TASK A

1. If x is odd, then the formula $3^x + 2^x$ will always end in 5 (and therefore be part of the sequence $10n + 5$).

1. Explanation: At first, the basics must be thought about; 2 + 3 = 5. From this, you can build up your explanation. $2^2 + 3^2$, or $2^x + 3^x$ for any even value of x, for that matter, will not end in 5. However, I noticed that these even powers would end successively in 3, 7, 3, 7, etc. Interestingly, both of these numbers (7 & 3) differentiate from 5 by 2. So, why all the odd ones? 3 to the power of an odd number always ends in (once again) 3 and 7: 3, 27, 243, 2187, 19683, etc. Secondly, 2 to the power of an odd number will end in 2 or 8: 2, 8, 32, 128, 512, etc. Because 2 + 3 is 5, and 7 + 8 ends in 5, it now seems obvious why $2^x + 3^x$ (with an odd value of x) will end in 5. This answers the second question, as I have already stated that when x is a multiple of 4, $2^x + 3^x$ will end in 7.

2. All of them. This is because 1 to the power of any number is 1, an odd number. 3 to the power of any number will also be odd. 2 to the power of any number will be even (a multiple of 2). Odd + Odd = Even, and Even + Even = Even. Therefore $1^n + 2^n + 3^n$ will be even, for any value of n.

3. The sequence will go like this (in terms of the last digit of the numbers): 0, 0, 0, 4, 0, 0, 4, etc.

4. The end digit of the numbers will go like this: 5, 5, 5, 9, 5, 5, 5, 9, 5, etc. This is easy to explain, because of the answer to Q3. 5^n, n being an abstract number, will end in 5. Taking into account the last question, add 5 to the power of last digit of each number, and you get the sequence of last digits I mentioned earlier (5, 5, 5, 9, etc.).

Other:

1. *$(4^n + 5^n + 6^n)$:* In this sequence, the numbers will end like this: 5, 77, 5, 77, etc. 4^n will end in these digits: 4, 6, 4, 6, 4, 6, etc. 5^n will end in 5 and 6^n will end in 6, so it is no surprise that the last digits of the added numbers will be 5, 7, 5, 7, etc. However, I am unsure why the last two digits of the number (for an even value of n) will be 77.

2. *$(3^n + 8^n)$:* In this sequence, the numbers will end like this: 11, 73, 39, 77, 11, 39, etc. 8^n ends 8, 4, 2, 6, 8, 4, 2, 6, etc. 3^n ends 3, 9, 7, 1, 3, 9, 7, 1, etc. Add these together and you get 1, 3, 9, 7, 1, 3, 9, 7, etc. Again, I am not sure where the second last digit comes in.

3. *$(2^n + 4^n + 6^n)$:* Here, the last digits of the numbers will be 2, 6, 8, 8, 2, 6, 8, 8, etc. 2^n ends 2, 4, 8, 6, 2, 4, 8, etc. 4^n ends 4, 6, 4, 6, etc. 6^n ends in 6. Add these together to get last digits of 2, 6, 8, 8, 2, 6, 8, 8, etc.

4. *$(3^n + 5^n + 7^n)$:* In this sequence, the numbers will end: 5, 3, 5, 7, 5, 3, 5, 7, etc. 3^n ends 3, 9, 7, 1, etc. 7^n ends 7, 9, 3, 1, 7, 9, 3, 1, etc. 5^n ends 5. Add these together to get 5, 3, 5, 7, 5, 3, 5, 7, etc.

5. *$(3^n – 2^n)$:* This time, the numbers end in these digits: 1, 5, 9, 5, 1, 5, 9, 5, etc.

3^n ends 3, 9, 7, 1, 3, 9, 7, 1, etc. 2^n ends 2, 4, 8, 6, 2, 4, 8, 6, etc. subtract the latter from the former to get 1, 5, 9, 5, 1, 5, 9, 5, etc.

6. *($7^n + 5^n - 3^n$):* In this sequence, the numbers end like this: 9, 5, 1, 5, 9, 5, 1, 5, etc.

7^n ends in 7, 9, 3, 1, 7, 9, 3, 1, etc. 5^n ends in 5. 3^n ends 3, 9, 7, 1, 3, 9, 7, 1, etc. (7,9,3,1) + 5 - (3,9,7,1) = (1,5,9,5).

TASK B

1. What is half of 2^{20}?

A 1^{10}
B 1^{20}
C 20
D 2^{10}
E 2^{19}

2. Which of these numbers is biggest?

A 19
B 199
C $\times 99$
$\times 9$
199^9
D $1^9 \times 9^9$
E 1^{999}

3. Below are three statements. Exactly which ones are true?

(i) 3^{10} is even (ii) 3^{10} is odd (iii)3^{10} is square

A (i) only
B (ii) only
C (iii) only
D (i) and (iii)
E (ii) and (iii)

4. The number $3^4 \times 4^5 \times 5^6$ is written out in full.

How many zeros are there at the end of the number?

A none
B 4

C 5
D 6
E more than 6

5. Which of these five expressions represents the largest number?

A $9^{(9^9)}$
B 999
C 9^{99}
D $(9^9)^9$
E 99^9