1. What output is produced when the following Java program fragment is executed? You should show your working.

```java
int v = 1;
int i = 1;
while (i <= 7) {
    i += 2;
    v += i;
}
System.out.println(v);
```

(6 marks)

Answer:

Working:
2. Let country and state be variables of type String. Write an expression (of type boolean) that checks whether country is "USA" but state is neither "HI" nor "AK". (5 marks)

Answer:

3. What output is produced when the following Java program fragment is executed in each case?

(a) aNumber is 1.
(b) aNumber is 0.
(c) aNumber is -1.

You should show your working.

```java
if (aNumber >= 0)
    if (aNumber == 0)
        System.out.print("A");
    else
        System.out.print("B");
else
    System.out.print("C");
```

(5 marks)

Answer:
4. Implement a method

\[
\text{public static double midrange(double[]} \ a) \\
\text{that takes an array } a \text{ and returns the midrange of } a, \text{ that is }
\]

\[
\frac{\min a + \max a}{2},
\]

where \( \max a \) is the largest and \( \min a \) is the smallest element in the array. For instance, if the input array is \( \{ 0, 1, -2, 4 \} \) then the output is 1 because the largest element is 4 and the smallest element is -2: \( (4 + (-2))/2 = 1 \).  

(15 marks)

Answer:
5. Implement a method

\[
\text{public static double[]} \ \text{multiply(double[]} \ v, \ \text{double c)}
\]

that returns a new array containing the elements of \( v \) multiplied by \( c \): for example, if the parameter array is \{ 0, 1, 2, 3 \} and \( c \) is 2 then the output is \{ 0, 2, 4, 6 \}.

Answer:

6. What output is produced when the following Java program is executed?

```
public class E15 {
    public static void main(String args[]) {
        int[] a = { 0, 1, 2, 1 };
        int[] b = { 0, 0, 0, 6, -2 };
        if (c(a,1) == c(b,2))
            System.out.println("yes");
        else
            System.out.println("no");
    }

    public static int c(int a[], int i) {
        return a[i] + a[i + 1] + a[i + 2];
    }
}
```

You should show your working.

Answer:

Working:
7. A loyalty card is used by a supermarket to reward regular shopping as follows. A customer has *points* added to their card every time they shop at one of the supermarket’s stores. The customer may subsequently redeem these points for a cash equivalent.

Write a class `LoyaltyCard` to simulate a simplified loyalty card.

(a) Each loyalty card stores a card number and a current balance (the number of points). Implement a constructor, which automatically generates the card number. The card number is a `String` that consists of "LC" followed by a 7-digit number: the numbers start from 0 and incremented each time a new loyalty card is created. (9 marks)

(b) Implement methods `getCardNumber()` and `getPoints()`. (3 marks)

(c) Implement a method `collect(double amount, int bags)` that receives the amount spent (in pounds) and the number of bags re-used and increases the balance by two points for every pound spent and by one point for each bag re-used. (6 marks)

(d) Implement a method `redeem(int points)` that receives a number of points to be redeemed and returns its cash equivalent (in pounds). If the operation is allowed then the method should reduce the balance by the specified number of points and return £0.01 for every 2 points. The operation is not allowed if less than 500 points is requested to be redeemed or the number of points to be redeemed exceeds the current balance; in these cases the method should return 0 without changing the balance. (7 marks)

Answer:
8. Suppose you have declared an interface `Shape` as follows:

```java
public interface Shape {
    public int getCentreX();
    public int getCentreY();
    public int getArea();
}
```

(these methods return the co-ordinates of the centre and the area of the shape, respectively).

(a) Write a class `Rectangle` that implements interface `Shape` (remember to implement all methods of the interface). The constructor of `Rectangle` should take the co-ordinates of the bottom-left corner and the width and the height of the rectangle.

(b) Write a method

```java
public static void printAreas(Shape shapes[])
```

that takes an array of shapes, instances of `Shape`, and prints out the area of each shape on a separate line.

**Answer:**
9. Find five compile-time errors in the following class declaration:

```java
public class Y15 {
    private static int b = 2;
    public static int main(String args)
    {
        int b = 0;
        int[] array = {2, 3, "4"};
        for (c : array) {
            b += c + c;
        }
        System.out.println(array[array[this.b]]);
    }
}
```

How would you correct the errors you have found? (7 marks)

Answer: