1. Consider a set of Java statements:
   ```java
   int d = 3 * 4;
   d = -3 + d + d / 4;
   d = 72 / d + d / 2;
   ```
   What is the value of `d` after these statements are executed?  
   (3 marks)

   **Answer:** 12

   **Working:**
   
   
   d = 12, d = -3 + 12 + 3, d = 6 + 6 = 12

2. Given a String `colour`, write an expression of type `boolean`, which is evaluated to `true` if the length of `colour` is either 7 or 4 and to `false` otherwise.  
   (5 marks)

   **Answer:** `colour.length() == 7 || colour.length() == 4`
3. What is the default value for local variables?
   (a) null
   (b) 0
   (c) depends on the datatype
   (d) no default value for local variables

   Answer: (d) — local variables must be initialised before use

4. Identify seven compile-time errors in the following Java code:

   ```java
   public class test2!
   {
   public static int main(String args) {
      String s;
      String t = "tom";
      Integer len = s.length();
      s = "tomato";
      s = s.substring(0,3);
      if (s = t) {
         System.out.println("result: " + (s == t));
      }
   }
   return "1";
   }
   }
   ```

   How would you correct the errors you have found?

   Answer:

   ```java
   public class test2/*!*/ {
      // not an identifier
      public static int main(String args) {
         // no [] isn’t a compile-time err
         String s = "tomato"; // not initialised
         String t = "tom";
         int len = s.length();
         s = s.substring(0,3);
         if (s == t) {
            System.out.println("result: " + (s == t));
            String args = s + "/" + len;
            System.out.println(args);
         }
         return 1; // type mismatch
      }
   }
   ```
5. Which of the following are valid Java identifiers (i.e., names of variables or methods)?

(a) DOUBLE
(b) constructor
(c) long
(d) 1stName
(e) big_int

Answer: (a), (b), (e) (5 marks)

6. Implement a method to determine the type of a radio station depending on its broadcast frequency:

- long-wave AM 30 – 300 kHz.
- medium-wave AM 300 kHz – 3 MHz.
- short-wave AM 3 – 30 MHz.
- FM 30 – 300 MHz.

The method should take one argument of type int, the frequency in kHz, and return the type of the radio station, of type String.

(Remember that 1 kHz = 1000 Hz and 1 MHz = 1000 kHz.)

Answer:

```java
public static String getType(int freq) {
    if (freq >= 30000)
        return "FM";
    if (freq >= 3000)
        return "short-wave AM";
    if (freq >= 300)
        return "medium-wave AM";
    return "long-wave AM";
}
```
7. What is printed as a result of executing the following fragment of code?

```java
int v = 1;
while (v < 20) {
    v = v * 2;
    System.out.println(v - 1);
}
```

Answer: 7

<table>
<thead>
<tr>
<th>v</th>
<th>v &lt; 20</th>
<th>v*2</th>
<th>printout</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>true</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>true</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>true</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>true</td>
<td>16</td>
<td>15</td>
</tr>
<tr>
<td>16</td>
<td>true</td>
<td>32</td>
<td>31</td>
</tr>
<tr>
<td>32</td>
<td>false</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Working:

8. Implement a method that returns true if its argument of type String is a valid colour reference in HTML (see the definition below); otherwise, the method should return false.

A colour reference is a string that consists of '#' followed by 6 hexadecimal digits.

Assume that there is a method

```java
public static boolean isHexadecimal(char ch)
```

that returns true if ch is a hexadecimal digit ('0'–'9', 'a'–'f').

Answer:

```java
public static boolean isColourRef(String s) {
    if (s.length() != 7) return false;
    if (s.charAt(0) != '#') return false;
    for (int i = 1; i < 7; i++)
        if (!isHexadecimal(s.charAt(i))) return false;
    return true;
}
```
9. What is the type and the value of the following expression
   
   ```java
   s.length() + b * 3.0 > 7 && s.length() + b / 2 < 3
   ```

   if `s` is "10" and `b` is 2.

   **Answer:**

   `boolean` and `false` (because the second argument of the logical AND is `false`)

10. Transform the following for loop into a while loop and explain its action.

    ```java
    int n = 173;
    String s = "";
    for (int p = 256; p > 0; p = p / 2) {
        if (n / p == 0)
            s = s + "0";
        else
            s = s + "1";
        n = n % p;
    }
    System.out.println("result: " + s);
    ```

    **Answer:**

    ```java
    int n = 173;
    String s = "";
    int p = 256; // first argument of the for loop
    while (p > 0) { // second argument of the for loop turns into
        // the while condition
            if (n / p == 0)
                s = s + "0";
            else
                s = s + "1";
            n = n % p;
        p = p / 2; // do not forget the third argument of the for loop
    }
    System.out.println("result: " + s);
    ```

    The loop converts `n` (=173; in general, any positive integer up to 512) into the string representing `n` in binary. The result is `010101101`. 
11. (a) Implement a method sumOfDivisors that takes a positive integer n and returns the sum of all its positive divisors excluding the number itself: for example, if n is 5 then the method returns 1; if n is 10 then the method returns 8 (= 1+2+5).

(b) Implement a method that takes a positive integer N and prints out all perfect numbers not exceeding N.
A number is perfect if it is equal to the sum of its proper positive divisors (that is, to the sum of all positive divisors excluding the number itself).

Hint: use sumOfDivisors to check whether a number is perfect. (22 marks)

Answer:

```java
public static int sumOfDivisors(int n) {
    int sum = 0;
    for (int i = 1; i <= n/2; i++)
        if (n % i == 0)
            sum += i;
    return sum;
}

public static void printPerfect(int N) {
    for (int n = 1; n <= N; n++)
        if (sumOfDivisors(n) == n)
            System.out.println("perfect: " + n);
}
```