAS
- C. SATR
- D. TARS

Your answer: _____

19. diagrammatic-reasoning-s02-q09

The number 18 enters [Subtract 4] and the result enters [Halve]. What is the output?

- A. 9
- B. 5
- C. 7
- D. 14

Your answer: _____

20. diagrammatic-reasoning-s02-q10

The number 6 enters [Add 2] then [Double], giving 16. If the same two boxes are wired in the opposite order, [Double] then [Add 2], what output does 6 produce?

- A. 16
- B. 14
- C. 12
- D. 10

Your answer: _____

Inferring hidden rules from examples

Each box's rule is unknown: deduce it from the example pairs by testing every candidate against every pair.

21. diagrammatic-reasoning-s03-q01

A mystery box turns 3 into 6, 5 into 10, and 9 into 18. What is the box's rule?

- A. It adds 3
- B. It doubles
- C. It squares
- D. It adds 5

Your answer: _____

22. diagrammatic-reasoning-s03-q02

A mystery box turns 10 into 7, 8 into 5, and 6 into 3. What is its rule?

- A. It halves
- B. It subtracts 2
- C. It subtracts 4
- D. It subtracts 3

Your answer: _____

23. diagrammatic-reasoning-s03-q03

A mystery box turns CAT into TAC and STOP into POTS. What is its rule?

- A. It reverses all the letters
- B. It swaps only the first and last letters
- C. It moves the last letter to the front
- D. It writes the letters in alphabetical order

Your answer: _____

24. diagrammatic-reasoning-s03-q04

A mystery box turns 4 into 16, 5 into 25, and 7 into 49. What is its rule?

- A. It multiplies by 4
- B. It adds 12
- C. It squares
- D. It multiplies by 5

Your answer: _____

25. diagrammatic-reasoning-s03-q05

A mystery box turns the sequence 1-2-3 into 1-2-3-1, and the sequence X-Y into X-Y-X. What is its rule?

- A. It repeats the whole sequence
- B. It copies the first symbol onto the end
- C. It copies the last symbol onto the front
- D. It reverses the sequence

Your answer: _____

26. diagrammatic-reasoning-s03-q06

A mystery box turns 7 into 15, 10 into 21, and 4 into 9. What is its rule?

- A. It doubles, then adds 1
- B. It adds 8
- C. It doubles, then subtracts 1
- D. It triples, then subtracts 6

Your answer: _____

27. diagrammatic-reasoning-s03-q07

A mystery box turns a black square into a white square, and a white triangle into a black triangle. What is its rule?

- A. It turns every figure black
- B. It turns every figure white
- C. It changes the shape but keeps the shading
- D. It swaps the shading but keeps the shape

Your answer: _____

28. diagrammatic-reasoning-s03-q08

A mystery box turns 12 into 6, 20 into 10, and 8 into 4. What is its rule?

- A. It subtracts 6
- B. It subtracts 10
- C. It halves
- D. It divides by 3

Your answer: _____

29. diagrammatic-reasoning-s03-q09

A mystery box turns BOLT into BOL, RAIN into RAI, and TREE into TRE. What is its rule?

- A. It removes the last letter
- B. It removes the first letter
- C. It keeps only the first letter
- D. It removes all vowels

Your answer: _____

30. diagrammatic-reasoning-s03-q10

A mystery box turns 2 into 8. Which rule is consistent with BOTH 2->8 and 3->27?

- A. It multiplies by 4
- B. It cubes
- C. It adds 6
- D. It squares, then adds 4

Your answer: _____

Sequence and series patterns

Work out the pattern that generates each series, then predict the next term.

31. diagrammatic-reasoning-s04-q01

A series of frames shows: 1 dot, 2 dots, 3 dots, 4 dots. How many dots are in the next frame?

- A. 4 dots
- B. 6 dots
- C. 3 dots
- D. 5 dots

Your answer: _____

32. diagrammatic-reasoning-s04-q02

A series of squares alternates: black, white, black, white. What colour is the next square?

- A. Black
- B. White
- C. Grey
- D. Striped

Your answer: _____

33. diagrammatic-reasoning-s04-q03

An arrow rotates the same amount each frame: it points up, then right, then down. Where does it point next?

- A. Up
- B. Right
- C. Left
- D. Down

Your answer: _____

34. diagrammatic-reasoning-s04-q04

A series of frames shows: 1 black dot, then 2 white dots, then 3 black dots, then 4 white dots. What does the next frame show?

- A. 5 white dots
- B. 5 black dots
- C. 4 black dots
- D. 6 white dots

Your answer: _____

35. diagrammatic-reasoning-s04-q05

A series of shapes shows: triangle, square, pentagon. Which shape comes next?

- A. Circle
- B. Triangle
- C. Octagon
- D. Hexagon

Your answer: _____

36. diagrammatic-reasoning-s04-q06

A star sits in the top-left corner of a square frame, then the top-right corner, then the bottom-right corner. Where is it in the next frame?

- A. Top-left corner
- B. Bottom-left corner
- C. Top-right corner
- D. The centre

Your answer: _____

37. diagrammatic-reasoning-s04-q07

What is the next number in the series: 2, 4, 3, 6, 5, 10, 9, ...?

- A. 18
- B. 11
- C. 8
- D. 13

Your answer: _____

38. diagrammatic-reasoning-s04-q08

What is the next letter in the series: A, C, F, J, ...?

- A. N
- B. M
- C. O
- D. P

Your answer: _____

39. diagrammatic-reasoning-s04-q09

A series shows: a small arrow pointing up, a medium arrow pointing right, a large arrow pointing down. Sizes cycle small -> medium -> large -> small, and the arrow keeps rotating 90° clockwise. What comes next?

- A. A large arrow pointing left
- B. A medium arrow pointing left
- C. A small arrow pointing up
- D. A small arrow pointing left

Your answer: _____

40. diagrammatic-reasoning-s04-q10

A 3x3 grid of dot counts reads: row 1: 1, 2, 3; row 2: 2, 3, 4; row 3: 3, 4, ?. What number completes the grid?

- A. 4
- B. 6
- C. 5
- D. 7

Your answer: _____

Branching flowcharts and decisions

Follow each decision diamond carefully. Answer the question asked at each branch before moving on.

41. diagrammatic-reasoning-s05-q01

A flowchart takes the number 7 to a decision: 'Is it even?' Yes leads to [Add 1]; No leads to [Add 3]. What is the output?

- A. 8
- B. 7
- C. 10
- D. 11

Your answer: _____

42. diagrammatic-reasoning-s05-q02

A flowchart takes the number 12 to a decision: 'Is it greater than 10?' Yes leads to [Halve]; No leads to [Double]. What is the output?

- A. 6
- B. 24
- C. 12
- D. 5

Your answer: _____

43. diagrammatic-reasoning-s05-q03

A flowchart takes the number 9 through two decisions. First: 'Is it even?' Yes -> [Halve]; No -> [Add 1]. Then: 'Is the result greater than 8?' Yes -> [Subtract 5]; No -> [Add 5]. What is the output?

- A. 15
- B. 5
- C. 10
- D. 4

Your answer: _____

44. diagrammatic-reasoning-s05-q04

A flowchart takes the word ORANGE through two decisions. First: 'Does it have more than 5 letters?' Yes -> [Remove the last letter]. Then: 'Does it start with a vowel?' Yes -> [Reverse it]. What comes out?

- A. ORANG
- B. EGNARO
- C. ORANGE
- D. GNARO

Your answer: _____

45. diagrammatic-reasoning-s05-q05

A flowchart takes the number 15 through two decisions. First: 'Is it a multiple of 3?' Yes -> [Divide by 3]; No -> [Add 3]. Then: 'Is the result odd?' Yes -> [Add 1]; No -> [Halve]. What is the output?

- A. 6
- B. 5
- C. 18
- D. 9

Your answer: _____

46. diagrammatic-reasoning-s05-q06

A parcel-sorting flowchart asks in order: 'Does it weigh over 2 kg?' Yes -> send to Depot B. No -> 'Is it marked fragile?' Yes -> send to Depot C; No -> send to Depot A. Where does a 1.5 kg parcel marked fragile go?

- A. Depot A
- B. Depot B
- C. Depot C
- D. It cannot be determined

Your answer: _____

47. diagrammatic-reasoning-s05-q07

Using the same sorting chart, over 2 kg -> Depot B; otherwise fragile -> Depot C; otherwise -> Depot A, which parcel ends up at Depot A?

- A. A 3 kg parcel, not fragile
- B. A 1 kg parcel, marked fragile
- C. A 2.5 kg parcel, marked fragile
- D. A 1.8 kg parcel, not fragile

Your answer: _____

48. diagrammatic-reasoning-s05-q08

A flowchart takes 24 through three decisions in order: 'Even?' Yes -> [Halve]. 'Multiple of 3?' Yes -> [Divide by 3]. 'Greater than 5?' No -> [Add 10]. What is the output?

- A. 4
- B. 14
- C. 12
- D. 24

Your answer: _____

49. diagrammatic-reasoning-s05-q09

A flowchart doubles even inputs and adds 5 to odd inputs. The output was 18. What was the input?

- A. 9
- B. 13
- C. 36
- D. 23

Your answer: _____

50. diagrammatic-reasoning-s05-q10

A flowchart takes the pair (6, 9). First decision: 'Is the first number even?' Yes -> [Swap the pair]. Second decision: 'Is the sum greater than 14?' Yes -> output the sum; No -> output the difference. What is the output?

- A. 3
- B. 6

- C. 9
- D. 15

Your answer: _____

State and process diagrams

Track the current state after each signal. States change only when a listed transition allows it.

51. diagrammatic-reasoning-s06-q01

A traffic system cycles Green -> Amber -> Red -> Green, one step per change. It currently shows Amber. What does it show after two changes?

- A. Green
- B. Red
- C. Amber
- D. Flashing amber

Your answer: _____

52. diagrammatic-reasoning-s06-q02

A door has states Locked, Closed, and Open. 'Turn key' switches between Locked and Closed. 'Push' moves Closed to Open and has no effect otherwise. Starting from Locked, apply: turn key, push. What state results?

- A. Locked
- B. Closed
- C. Open
- D. It cannot be determined

Your answer: _____

53. diagrammatic-reasoning-s06-q03

A ticket machine moves Idle -> (insert coin) -> Ready -> (press button) -> Printing -> (finishes automatically) -> Idle. From Idle, a coin is inserted and the button is pressed. What state is the machine in?

- A. Idle
- B. Ready
- C. Refunding
- D. Printing

Your answer: _____

54. diagrammatic-reasoning-s06-q04

The same ticket machine ignores a button press while Idle. From Idle, the sequence is: press button, insert coin, press button. What state results?

- A. Idle
- B. Printing
- C. Ready
- D. The machine jams

Your answer: _____

55. diagrammatic-reasoning-s06-q05

A lift starts at floor 2. Each U signal moves it up one floor and each D signal moves it down one. After the signals U, U, D, U, which floor is it on?

- A. Floor 3
- B. Floor 5
- C. Floor 4
- D. Floor 2

Your answer: _____

56. diagrammatic-reasoning-s06-q06

A washing machine runs Fill -> Wash -> Rinse -> Spin -> Done. An 'advance' signal moves it one stage on; a 'hold' signal keeps the current stage. From Fill, the signals are: advance, advance, hold, advance. What stage is it in?

- A. Spin
- B. Rinse
- C. Wash
- D. Done

Your answer: _____

57. diagrammatic-reasoning-s06-q07

A turnstile has two states. In Locked, a coin unlocks it and a push does nothing. In Unlocked, a push locks it again and a coin does nothing. From Locked, apply: coin, coin, push, push. What state results?

- A. Unlocked
- B. Locked
- C. Jammed
- D. It cannot be determined

Your answer: _____

58. diagrammatic-reasoning-s06-q08

In a conveyor network, Station 1 sends even-numbered crates to Station 3 and odd-numbered crates to Station 2. Which stations does crate number 8 visit?

- A. Stations 1 and 2
- B. Station 2 only
- C. Stations 1, 2 and 3
- D. Stations 1 and 3

Your answer: _____

59. diagrammatic-reasoning-s06-q09

A worker's status moves down one level (Fresh -> Tired -> Exhausted) after every second task completed at the current level. A rest moves the status up one level and resets the task count. Starting Fresh, the sequence is: task, task, task, rest, task. What is the final status?

- A. Fresh

- B. Tired
- C. Exhausted
- D. It cannot be determined

Your answer: _____

60. diagrammatic-reasoning-s06-q10

A vending machine charges 30p. Credit accumulates as coins are inserted; the moment credit reaches 30p or more it vends and keeps only the excess as credit. Coins inserted: 20p, 20p, 10p. What is the final credit?

- A. 0p
- B. 10p
- C. 20p
- D. 30p

Your answer: _____

Deducing unknown operators in pipelines

Work out what each mystery operator does from its examples before applying it to the new input.

61. diagrammatic-reasoning-s07-q01

Operator ? turns 4 into 8 and 10 into 20. What does ? give for the input 6?

- A. 10
- B. 12
- C. 8
- D. 36

Your answer: _____

62. diagrammatic-reasoning-s07-q02

Operator ? turns A-B-C into C-B-A and P-Q into Q-P. What does ? give for R-S-T?

- A. R-S-T
- B. S-R-T
- C. R-T-S
- D. T-S-R

Your answer: _____

63. diagrammatic-reasoning-s07-q03

Operator ? doubles its input. Operator ? turns 5 into 8 and 9 into 12. What is the output of 4 -> [?] -> [?]?

- A. 11
- B. 14
- C. 10
- D. 19

Your answer: _____

64. diagrammatic-reasoning-s07-q04

Operator ? turns 1-2-3 into 2-3, and 7-8-9-10 into 8-9-10. What does ? give for X-Y-Z?

- A. X-Y
- B. Z
- C. Y-Z
- D. X-Z

Your answer: _____

65. diagrammatic-reasoning-s07-q05

A single mystery box turns 3 into 9 and 5 into 15. What is its rule?

- A. It squares
- B. It adds 6
- C. It multiplies by 3
- D. It adds 10

Your answer: _____

66. diagrammatic-reasoning-s07-q06

In the pipeline input $\rightarrow$ [P] $\rightarrow$ [Q] $\rightarrow$ output, the input 2 produces 9 and the input 5 produces 15. P doubles its input. What must Q do?

- A. Add 3
- B. Double
- C. Subtract 5
- D. Add 5

Your answer: _____

67. diagrammatic-reasoning-s07-q07

Operator ? toggles shading (white ? black). Operator ? rotates a figure 90° clockwise. A white arrow pointing up passes through [?] then [?]. What comes out?

- A. A white arrow pointing right
- B. A black arrow pointing right
- C. A black arrow pointing up
- D. A black arrow pointing left

Your answer: _____

68. diagrammatic-reasoning-s07-q08

Two boxes, [Add 2] and [Halve], are wired one after the other in an unknown order. The input 6 produces the output 5. Which order are they in?

- A. Halve first, then Add 2
- B. Add 2 first, then Halve
- C. Either order gives 5
- D. Neither order can give 5

Your answer: _____

69. diagrammatic-reasoning-s07-q09

In the pipeline input -> [Reverse] -> [?] -> output, the input 4-7-2 produces 2-7 and the input 1-5 produces 5. What does ? do?

- A. It removes the first item
- B. It keeps only the first item
- C. It reverses again
- D. It removes the last item

Your answer: _____

70. diagrammatic-reasoning-s07-q10

In the pipeline 5 -> [Double] -> [X] -> [Double] -> 14, operator X applies the same rule every time. What does X give for the input 12?

- A. 9
- B. 15
- C. 24
- D. 6

Your answer: _____

Loops and repeated processes

Repeat the rule exactly as stated and re-check the stopping condition after every pass.

71. diagrammatic-reasoning-s08-q01

Start with 3. Keep doubling until the number exceeds 20, then stop. What is the final number?

- A. 12
- B. 20
- C. 48
- D. 24

Your answer: _____

72. diagrammatic-reasoning-s08-q02

Start with 2. Keep doubling until the number exceeds 30. How many doublings are performed?

- A. 5
- B. 4
- C. 3
- D. 6

Your answer: _____

73. diagrammatic-reasoning-s08-q03

Start with 100. Repeatedly subtract 15 until the result is 40 or less. What is the final number?

- A. 40
- B. 25
- C. 55

- D. 45

Your answer: _____

74. diagrammatic-reasoning-s08-q04

Start with 1. Add 3 on each pass and stop as soon as the total reaches 13 or more. How many passes run?

- A. 3
- B. 5
- C. 4
- D. 6

Your answer: _____

75. diagrammatic-reasoning-s08-q05

Start with the word DIAGRAMS. Remove the last letter repeatedly until exactly 4 letters remain. What is left?

- A. DIAG
- B. DIAGR
- C. RAMS
- D. DIA

Your answer: _____

76. diagrammatic-reasoning-s08-q06

A loop applies this rule: if the number is even, halve it; if odd, add 5. Start with 9 and apply the rule exactly 3 times. What results?

- A. 7
- B. 14
- C. 6
- D. 12

Your answer: _____

77. diagrammatic-reasoning-s08-q07

Start with 5. On odd-numbered passes (1st, 3rd, ...) add 2; on even-numbered passes subtract 1. Run exactly 4 passes. What results?

- A. 9
- B. 6
- C. 7
- D. 8

Your answer: _____

78. diagrammatic-reasoning-s08-q08

A loop halves the number while it is even. Start with 48. What is the final number?

- A. 6
- B. 3

- C. 1
- D. 24

Your answer: _____

79. diagrammatic-reasoning-s08-q09

Start with 7. Loop: if the number is odd, add 3; if even, halve it. Stop when the number is below 5. What is the final number?

- A. 4
- B. 5
- C. 2
- D. 8

Your answer: _____

80. diagrammatic-reasoning-s08-q10

A loop applies this rule: if the number is odd, add 2; stop when the number becomes even. Start with 9. What happens?

- A. It stops at 10
- B. It stops at 11
- C. It stops after exactly five passes
- D. It never stops

Your answer: _____

Fault-finding in operator networks

A box may fail by passing its input through unchanged. Compare expected and actual outputs to isolate the fault.

81. diagrammatic-reasoning-s09-q01

The pipeline [Add 5] -> [Double] receives 3. The expected output is 16, but the actual output is 8. Which box failed by passing its input unchanged?

- A. The Add 5 box
- B. The Double box
- C. Both boxes
- D. Neither box

Your answer: _____

82. diagrammatic-reasoning-s09-q02

The pipeline [Reverse] -> [Remove the last item] receives A-B-C-D. The expected output is D-C-B, but the actual output is A-B-C. Which box failed by passing its input unchanged?

- A. The Reverse box
- B. The Remove box
- C. Both boxes
- D. Neither box

Your answer: _____

83. diagrammatic-reasoning-s09-q03

The pipeline [Subtract 2] -> [Triple] receives 6. The expected output is 12, but the actual output is 18. Which box failed by passing its input unchanged?

- A. The Triple box
- B. Both boxes
- C. The Subtract 2 box
- D. Neither box

Your answer: _____

84. diagrammatic-reasoning-s09-q04

The pipeline [Toggle shading] -> [Rotate 180°] receives a white arrow pointing up. The expected output is a black arrow pointing down, but the actual output is a white arrow pointing down. Which box failed by passing its input unchanged?

- A. The Rotate box
- B. Both boxes
- C. Neither box
- D. The Toggle shading box

Your answer: _____

85. diagrammatic-reasoning-s09-q05

The pipeline [Add 1] -> [Double] -> [Subtract 3] receives 4. The expected output is 7, but the actual output is 5. Exactly one box passed its input unchanged. Which one?

- A. The Add 1 box
- B. The Double box
- C. The Subtract 3 box
- D. It cannot be determined

Your answer: _____

86. diagrammatic-reasoning-s09-q06

The pipeline [Double] -> [Subtract 4] -> [Double] receives 5. The expected output is 12, but the actual output is 20. Exactly one box passed its input unchanged. Which one?

- A. The first Double box
- B. The second Double box
- C. The Subtract 4 box
- D. None of the boxes

Your answer: _____

87. diagrammatic-reasoning-s09-q07

A box labelled 'Add 10' receives 7 and outputs 27. Which fault mode best describes its behaviour?

- A. It did nothing

- B. It applied its rule twice
- C. It subtracted instead of adding
- D. It worked correctly

Your answer: _____

88. diagrammatic-reasoning-s09-q08

A network splits the input 12 down two paths, top: [Halve]; bottom: [Subtract 8], then adds the two results. The expected output is 10, but the actual output is 16. Which component failed by passing its input unchanged?

- A. The Subtract 8 box
- B. Both boxes
- C. Neither box
- D. The Halve box

Your answer: _____

89. diagrammatic-reasoning-s09-q09

The pipeline [Remove the first item] -> [Reverse] -> [Remove the first item] receives 1-2-3-4. The expected output is 3-2, but the actual output is 3-2-1. Exactly one box passed its input unchanged. Which one?

- A. The Reverse box
- B. The second Remove box
- C. None of the boxes
- D. The first Remove box

Your answer: _____

90. diagrammatic-reasoning-s09-q10

A 'Double' box is tested twice. Test 1: input 3 gives output 6. Test 2: input 8 gives output 8. What is the soundest conclusion?

- A. It doubled correctly in the first test but passed the input unchanged in the second
- B. It always works correctly
- C. It never works correctly
- D. It halves even numbers

Your answer: _____

Integrated system challenges

These combine rule deduction, ordering, loops, and faults. Verify each stage before moving to the next.

91. diagrammatic-reasoning-s10-q01

A white arrow pointing north passes through [Rotate 90° clockwise] -> [Toggle shading] -> [Rotate 90° clockwise]. What comes out?

- A. A white arrow pointing south
- B. A black arrow pointing north
- C. A black arrow pointing south
- D. A black arrow pointing west

Your answer: _____

92. diagrammatic-reasoning-s10-q02

Operator ? doubles its input; operator ? adds a fixed number. The pipeline [?] -> [?] turns 6 into 15 and 10 into 23. What does the reversed pipeline [?] -> [?] give for the input 8?

- A. 19
- B. 16
- C. 13
- D. 22

Your answer: _____

93. diagrammatic-reasoning-s10-q03

In a network, the numbers 3 and 5 enter a [Multiply] box. Its result and the number 4 then enter a [Difference] box that subtracts the smaller from the larger. What is the final output?

- A. 19
- B. 11
- C. 60
- D. 7

Your answer: _____

94. diagrammatic-reasoning-s10-q04

A network routes by parity: even inputs go through [Square]; odd inputs go through [Add 7, then Halve]. The input 9 enters, and the result then passes through the network once more. What is the final output?

- A. 64
- B. 8
- C. 16
- D. 32

Your answer: _____

95. diagrammatic-reasoning-s10-q05

Analogy: a white arrow pointing up is to a white arrow pointing right as a black arrow pointing left is to what?

- A. A black arrow pointing down
- B. A white arrow pointing up
- C. A black arrow pointing right
- D. A black arrow pointing up

Your answer: _____

96. diagrammatic-reasoning-s10-q06

The pipeline [Add 2] -> [Double] -> [Subtract 1] should turn 5 into 13, but a test run produced 9. Exactly one box passes its input unchanged. What output will the same faulty machine give for the input 10?

- A. 23
- B. 21

- C. 19
- D. 20

Your answer: _____

97. diagrammatic-reasoning-s10-q07

Start with 2. Each pass sends the value through [Double] then [Add 1]. Repeat passes until the value exceeds 20, then stop. What is the final value?

- A. 23
- B. 11
- C. 22
- D. 21

Your answer: _____

98. diagrammatic-reasoning-s10-q08

A machine has a single store. When a number arrives: if the store is empty, the number is stored; otherwise the machine outputs the sum of the store and the arrival, then clears the store. The inputs are 3, 4, 6, 2 in that order. What is the second number the machine outputs?

- A. 7
- B. 8
- C. 6
- D. 9

Your answer: _____

99. diagrammatic-reasoning-s10-q09

A figure series shows: (1 black dot, 8 white dots), (2 black, 6 white), (3 black, 4 white), (4 black, 2 white). How many dots in total does the fifth figure contain?

- A. 7
- B. 6
- C. 5
- D. 9

Your answer: _____

100. diagrammatic-reasoning-s10-q10

Operator ? turns 3 into 9 and 5 into 15. Operator ? turns 12 into 6 and 8 into 4. Starting with 4, apply ?, then ?, then ?, then ?. What is the final value?

- A. 12
- B. 9
- C. 18
- D. 6

Your answer: _____

Authored hints

This cognitive practice source does not publish authored hints. Every item is listed as missing a hint, and no hint text is generated or inferred.

100 worksheet items do not have an authored hint. No hint text was generated for them.

Answer key

The answer key and worked explanations in this file belong only to this public, untimed educational practice source. No active aptitude suite or Novus Reasoning Challenge answer key is ever included in any download.

Diagrammatic reasoning: transformations, flows, and rule diagrams: open practice pack answer key

Item	Choice	Answer
diagrammatic-reasoning-s01-q01	C	13
diagrammatic-reasoning-s01-q02	B	14
diagrammatic-reasoning-s01-q03	C	R-Q-P
diagrammatic-reasoning-s01-q04	A	apple, pear
diagrammatic-reasoning-s01-q05	D	Right
diagrammatic-reasoning-s01-q06	A	? ? ? ?
diagrammatic-reasoning-s01-q07	B	13
diagrammatic-reasoning-s01-q08	D	A black triangle
diagrammatic-reasoning-s01-q09	B	A-B-A-B
diagrammatic-reasoning-s01-q10	A	0
diagrammatic-reasoning-s02-q01	B	16
diagrammatic-reasoning-s02-q02	A	4
diagrammatic-reasoning-s02-q03	D	T-A
diagrammatic-reasoning-s02-q04	C	West
diagrammatic-reasoning-s02-q05	B	8, 6, 4
diagrammatic-reasoning-s02-q06	D	10
diagrammatic-reasoning-s02-q07	A	A black circle
diagrammatic-reasoning-s02-q08	C	SATR
diagrammatic-reasoning-s02-q09	C	7
diagrammatic-reasoning-s02-q10	B	14
diagrammatic-reasoning-s03-q01	B	It doubles
diagrammatic-reasoning-s03-q02	D	It subtracts 3
diagrammatic-reasoning-s03-q03	A	It reverses all the letters
diagrammatic-reasoning-s03-q04	C	It squares
diagrammatic-reasoning-s03-q05	B	It copies the first symbol onto the end
diagrammatic-reasoning-s03-q06	A	It doubles, then adds 1
diagrammatic-reasoning-s03-q07	D	It swaps the shading but keeps the shape
diagrammatic-reasoning-s03-q08	C	It halves
diagrammatic-reasoning-s03-q09	A	It removes the last letter

diagrammatic-reasoning-s03-q10	B	It cubes
diagrammatic-reasoning-s04-q01	D	5 dots
diagrammatic-reasoning-s04-q02	A	Black
diagrammatic-reasoning-s04-q03	C	Left
diagrammatic-reasoning-s04-q04	B	5 black dots
diagrammatic-reasoning-s04-q05	D	Hexagon
diagrammatic-reasoning-s04-q06	B	Bottom-left corner
diagrammatic-reasoning-s04-q07	A	18
diagrammatic-reasoning-s04-q08	C	O
diagrammatic-reasoning-s04-q09	D	A small arrow pointing left
diagrammatic-reasoning-s04-q10	C	5
diagrammatic-reasoning-s05-q01	C	10
diagrammatic-reasoning-s05-q02	A	6
diagrammatic-reasoning-s05-q03	B	5
diagrammatic-reasoning-s05-q04	D	GNARO
diagrammatic-reasoning-s05-q05	A	6
diagrammatic-reasoning-s05-q06	C	Depot C
diagrammatic-reasoning-s05-q07	D	A 1.8 kg parcel, not fragile
diagrammatic-reasoning-s05-q08	B	14
diagrammatic-reasoning-s05-q09	B	13
diagrammatic-reasoning-s05-q10	D	15
diagrammatic-reasoning-s06-q01	A	Green
diagrammatic-reasoning-s06-q02	C	Open
diagrammatic-reasoning-s06-q03	D	Printing
diagrammatic-reasoning-s06-q04	B	Printing
diagrammatic-reasoning-s06-q05	C	Floor 4
diagrammatic-reasoning-s06-q06	A	Spin
diagrammatic-reasoning-s06-q07	B	Locked
diagrammatic-reasoning-s06-q08	D	Stations 1 and 3
diagrammatic-reasoning-s06-q09	A	Fresh
diagrammatic-reasoning-s06-q10	C	20p
diagrammatic-reasoning-s07-q01	B	12
diagrammatic-reasoning-s07-q02	D	T-S-R
diagrammatic-reasoning-s07-q03	A	11
diagrammatic-reasoning-s07-q04	C	Y-Z
diagrammatic-reasoning-s07-q05	C	It multiplies by 3
diagrammatic-reasoning-s07-q06	D	Add 5
diagrammatic-reasoning-s07-q07	B	A black arrow pointing right
diagrammatic-reasoning-s07-q08	A	Halve first, then Add 2
diagrammatic-reasoning-s07-q09	D	It removes the last item

diagrammatic-reasoning-s07-q10	A	9
diagrammatic-reasoning-s08-q01	D	24
diagrammatic-reasoning-s08-q02	B	4
diagrammatic-reasoning-s08-q03	A	40
diagrammatic-reasoning-s08-q04	C	4
diagrammatic-reasoning-s08-q05	A	DIAG
diagrammatic-reasoning-s08-q06	D	12
diagrammatic-reasoning-s08-q07	C	7
diagrammatic-reasoning-s08-q08	B	3
diagrammatic-reasoning-s08-q09	A	4
diagrammatic-reasoning-s08-q10	D	It never stops
diagrammatic-reasoning-s09-q01	B	The Double box
diagrammatic-reasoning-s09-q02	A	The Reverse box
diagrammatic-reasoning-s09-q03	C	The Subtract 2 box
diagrammatic-reasoning-s09-q04	D	The Toggle shading box
diagrammatic-reasoning-s09-q05	A	The Add 1 box
diagrammatic-reasoning-s09-q06	C	The Subtract 4 box
diagrammatic-reasoning-s09-q07	B	It applied its rule twice
diagrammatic-reasoning-s09-q08	D	The Halve box
diagrammatic-reasoning-s09-q09	D	The first Remove box
diagrammatic-reasoning-s09-q10	A	It doubled correctly in the first test but passed the input unchanged in the second
diagrammatic-reasoning-s10-q01	C	A black arrow pointing south
diagrammatic-reasoning-s10-q02	D	22
diagrammatic-reasoning-s10-q03	B	11
diagrammatic-reasoning-s10-q04	A	64
diagrammatic-reasoning-s10-q05	D	A black arrow pointing up
diagrammatic-reasoning-s10-q06	C	19
diagrammatic-reasoning-s10-q07	A	23
diagrammatic-reasoning-s10-q08	B	8
diagrammatic-reasoning-s10-q09	C	5
diagrammatic-reasoning-s10-q10	B	9

Worked explanations

diagrammatic-reasoning-s01-q01: An 'Add 4' box outputs its input plus 4, so 9 becomes $9 + 4 = 13$.

diagrammatic-reasoning-s01-q02: Doubling multiplies the input by 2, so 7 becomes 14.

diagrammatic-reasoning-s01-q03: Reversing writes the sequence back to front, so P-Q-R becomes R-Q-P. The middle item stays in place for a three-item sequence.

diagrammatic-reasoning-s01-q04: The box deletes only the final item (plum), leaving the rest in their original order.

diagrammatic-reasoning-s01-q05: A quarter turn clockwise moves an upward arrow to point right, imagine turning a clock hand from 12 to 3.

diagrammatic-reasoning-s01-q06: Only the two end symbols trade places (? and ?); the middle symbols stay exactly where they were.

diagrammatic-reasoning-s01-q07: Halving divides the input by 2, so 26 becomes 13.

diagrammatic-reasoning-s01-q08: The box changes shading only, so the triangle keeps its shape but flips from white to black.

diagrammatic-reasoning-s01-q09: Repeating the whole sequence writes the complete run again after itself, giving A-B followed by A-B, not each symbol doubled in place.

diagrammatic-reasoning-s01-q10: $6 - 6 = 0$, a valid output; an operator can produce zero.

diagrammatic-reasoning-s02-q01: Work left to right: $5 + 3 = 8$, then $8 \times 2 = 16$.

diagrammatic-reasoning-s02-q02: $12 \div 2 = 6$, then $6 - 2 = 4$.

diagrammatic-reasoning-s02-q03: Reversing gives T-A-C; removing the last letter of that result leaves T-A. Apply each box to the previous box's output, not to the original input.

diagrammatic-reasoning-s02-q04: North turned 90° clockwise points east; a further 180° turn points it the opposite way, west.

diagrammatic-reasoning-s02-q05: Removing the first item leaves 4, 6, 8; reversing that gives 8, 6, 4.

diagrammatic-reasoning-s02-q06: 3 squared is 9, and $9 + 1 = 10$.

diagrammatic-reasoning-s02-q07: Toggling makes the circle black, and rotating a circle produces no visible change. Some operators have no effect on symmetric figures.

diagrammatic-reasoning-s02-q08: Swapping the end letters of STAR gives RTAS; reversing RTAS gives SATR. Track the intermediate result carefully at each stage.

diagrammatic-reasoning-s02-q09: $18 - 4 = 14$, then $14 \div 2 = 7$.

diagrammatic-reasoning-s02-q10: Order matters in a pipeline: doubling first gives 12, then adding 2 gives 14, a different result from the original wiring.

diagrammatic-reasoning-s03-q01: Test each candidate against every pair: adding 3 fits $3 \rightarrow 6$ but fails $5 \rightarrow 10$, and squaring would turn 9 into 81. Only doubling fits all three examples.

diagrammatic-reasoning-s03-q02: Halving fits $6 \rightarrow 3$ but fails $10 \rightarrow 7$; subtracting 3 is the only rule that fits every pair.

diagrammatic-reasoning-s03-q03: For a three-letter word several rules look identical, so use the longer example to separate them: swapping only the end letters of STOP would give PTOS, not POTS. Full reversal fits both.

diagrammatic-reasoning-s03-q04: Multiplying by 4 fits $4 \rightarrow 16$ but fails $5 \rightarrow 25$, and adding 12 fails $5 \rightarrow 25$ too. Each output is the input multiplied by itself, so the box squares.

diagrammatic-reasoning-s03-q05: In both examples the output is the original sequence with its opening symbol appended at the end, nothing else moves.

diagrammatic-reasoning-s03-q06: Adding 8 fits $7 \rightarrow 15$ but fails $10 \rightarrow 21$, and tripling-minus-6 also fails $10 \rightarrow 21$. Doubling then adding 1 fits all three pairs. Always check every example, not just the first.

diagrammatic-reasoning-s03-q07: Both examples keep their shape while black and white exchange, so the rule acts on shading alone.

diagrammatic-reasoning-s03-q08: Subtracting 6 fits $12 \rightarrow 6$ but fails $20 \rightarrow 10$; each output is exactly half its input, so the box halves.

diagrammatic-reasoning-s03-q09: Every output is the input with just its final letter missing: removing vowels would have turned RAIN into RN.

diagrammatic-reasoning-s03-q10: All four candidate rules turn 2 into 8, but only cubing also turns 3 into 27: a single example rarely pins down a rule, so seek a second one before deciding.

diagrammatic-reasoning-s04-q01: The count rises by one dot per frame, so the next frame shows 5 dots.

diagrammatic-reasoning-s04-q02: The shading alternates every frame, and the last square shown was white, so black follows.

diagrammatic-reasoning-s04-q03: Each frame turns the arrow 90° clockwise (up -> right -> down), so the next quarter turn points it left.

diagrammatic-reasoning-s04-q04: Two features change independently: the count rises by one each frame while the shading alternates. After 4 white comes 5 black.

diagrammatic-reasoning-s04-q05: Each shape has one more side than the last (3, 4, 5), so a six-sided hexagon comes next.

diagrammatic-reasoning-s04-q06: The star moves one corner clockwise each frame, so from bottom-right it reaches bottom-left.

diagrammatic-reasoning-s04-q07: Two rules alternate: double, then subtract 1 (2->4->3->6->5->10->9). The next step doubles again: $9 \times 2 = 18$.

diagrammatic-reasoning-s04-q08: The gaps grow by one each step: +2, +3, +4, so the next gap is +5. Five letters past J is O.

diagrammatic-reasoning-s04-q09: Track each feature separately: the size cycle returns to small, while the rotation continues from down to left.

diagrammatic-reasoning-s04-q10: Each row rises by 1 from left to right (and each row starts one higher than the row above), so the final cell holds 5.

diagrammatic-reasoning-s05-q01: 7 is odd, so the No branch applies: $7 + 3 = 10$.

diagrammatic-reasoning-s05-q02: 12 is greater than 10, so it is halved to 6.

diagrammatic-reasoning-s05-q03: 9 is odd, so it becomes 10; 10 is greater than 8, so subtracting 5 gives 5. Re-test the condition on the updated value, not the original.

diagrammatic-reasoning-s05-q04: ORANGE has 6 letters, so it becomes ORANG; ORANG starts with the vowel O, so it is reversed to GNARO.

diagrammatic-reasoning-s05-q05: 15 is a multiple of 3, giving 5; 5 is odd, so adding 1 gives 6.

diagrammatic-reasoning-s05-q06: At 1.5 kg the parcel passes the weight test, so the fragile question decides: fragile parcels go to Depot C.

diagrammatic-reasoning-s05-q07: Weight is tested first, so the 2.5 kg fragile parcel still goes to Depot B. Only a parcel at 2 kg or under that is not fragile reaches Depot A.

diagrammatic-reasoning-s05-q08: 24 halves to 12; 12 divides by 3 to give 4; 4 is not greater than 5, so adding 10 gives 14.

diagrammatic-reasoning-s05-q09: Check each backwards path for consistency: an even input would be 9, but 9 is odd, contradiction. An odd input of 13 gives $13 + 5 = 18$ and stays consistent.

diagrammatic-reasoning-s05-q10: 6 is even, so the pair becomes (9, 6); the sum 15 exceeds 14, so the sum itself is output. Note that swapping never changes a sum.

diagrammatic-reasoning-s06-q01: From Amber, one change reaches Red and a second completes the cycle to Green.

diagrammatic-reasoning-s06-q02: Turning the key moves Locked to Closed, and pushing then opens the door.

diagrammatic-reasoning-s06-q03: The coin moves the machine to Ready and the button press moves it on to Printing.

diagrammatic-reasoning-s06-q04: The first press does nothing in Idle; the coin then moves it to Ready and the second press starts Printing. Signals with no listed transition are simply ignored.

diagrammatic-reasoning-s06-q05: Trace floor by floor: 2 -> 3 -> 4 -> 3 -> 4.

diagrammatic-reasoning-s06-q06: Fill advances to Wash, then Rinse; the hold keeps it at Rinse; the final advance reaches Spin.

diagrammatic-reasoning-s06-q07: The first coin unlocks it, the second coin is ignored, the first push relocks it, and the second push is ignored, ending Locked.

diagrammatic-reasoning-s06-q08: Every crate passes through Station 1 first; crate 8 is even, so it is routed on to Station 3 and never sees Station 2.

diagrammatic-reasoning-s06-q09: Two tasks drop the status to Tired; the third task only counts one of two; the rest restores Fresh and clears the count; the final task leaves the status still Fresh.

diagrammatic-reasoning-s06-q10: The second 20p lifts credit to 40p, triggering a vend that leaves 10p; the final 10p brings credit to 20p, below the vend threshold.

diagrammatic-reasoning-s07-q01: Both examples double their input, so ? turns 6 into 12.

diagrammatic-reasoning-s07-q02: Both examples reverse the sequence, so R-S-T becomes T-S-R.

diagrammatic-reasoning-s07-q03: ? adds 3 in both examples, so the pipeline gives $4 \times 2 = 8$, then $8 + 3 = 11$.

diagrammatic-reasoning-s07-q04: In both examples only the first item disappears, so ? removes the opening item and X-Y-Z becomes Y-Z.

diagrammatic-reasoning-s07-q05: Squaring fits 3->9 but fails 5->15, and adding 6 fails 5->15 too, only multiplying by 3 fits both examples.

diagrammatic-reasoning-s07-q06: P turns 2 into 4 and 5 into 10, so Q must turn 4 into 9 and 10 into 15, adding 5 fits both runs.

diagrammatic-reasoning-s07-q07: The rotation turns the arrow to point right, and the toggle then flips it from white to black.

diagrammatic-reasoning-s07-q08: Test both wirings: halving first gives 3 then 5, while adding 2 first gives 8 then 4, only halve-then-add matches the observed output.

diagrammatic-reasoning-s07-q09: Compute the intermediate stage first: reversing gives 2-7-4 and 5-1, so ? must drop the final item to leave 2-7 and 5.

diagrammatic-reasoning-s07-q10: Work backwards: the final Double must have received 7, so X turned 10 into 7: it subtracts 3, turning 12 into 9.

diagrammatic-reasoning-s08-q01: 3 -> 6 -> 12 -> 24; 24 is the first value over 20, and the loop stops there rather than doubling again.

diagrammatic-reasoning-s08-q02: 2 -> 4 -> 8 -> 16 -> 32, four doublings bring the number past 30.

diagrammatic-reasoning-s08-q03: 100 -> 85 -> 70 -> 55 -> 40; the condition '40 or less' is met exactly at 40, so no further pass runs.

diagrammatic-reasoning-s08-q04: 1 -> 4 -> 7 -> 10 -> 13: four additions reach the threshold exactly.

diagrammatic-reasoning-s08-q05: DIAGRAMS has 8 letters, so four removals from the end leave the first four: DIAG.

diagrammatic-reasoning-s08-q06: 9 is odd -> 14; 14 is even -> 7; 7 is odd -> 12. Re-test the even/odd condition on each new value.

diagrammatic-reasoning-s08-q07: Track the pass number separately from the value: 5 -> 7 -> 6 -> 8 -> 7 after passes 1 to 4.

diagrammatic-reasoning-s08-q08: 48 -> 24 -> 12 -> 6 -> 3; the loop stops at 3 because the condition 'while even' finally fails.

diagrammatic-reasoning-s08-q09: $7 \rightarrow 10 \rightarrow 5 \rightarrow 8 \rightarrow 4$. Note that 5 is not below 5, so the loop must continue past it. Read stopping conditions literally.

diagrammatic-reasoning-s08-q10: Adding 2 to an odd number always gives another odd number, so the stopping condition can never be met, checking whether a loop can terminate is part of reading a process diagram.

diagrammatic-reasoning-s09-q01: Simulate each fault: with Add 5 broken the output would be 6, and with both broken it would be 3. Only a broken Double explains 8, since $3 + 5 = 8$ passed straight through.

diagrammatic-reasoning-s09-q02: If Reverse did nothing, the Remove box would trim A-B-C-D to A-B-C. Exactly what was observed. A broken Remove box would instead have produced D-C-B-A.

diagrammatic-reasoning-s09-q03: With Subtract 2 broken, the Triple box receives 6 unchanged and outputs 18, matching the observation. A broken Triple box would have given 4.

diagrammatic-reasoning-s09-q04: The rotation clearly happened (the arrow points down), but the shading never flipped, so the toggle box passed its input through untouched.

diagrammatic-reasoning-s09-q05: Simulate each single fault: a broken Add 1 gives $4 \rightarrow 8 \rightarrow 5$; a broken Double gives 2; a broken Subtract 3 gives 10. Only the first matches the actual output of 5.

diagrammatic-reasoning-s09-q06: A broken first Double gives $5 \rightarrow 1 \rightarrow 2$; a broken second Double gives 6; a broken Subtract 4 gives $10 \rightarrow 10 \rightarrow 20$, which matches the observation.

diagrammatic-reasoning-s09-q07: Correct behaviour would give 17 and doing nothing would give 7; the observed 27 equals $7 + 10 + 10$, the rule applied twice over.

diagrammatic-reasoning-s09-q08: With Halve broken the sum is $12 + 4 = 16$, matching the observation; a broken Subtract 8 would give $6 + 12 = 18$ and both broken would give 24.

diagrammatic-reasoning-s09-q09: With the first Remove broken, the full list is reversed to 4-3-2-1 and then trimmed to 3-2-1: the observed result. A broken Reverse would give 3-4, and a broken second Remove would give 4-3-2.

diagrammatic-reasoning-s09-q10: Judge each run separately against its expected output: 6 matches 3 doubled, but 8 does not match 16, an intermittent fault that only some test runs reveal.

diagrammatic-reasoning-s10-q01: Stage by stage: the arrow turns east, is toggled to black, then turns south. The two quarter turns combine into a half turn regardless of the toggle between them.

diagrammatic-reasoning-s10-q02: From the examples, ? adds 3 ($12 \rightarrow 15$ and $20 \rightarrow 23$). Reversing the order changes the result: $8 + 3 = 11$, then doubled to 22.

diagrammatic-reasoning-s10-q03: $3 \times 5 = 15$, and the difference between 15 and 4 is 11.

diagrammatic-reasoning-s10-q04: First pass: 9 is odd, so $(9 + 7) \div 2 = 8$. Second pass: 8 is even, so it is squared to 64. Re-test the routing condition on the new value.

diagrammatic-reasoning-s10-q05: The first pair shows a 90° clockwise rotation with shading preserved; rotating a left-pointing arrow 90° clockwise points it up, still black.

diagrammatic-reasoning-s10-q06: Only a broken Add 2 explains the test: $5 \rightarrow 10 \rightarrow 9$ (a broken Double gives 6 and a broken Subtract 1 gives 14). Through the same fault, 10 doubles to 20 and then loses 1, giving 19.

diagrammatic-reasoning-s10-q07: Each full pass maps n to $2n + 1$: $2 \rightarrow 5 \rightarrow 11 \rightarrow 23$, and 23 is the first value past 20.

diagrammatic-reasoning-s10-q08: The machine pairs arrivals: 3 is stored, 4 triggers the output 7; then 6 is stored and 2 triggers the output 8.

diagrammatic-reasoning-s10-q09: Black dots rise by 1 while white dots fall by 2 each frame, so the fifth figure has 5 black and 0 white, 5 dots in total.

diagrammatic-reasoning-s10-q10: ? triples and ? halves, so the chain runs $4 \rightarrow 12 \rightarrow 6 \rightarrow 18 \rightarrow 9$. Deduce each operator from its examples first, then trace the chain one step at a time.

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