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VCE Specialist Mathematics ½

Logic & Algorithms I [2.4]

Test Solutions

24.5 Marks. 1 Minute Reading. 20 Minutes Writing.

Results:

Test Questions	_____ / 24.5

Section A: Test Questions (24.5 Marks)

Question 1 (2.5 marks)

Tick whether the following statements are **true** or **false**.

Statement	True	False
a. Selections allow us to selectively perform an operation.	✓	
b. For loops can be used when we don't know how many loops it will exactly take to finish.		✓
c. Infinite loop can be created if the variable controlling the loop is updated within the operation of the loop.	✓	
d. Function can be defined to hold an algorithm and can be called within another algorithm.	✓	
e. List can be used to hold multiple values at once.	✓	

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Question 2 (2 marks)

Turn the following hybrid function into an algorithm:

$$f(n) = \begin{cases} 2n+1, & \text{if } n \text{ is odd} \\ 4, & \text{if } n = 4 \\ 3n-2, & \text{otherwise} \end{cases}$$

Step 1: Input n.

Step 2: **If** n is odd, **then** $y \leftarrow 2n+1$
else if $n = 4$, **then** $y \leftarrow 4$
else $y \leftarrow 3n-2$.

Step 3: Print y.

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Question 3 (2 marks)

Write an algorithm to find the first six terms of the arithmetic sequence with the first term 19 and common difference 3.

Step 1: $T \leftarrow 19$ and $n \leftarrow 1$.

Step 2: Print n and print T.

Step 3: $T \leftarrow T + 3$ and $n \leftarrow n + 1$.

Step 4: Print n and print T.

Step 5: Repeat from Step 3 while $n < 6$.

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Question 4 (2 marks)

James decides to invest \$50000 at an interest rate of 3% compounded annually. Construct an algorithm that outputs the number of years needed for James' initial investment to double.

Step 1: $I \leftarrow 50000$ and $T = 0$.

Step 2: $I \leftarrow 1.03I$ and $T \leftarrow T + 1$.

Step 3: **Repeat** from step 2 **while** $I < 10000$.

Step 4: Print T.

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Question 5 (6 marks)

Consider the sequence $3,5,7,9,\ldots,2n+1$.

Using pseudocode, write an algorithm to calculate:

a. The sum of the terms in this sequence. (2 marks)

```
input n
sum ← 0
for i from 1 to n
        sum ← sum + 2i + 1
End for
Print sum
```

b. The product of the terms in this sequence. (2 marks)

```
input n
product ← 1
for i from 1 to n
        product ← product × (2i + 1)
End for
Print product
```

c. Provide a table of values to demonstrate each algorithm when $n = 3$. (2 marks)

i	sum
	0
1	$0 + 3 = 3$
2	$3 + 5 = 8$
3	$8 + 7 = 15$

i	sum
	1
1	$1 \times 3 = 3$
2	$3 \times 5 = 15$
3	$15 \times 7 = 105$

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Question 6 (3 marks)

Using pseudocodes, construct an algorithm for the following:

An algorithm that outputs the remainder of a division with a given input of number and divisor.

```
input number, divisor
remainder ← number
while remainder ≥ divisor
        remainder ← remainder−divisor
end while
print remainder
```

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Question 7 (4 marks)

Using pseudocodes, construct an algorithm for the following:

An algorithm that reads 3 numbers (a, b, c) and writes them in ascending order.

```
input a, b, c

if a ≥ b then
        if a ≥ c then
                max ← a
                if b ≥ c then
                        mid ← b
                        min ← c
                else
                        mid ← c
                        min ← b
                end if
        else
                max ← c
                mid ← a
                min ← b
        end if
else if a < b then
        if a ≥ c then
                max ← b
                mid ← a
                min ← c
        else
                min ← a
                if b ≥ c then
                        max ← b
                        mid ← c
                else
                        max ← c
                        mid ← b
                end if
        end if
end if

print min, mid, max.
```

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Question 8 (3 marks)

Using pseudocode, write an algorithm to find the positive integer solutions of the equation.

$$43x + 17y + 7z = 200$$

We use three loops to run through all the possible positive integer values of x, y and z.
We first note that:

$$200 \div 43 \approx 4.7, \qquad 200 \div 17 \approx 11.8, \qquad 200 \div 7 \approx 28.6$$

Therefore, we know that we will find all the solutions from the following nest of three loops.

```
for x from 1 to 4
        for y from 1 to 11
                for z from 1 to 28
                        if 43x + 17y + 7z = 200 then
                                print (x, y, z)
                        end if
                end for
        end for
end for
```

This algorithm prints the three solutions $(1, 1, 20), (1, 8, 3)$ and $(2, 3, 9)$.

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