



KS3.M-A7 Function Machines and Inverse Operations

AQA KS3.M-A7 · Calculators not allowed · about 60 minutes

Name: _____ Date: ____ / ____ / ____

Answer ALL questions. Show all your working.

1 A function machine does: add 3. For each input, write the output.

(a) Input 2 (1)

(b) Input 10 (1)

(c) Input 0 (1)

(d) Input -4 (1)

2 A function machine does: multiply by 5. For each input, write the output.

(a) Input 3 (1)

(b) Input 7 (1)

(c) Input -2 (1)

3 The function machine: multiply by 2 then add 1. Find the output when the input is 4.

(2)

4 A function machine does: subtract 6. Work out the input if the output is given.

(a) Output 2. What was the input?

(1)

(b) Output -3. What was the input?

(1)

5 Reverse the function: the machine does add 7. Work out the input when the output is 12.

(2)

6 A two-step machine does: multiply by 3, then subtract 4. Work out the output for input 6 and show the two steps.

(3)

7 The machine does: add 10, then divide by 2. For each input, find the output.

(a) Input 6

(1)

(b) Input 0

(1)

- 8** Work backwards: a machine does add 4 then multiply by 2. The final output is 18. What was the original input?

(2)

-
- 9** Describe the inverse operation of each. Give the inverse as a one-step instruction.

(a) Original: add 9 (1)

(b) Original: divide by 4 (1)

(c) Original: multiply by -2 (1)

-
- 10** A machine does: square the number, then subtract 1. For each input find the output.

(a) Input 2 (1)

(b) Input 5 (1)

(c) Input -3 (1)

-
- 11** Find the input when a machine does: multiply by 4 then add 6, and the output is 26.

(2)

- 12** A machine does: add 2, multiply by 3, then subtract 5. The final output is 16. Work backwards to find the original input and show steps.

(3)

-
- 13** The machine does: subtract 2 then divide by 3. What input gives output 4?

(2)

-
- 14** Write a one-step machine instruction that is the inverse of: multiply by 7.

(3)

-
- 15** A machine does: add 12 then multiply by 1. Find the input that gives output 25. Explain the inverse step you use.

(2)

-
- 16** Challenge: A machine does: multiply by 2, add 3, multiply by 4. The final output is 44. Work backwards to find the original input. Show each inverse step clearly.

(4)

- 17** Stretch: A box contains a hidden input n . A function machine does: add n , then multiply by 3. The final output is 27. Find n .

(4)

-
- 18** Stretch: A two-step inverse puzzle. A machine does: multiply by 5 then add k . If an input of 2 gives output 17, find k . Then state the inverse one-step instruction for this machine.

(a) Find k

(2)

(b) Give the inverse one-step instruction

(1)

Mark scheme · KS3.M-A7 Function Machines and Inverse Operations

Question 1

- (a) **B1** 5 cao
- (a) Answer: **5**
- (b) **B1** 13 cao
- (b) Answer: **13**
- (c) **B1** 3 cao
- (c) Answer: **3**
- (d) **B1** -1 cao
- (d) Answer: **-1**

Question 2

- (a) **B1** 15 cao
- (a) Answer: **15**
- (b) **B1** 35 cao
- (b) Answer: **35**
- (c) **B1** -10 cao
- (c) Answer: **-10**

Question 3

- **M1** correct method: $4 \times 2 = 8$ then $+1$
- **A1** 9 cao
- Answer: **9**

Question 4

- (a) **B1** 8 cao
- (a) Answer: **8**
- (b) **B1** 3 cao
- (b) Answer: **3**

Question 5

- **M1** recognition of inverse: $\text{input} = \text{output} - 7$
- **A1** 5 cao
- Answer: **5**

Question 6

- **M1** correct first step $6 \times 3 = 18$
- **M1** correct second step $18 - 4 = 14$
- **A1** 14 cao
- Answer: **14**

Question 7

- (a) **B1** 8 cao
- (a) Answer: **8**
- (b) **B1** 5 cao
- (b) Answer: **5**

Question 8

- **M1** inverse steps attempted: $18 / 2 = 9$ or $9 - 4$
- **A1** 5 cao
- Answer: **5**

Question 9

- (a) **B1** subtract 9 oe
- (a) Answer: **subtract 9**
- (b) **B1** multiply by 4 oe
- (b) Answer: **multiply by 4**
- (c) **B1** divide by -2 oe
- (c) Answer: **divide by -2**

Question 10

- (a) **B1** 3 cao
- (a) Answer: **3**
- (b) **B1** 24 cao
- (b) Answer: **24**
- (c) **B1** 8 cao
- (c) Answer: **8**

Question 11

- **M1** inverse steps attempted: $26 - 6 = 20$ then $20 / 4 = 5$
- **A1** 5 cao
- Answer: **5**

Question 12

- **M1** correct first inverse: $16 + 5 = 21$
- **M1** correct second inverse: $21 / 3 = 7$
- **A1** 5 cao
- Answer: **5**

Question 13

- **M1** inverse attempt: $4 \times 3 = 12$ then $+2$
- **A1** 14 cao
- Answer: **14**

Question 14

- **M1** recognition that inverse is divide by 7
- **M1** correct phrasing, e.g. divide by 7
- **A1** divide by 7 cao
- Answer: **divide by 7**

Question 15

- **M1** use inverse: input = output - 12 or recognise multiply by 1 does not change number
- **A1** 13 cao
- Answer: **13**

Question 16

- **M1** first inverse step: $44 / 4 = 11$
- **M1** second inverse step: $11 - 3 = 8$
- **M1** third inverse step: $8 / 2 = 4$
- **A1** 4 cao
- Answer: **4**

Question 17

- **M1** set up equation: $3(n + n)$ or interpretation that first step adds n to hidden input
- **M1** correct equation formed: $3(2n) = 27$ or equivalent reasoning
- **M1** solve to get $n = 27 / 6 = 4.5$
- **A1** 4.5 cao
- Answer: **4.5**

Question 18

- (a) **M1** substitute 2: $5 \times 2 + k = 17$ or $10 + k = 17$
- (a) **A1** 7 cao
- (a) Answer: **7**
- (b) **B1** subtract 7 then divide by 5 oe
- (b) Answer: **subtract 7 then divide by 5**