2.8 Function Machines: 2-hour Pack

EDEXCEL 1MA1 · Calculator allowed · about 120 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Here is a function machine.
input --> [+ 9] --> [x 4] --> output
The input is n. (a) Write an expression for the output. (b) Work out the output when n = 10.

(Total for Question 1 is 3 marks)

2 Here is a function machine.
input --> [- 5] --> output
Work out the output when the input is each of 6, 7, 5.

(Total for Question 2 is 3 marks)

3 Here is a function machine.
input --> [+ 8] --> [x 3] --> output
The output is 36. Work out the input.

(Total for Question 3 is 3 marks)

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4 Here is a function machine.

input --> [+ 4] --> [- 9] --> [- 8] --> output

Work out the output when the input is 10, and when the input is 8.

(Total for Question 4 is 3 marks)

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5 Here is a function machine.

input --> [+ 4] --> [x 4] --> output

The input is n. (a) Write an expression for the output. (b) Work out the output when n = 3.

(Total for Question 5 is 3 marks)

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6 Here is a function machine.

input --> [+ 5] --> [- 9] --> output

The output is -2. Work out the input.

(Total for Question 6 is 3 marks)

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7 Here is a function machine.

input --> [x 11] --> output

Work out the output when the input is each of 4, 19, 13.

(Total for Question 7 is 3 marks)

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8 Here is a function machine.

input --> [x 9] --> [+ 4] --> output

Work out the output when the input is 15, and when the input is 8.

(Total for Question 8 is 3 marks)

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9 Here is a function machine.

input --> [x 4] --> [+ 9] --> output

The input is n. (a) Write an expression for the output. (b) Work out the output when n = 5.

(Total for Question 9 is 3 marks)

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10 Here is a function machine.

input --> [- 5] --> [x 5] --> output

The output is 35. Work out the input.

(Total for Question 10 is 3 marks)

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11 Here is a function machine.

input --> [+ 1] --> [x 4] --> output

The input is n. (a) Write an expression for the output. (b) Work out the output when n = 9.

(Total for Question 11 is 3 marks)

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12 Here is a function machine.

input --> [+ 8] --> [x 6] --> [+ 2] --> output

Work out the output when the input is 12, and when the input is 15.

(Total for Question 12 is 3 marks)

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13 Here is a function machine.

input --> [x 12] --> output

Work out the output when the input is each of 8, 19, 8.

(Total for Question 13 is 3 marks)

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14 Here is a function machine.

input --> [+ 8] --> output

The output is 12. Work out the input.

(Total for Question 14 is 2 marks)

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15 Here is a function machine.

input --> [x 4] --> output

Work out the output when the input is each of 17, 7, 6.

(Total for Question 15 is 3 marks)

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16 Here is a function machine.

input --> [+ 8] --> [x 2] --> [- 4] --> output

Work out the output when the input is 5, and when the input is 13.

(Total for Question 16 is 3 marks)

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17 Here is a function machine.

input --> [x 12] --> output

Work out the output when the input is each of 15, 16, 15.

(Total for Question 17 is 3 marks)

---

18 Here is a function machine.

input --> [- 8] --> [x 8] --> output

Work out the output when the input is 5, and when the input is 14.

(Total for Question 18 is 3 marks)

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19 Here is a function machine.

input --> [x 7] --> output

Work out the output when the input is each of 7, 10, 16.

(Total for Question 19 is 3 marks)

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20 A function machine multiplies the input by 3, then adds 5. The input is 4. Work out the output.

(Total for Question 20 is 2 marks)

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21 A function machine adds 8 to the input, then divides the result by 2. The input is 10. Work out the output.

(Total for Question 21 is 2 marks)

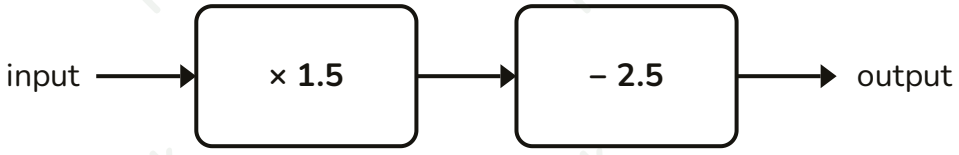
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22 A number enters Machine A which adds 4. The result goes into Machine B which multiplies by 5. The starting input is 6. Work out the final output.

(Total for Question 22 is 2 marks)

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23 A function machine has two steps: input --> [x 1.5] --> [-2.5] --> output.



(a) Work out the output when the input is 10. **(2)**

.....

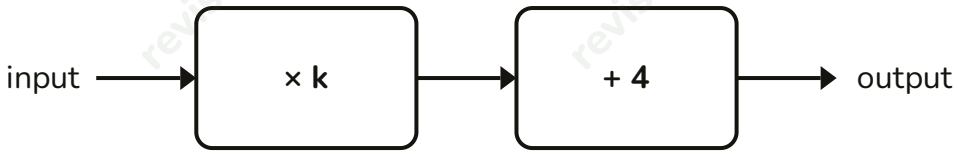
(b) The output is 5. Find the input. **(3)**

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(Total for Question 23 is 5 marks)

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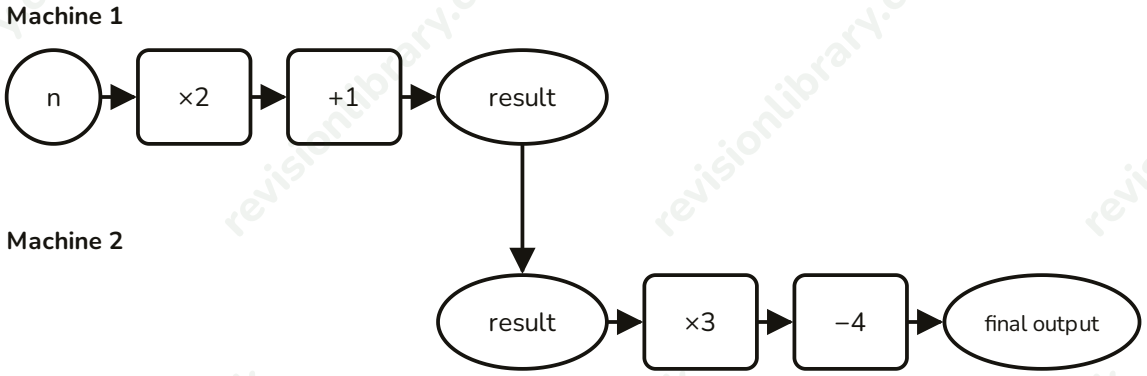
24 A function machine has the rule: input --> [x k] --> [+4] --> output, where k is a number. When the input is 3, the output is 19. Find the value of k.



(Total for Question 24 is 3 marks)

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25 Two function machines are connected. Machine 1: n --> [x 2] --> [+1] --> result. The result from Machine 1 becomes the input for Machine 2. Machine 2: result --> [x 3] --> [-4] --> final output.



(a) Work out the final output when n = 2. **(1)**

.....

(b) Find the value of n that gives a final output of 29. **(3)**

.....

(Total for Question 25 is 4 marks)

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26 A function machine adds 15 to the input then divides by 5. The output is 14. Work out the input.

(Total for Question 26 is 2 marks)

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27 A function machine doubles the input then subtracts 3. The output is 19. Work out the input.

(Total for Question 27 is 2 marks)

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28 Let $f(x) = 2x - 7$ and $g(x) = x + 3$. Work out $g(f(2))$.

(Total for Question 28 is 2 marks)

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29 A machine applies $f(x) = 3x + 2$ then a second machine applies $g(x) = x - 5$. Work out all values of x such that $g(f(x)) = 22$.

(Total for Question 29 is 3 marks)

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30 A function f is linear: f(x) = ax + b. Given f(2) = 11 and f(5) = 20, work out a and b, then find the input that gives output 38.

(Total for Question 30 is 4 marks)

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31 A machine multiplies the input by 3/2 then subtracts 4. The output is 8. Work out the input.

(Total for Question 31 is 3 marks)

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Mark scheme · 2.8 Function Machines: 2-hour Pack

A correct answer earns full marks unless the question asks for working, a method, proof or explanation.

Question 1

attempts to build the expression	**M1**
4(n + 9)	**A1**
76 cao	**B1**

Answer: (a) 4(n + 9), (b) 76

Question 2

one output correct	**B1**
two outputs correct	**B1**
all outputs correct	**B1**

Answer: 1, 2, 0

Question 3

uses inverse operations or works backwards	**M1**
all inverse operations in the correct order	**M1**
4 cao	**A1**

Answer: 4

Question 4

applies the operations in the correct order	**M1**
-3 cao	**A1**
-5 cao	**B1**

Answer: -3 and -5

Question 5

attempts to build the expression	**M1**
4(n + 4)	**A1**
28 cao	**B1**

Answer: (a) 4(n + 4), (b) 28

Question 6

uses inverse operations or works backwards	**M1**
all inverse operations in the correct order	**M1**
2 cao	**A1**

Answer: 2

Question 7

one output correct	**B1**
two outputs correct	**B1**
all outputs correct	**B1**

Answer: 44, 209, 143

Question 8

applies the operations in the correct order	**M1**
139 cao	**A1**
76 cao	**B1**

Answer: 139 and 76

Question 9

attempts to build the expression	**M1**
4n + 9	**A1**
29 cao	**B1**

Answer: (a) 4n + 9, (b) 29

Question 10

uses inverse operations or works backwards	**M1**
all inverse operations in the correct order	**M1**
12 cao	**A1**

Answer: 12

Question 11

attempts to build the expression	**M1**
4(n + 1)	**A1**
40 cao	**B1**

Answer: (a) 4(n + 1), (b) 40

Question 12

applies the operations in the correct order	**M1**
122 cao	**A1**
140 cao	**B1**

Answer: 122 and 140

Question 13

one output correct	**B1**
two outputs correct	**B1**
all outputs correct	**B1**

Answer: 96, 228, 96

Question 14

uses inverse operations or works backwards	**M1**
4 cao	**A1**

Answer: 4

Question 15

one output correct	**B1**
two outputs correct	**B1**
all outputs correct	**B1**

Answer: 68, 28, 24

Question 16

applies the operations in the correct order	**M1**
22 cao	**A1**
38 cao	**B1**

Answer: 22 and 38

Question 17

one output correct	**B1**
two outputs correct	**B1**
all outputs correct	**B1**

Answer: 180, 192, 180

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Question 18

applies the operations in the correct order	**M1**
-24 cao	**A1**
48 cao	**B1**

Answer: -24 and 48

Question 19

one output correct	**B1**
two outputs correct	**B1**
all outputs correct	**B1**

Answer: 49, 70, 112

Question 20

correct method shown, e.g. 3 x 4 = 12 and then 12 + 5	**M1**
17 cao	**A1**

Answer: 17 (3 x 4 + 5 = 17).

Question 21

attempt to add 8 then divide by 2, e.g. (10 + 8) / 2	**M1**
9 cao	**A1**

Answer: 9 (because (10 + 8) / 2 = 9).

Question 22

apply A then B correctly, e.g. (6 + 4) x 5	**M1**
50 cao	**A1**

Answer: 50 (because (6 + 4) x 5 = 50).

Question 23

(a) 15 seen (10 x 1.5)	**M1**
(a) 12.5 cao	**A1**

(a) Answer: 12.5

(b) 7.5 seen (5+2.5)	**M1**
(b) complete method: 7.5 / 1.5	**M1**
(b) 5 cao	**A1**

(b) Answer: 5

Question 24

3k+4=19 or equivalent equation formed	**M1**
3k=15 (correct rearrangement)	**M1**
k=5 cao	**A1**

Answer: k=5

Question 25

(a) 11 cao	**B1**

(a) Answer: 11

(b) 11 seen (reverse Machine 2: (29+4)/3)	**M1**
(b) 5 seen (reverse Machine 1: (11-1)/2)	**M1**
(b) n=5 cao	**A1**

(b) Answer: 5

Question 26

reverse method applied, e.g. 14 x 5 = 70	**M1**
55 cao (70 - 15)	**A1**

Answer: 55 (because input = 14 x 5 - 15 = 70 - 15 = 55).

Question 27

reverse method or simple algebra, e.g. 2x - 3 = 19 -> 2x = 22	**M1**
11 cao	**A1**

Answer: 11 (because 2x - 3 = 19 -> x = 11).

Question 28

substitute 2 into f, e.g. f(2) = 2 x 2 - 7 = -3	**M1**
0 cao (g(-3) = -3 + 3 = 0)	**A1**

Answer: 0 (f(2) = -3, g(-3) = 0).

Question 29

substitute and form equation: g(f(x)) = (3x + 2) - 5 = 3x - 3	**M1**
solve 3x - 3 = 22 -> 3x = 25	**M1**
x = 25/3 cao	**A1**

Answer: 25/3.

Question 30

form two equations: 2a + b = 11 and 5a + b = 20	**M1**
subtract to find a = 3	**M1**
substitute a to find b = 5	**M1**
input 11 cao (solve 3x + 5 = 38 -> x = 11)	**A1**

Answer: a = 3, b = 5, input = 11.

Question 31

form equation (3/2)x - 4 = 8 or equivalent	**M1**
isolate x: (3/2)x = 12 -> x = 12 x 2/3	**M1**
8 cao	**A1**

Answer: 8.

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