This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners’ meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2016 series for most Cambridge IGCSE®, Cambridge International A and AS Level components and some Cambridge O Level components.
1 (a) [7]

1 mark for each label
(b) (i) 1 mark per bullet to max 3:
- method header and close
- initialising amount to 0
- initialising state to “Idle”

e.g.

PYTHON:
```python
def __init__(self):
    self.__amount = 0
    self.__state = "Idle"
```

PASCAL/DELPHI:
```
constructor TicketMachine.Create();
begin
    Amount := 0;
    State := 'Idle';
end;
```

VB:
```
Public Sub New()
    Amount = 0
    State = "Idle"
End Sub
```

(ii) 1 mark per bullet to max 2:
- method header, close with parameter
- setting state to parameter value
- outputting state

e.g.

PYTHON:
```python
def SetState(self, NewState):
    self.__State = NewState
    print(self.__State)
```

PASCAL/DELPHI:
```
procedure TicketMachine.SetState(NewState : string);
begin
    State := NewState;
    Writeln(State);
end;
```
VB:
Public Sub SetState(NewState As String)
    Me.State = NewState
    Console.WriteLine(Me.State)
End Sub

VB:
Private _State As String
Public Property State() As String
    Get
        Return _State
    End Get
    Set(value As String)
        _State = value
    End Set
End Property
Public Sub SetState()
    Console.WriteLine(Me.State)
End Sub

(iii) 1 mark per bullet to max 2:

- output Amount
- set amount to zero

E.g.

PYTHON:
    def ReturnCoins(self):
        print(self.__Amount)
        self.__Amount = 0

PASCAL/DELPHI:
    procedure TicketMachine.ReturnCoins();
    begin
        Writeln(Amount);
        Amount := 0;
    end;

VB:
Public Sub ReturnCoins()
    Console.WriteLine(Me.Amount)
    Me.Amount = 0
End Sub
(iv) 1 mark per bullet to max 3:  
- function header, take string as parameter, return Boolean  
- check the parameter is a valid coin  
- return of value for both cases  

e.g.

PYTHON:
```python
def __validCoin(self, s):
    coins = ['10','20','50','100']
    if s in coins:
        isValid = True
    else:
        isValid = False
    return(isValid)
```

PASCAL/DELPHI:
```pascal/function TicketMachine.ValidCoin(s : string) : boolean;
begin
    if ((s = '10') or (s = '20') or (s = '50') or (s = '100'))
    then
       ValidCoin:= True;
    else
       ValidCoin := False;
end;
```

VB:
```vb
Public Function ValidCoin(ByVal s As String) As Boolean
   If s = "10" or s = "20" or s = "50" or s = "100" Then
      ValidCoin = True
   Else
      ValidCoin = False
   End If
End Sub
```
(v) 1 mark per bullet to max 2

- Cast parameter as integer
- Add value to amount

e.g.

**PYTHON:**
```
def coinInserted(self, s):
    coinValue = int(s)
    self.__amount = self.__amount + coinValue
```

**PASCAL/DELPHI:**
```
procedure TicketMachine.CoinInserted(s : string);
var
    CoinValue, Code : integer;
begin
    Val(s, CoinValue, Code);
    Amount := Amount + CoinValue;
end;
```

**VB:**
```
Public Sub CoinInserted(ByVal S As String)
    CoinValue = INT(s)
    Me.Amount = Me.Amount + CoinValue
End Sub
```
(vi) 1 mark per bullet to max 12

- read NewInput from keyboard
  - check if input ‘C’ and state = Counting
    - then set state to cancelled
    - call method returnCoins() and set state to Idle
  - check if input ‘A’
    - then check if amount = 0 then output no coins
    - else set state to Accepted
    - call PrintTicket method and Set state to Idle
  - else if input is a valid coin
    - call CoinInserted method with NewInput as parameter
    - set state to Counting
    - error message if not a valid coin

E.g.

**PYTHON:**
```
def stateChange(self):
    newInput = input("Insert coin: ")
    if newInput == "C":
        if self.__state == "Counting":
            self.setState("Cancelled")
            self.returnCoins()
            self.setState("Idle")
    elif newInput == "A":
        if self.__amount == 0:
            print("no coins inserted")
        else:
            self.setState("Accepted")
            self.__PrintTicket()
            self.setState("Idle")
    elif self.__validCoin(newInput):
        self.coinInserted(newInput)
        self.setState("Counting")
    else:
        print("Error - not a valid coin")
```

**PASCAL/DELPHI:**
```
procedure TicketMachine.StateChange();
var
    NewInput : string;
begin
    Write('Insert coin: ');
    Readln(NewInput);
    if (NewInput = 'C') then begin
        if (State = 'Counting') then begin
            State := 'Cancelled';
            ReturnCoins();
        end;
        SetState('Idle')
    end
    else if (NewInput = 'A') then
```
begin
  if (Amount = 0) then
    Writeln('No coins inserted')
  else
    begin
      SetState('Accepted');
      PrintTicket();
    end;
    SetState('Idle');
  end
else
  if (ValidCoin(NewInput)) then
    begin
      CoinInserted(NewInput);
      SetState('Counting')
    end
  else
    Writeln('Error - not a valid coin')
end;

VB:
Public Sub StateChange()
  Dim NewInput As String
  NewInput = Console.ReadLine()
  If NewInput = “C” Then
    If State = “Counting” Then
      SetState(“Cancelled”)
      ReturnCoins()
    End If
    SetState(“Idle”)
  Elseif NewInput = “A” Then
    If Amount = 0 Then
      Console.WriteLine(“No coins inserted”)
    Else
      SetState(“Accepted”)
      PrintTicket()
      If State = “Idle”
      Elseif ValidCoin(NewInput) Then
        CoinInserted(NewInput)
        SetState(“Counting”)”
      Else
        Console.WriteLine(“Error – not a valid coin”)
      EndIf
End Sub
(vii) 1 mark per bullet to max 4

- declaration of main method header
- Initialising ParkingMeter as instance of TicketMachine
- Looping while true/until false
  - Calling stateChange method on ParkingMeter

**e.g.**

**PYTHON:**
```python
def main():
    ParkingMeter = TicketMachine()
    while True:
        ParkingMeter.stateChange()
```

**PASCAL/DELPHI:**
```pascal
begin
    ParkingMeter := TicketMachine.Create();
    while True do
        ParkingMeter.StateChange();
end.
```

**VB:**
```vbnet
Sub Main()
    Dim ParkingMeter As New TicketMachine
    ParkingMeter.Create()
    While (True)
        Call ParkingMeter.StateChange()
    End While
End Sub
```
(c) (i) 1 mark per bullet to max 2:

- The attributes can only be accessed in the class
- Properties are needed to get/set the data // It provides/uses encapsulation
- Increase security/integrity of attributes

(ii) 1 mark per bullet

- The public methods can be called anywhere in the main program // Public methods can be inherited by sub-classes
- The private methods can only be called within the class definition // cannot be called outside the class definition // Private methods cannot be inherited by sub-classes

2

<table>
<thead>
<tr>
<th>(i) Alpha testing</th>
<th>(ii) Beta testing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Who</strong></td>
<td>(potential) (end) user(s)/client(s)</td>
</tr>
<tr>
<td>In house testers / developers / programmers</td>
<td></td>
</tr>
<tr>
<td><strong>When</strong></td>
<td>Before general release of software // passed Alpha testing</td>
</tr>
<tr>
<td>Near the end of development // program is nearly fully-usable // after integration and before beta</td>
<td></td>
</tr>
<tr>
<td><strong>Purpose</strong></td>
<td>For constructive comments/ feedback // to test in real-life scenarios/situations/ environments // ensure it is ready for release // ensure it meets users' needs</td>
</tr>
<tr>
<td>To find errors not found in earlier testing // ensure ready for beta testing</td>
<td></td>
</tr>
</tbody>
</table>

3 (a) (i) 1 mark per bullet to max 2:

- 11011111
- AND

(ii) 1 mark per bullet to max 2:

- 00100000
- OR
(b) 1 mark per line

<table>
<thead>
<tr>
<th>START:</th>
<th>LDR</th>
<th>#0</th>
<th>// initialise index register to zero</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LDX</td>
<td>WORD</td>
<td>// get first character of WORD</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>AND</td>
<td>MASK1</td>
<td>// ensure it is in upper case using MASK1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>OUT</td>
<td></td>
<td>// output character to screen</td>
<td></td>
</tr>
<tr>
<td></td>
<td>INC</td>
<td>IX</td>
<td>// increment index register</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>LDM</td>
<td>#1</td>
<td>// load 1 into ACC</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>STO</td>
<td>COUNT</td>
<td>// store in COUNT</td>
<td>1</td>
</tr>
<tr>
<td>LOOP:</td>
<td>LDX</td>
<td>WORD</td>
<td>// load next character from indexed address WORD</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>OR</td>
<td>MASK2</td>
<td>// make lower case using MASK2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>OUT</td>
<td></td>
<td>// output character to screen</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LDD</td>
<td>COUNT</td>
<td>// increment COUNT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>INC</td>
<td>ACC</td>
<td>//</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>STO</td>
<td>COUNT</td>
<td>//</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CMP</td>
<td>LENGTH</td>
<td>// is COUNT = LENGTH?</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>JPN</td>
<td>LOOP</td>
<td>// if FALSE - jump to LOOP</td>
<td>1</td>
</tr>
<tr>
<td>END:</td>
<td></td>
<td></td>
<td>// end of program</td>
<td>1</td>
</tr>
</tbody>
</table>

COUNT: 0

MASK1: B11011111 // bit pattern for upper case

MASK2: B00100000 // bit pattern for lower case

LENGTH: 4

WORD: B01100110 //ASCII code in binary for 'f'

B01101000 //ASCII code in binary for 'r'

B01000101 //ASCII code in binary for 'E'

B01000100 //ASCII code in binary for 'D'

[max 12]
4 (a) (i) 1 mark per feature to max 3

- auto-indent
- auto-complete / by example
- colour-coded keywords/ strings/ comments/ built-in functions/ user-defined function names pop-up help
- can set indent width
- expand/collapse subroutines/code
- block highlighting

incorrect syntax highlighting/ underlining // dynamic syntax checker

(ii) Read and mark the answer as one paragraph. Mark a how and a when anywhere in the answer.
1 mark for when, 1 mark for how.

- When:
  - the error has been typed
  - when the program is being run/compiled/interpreted

- How:
  - highlights/underlines
  - displays error message/pop-up

(iii) 1 mark for identifying the correct line, 1 mark for writing the corrected line

<table>
<thead>
<tr>
<th>A - Line 5</th>
<th>B - Line 6</th>
<th>C - Line 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>for i in range(Max-1):</code></td>
<td><code>FOR i := 1 TO (Max-1) DO</code></td>
<td><code>For i = 0 To (Max - 1)</code></td>
</tr>
</tbody>
</table>

(b) (i) Python: compiled/interpreted
VB.NET: compiled
Pascal: compiled/interpreted
Delphi: compiled/interpreted
(ii) 1 mark for naming error, 1 mark for line number and correction

<table>
<thead>
<tr>
<th>A Logic error</th>
<th>B Logic error</th>
<th>C Logic error</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 NoMoreSwaps = False</td>
<td>10 NoMoreSwaps := FALSE;</td>
<td>7 NoMoreSwaps = False</td>
</tr>
</tbody>
</table>

(iii) 1 mark for naming, 1 for description

- breakpoint
  - a point where the program can be halted to see if the program works at this point
- stepping / step through
  - executes one statement at a time and then pauses to see the effect of each statement
- variable watch window
  - observe how variables changed during execution