PAUL HAZEN

MAT250 HOMEWORK #1

2021-01-09

#1

$(1-6i)\cdot(-9+4i) = (1-6i)(-9) + (1-6i)(4i)$

$= -9 + 36i + 4i - 24i^2$

$= 40i - 9 - 24i^2$ BECAUSE $i = \sqrt{-1}$, $i^2 = -1$

$= 40i - 9 + 24$

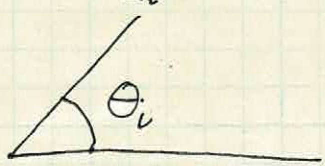
$= 15 + 40i$

#2

LET $z_1 = 2+i$, $z_2 = 2+7i$

ⓐ

Compute arguments of each number (i.e. the angles with the positive real axis)



$\begin{cases} |z| = \sqrt{a^2+b^2} \\ Arg(z) = \tan^{-1}(b/a) \end{cases} \Rightarrow$ If $a \neq 0$

$\begin{cases} |z| = \sqrt{a^2+b^2} \\ Arg(z) = \pm\frac{\pi}{2} \end{cases} \Rightarrow$ If $a = 0$, but $b \neq 0$

$Arg(z_1) = \tan^{-1}(1/2)$ $(0° \leq \theta_1 < 360°)$

≈ 0.463647609

$Arg(z_2) = \tan^{-1}(7/2)$ $(0° \leq \theta_2 < 360°)$

≈ 1.29249667

ⓑ

~~arctan~~

$\arctan(a) + \arctan(b) = \arctan\left(\frac{a+b}{1-ab}\right)$

$a = \frac{1}{2}$, $b = \frac{7}{2}$, $a+b = 8/2 = 4$

$(a)(b) = \frac{7}{4}$

$1 - ab = 1 - \frac{7}{4} = -\frac{3}{4}$

#2 CONTINUED

(b) CONTINUED

$$\theta_1 + \theta_2 = \arctan\left(\frac{\frac{1}{2} + \frac{7}{2}}{1 - \left(\frac{1}{2}\right)\left(\frac{7}{2}\right)}\right)$$

$$= \arctan\left(\frac{4}{1 - \frac{7}{4}}\right) = \arctan\left(\frac{4}{-\frac{3}{4}}\right)$$

$$= \cancel{\arctan\left(4 \cdot \left(-\frac{3}{4}\right)\right)} = \arctan\left(4 \cdot -\frac{4}{3}\right)$$

$$= \cancel{\arctan(-3)} = \boxed{\arctan\left(-\frac{16}{3}\right)}$$

(a)

$$\cancel{z_1 \cdot z_2 = (2+i) + (2+7i)}$$
$$= \boxed{\cancel{4 + 8i}}$$

$$z_1 \cdot z_2 = (2+i)\cdot(2+7i)$$
$$= (4 + 14i) + (2i + 7i^2)$$
$$= 4 - 7 + 16i$$
$$= -3 + 16i$$

(c)

$$\omega = z_1 \cdot z_2 = -3 + 16i$$
$$\mathrm{Arg}(\omega) = \arctan(-16/3)$$

PAUL HAZEN
MAT290 HOMEWORK #1 2021-01-09

#2

d) $|z_1| = \sqrt{(2)^2 + 1}$ $\qquad |z_2| = \sqrt{(2)^2 + (7)^2}$

$= \boxed{\sqrt{5}}$ $\qquad = \sqrt{4 + 49}$

$\qquad = \boxed{\sqrt{53}}$

$|z_1| \cdot |z_2| = \boxed{\sqrt{265}}$

$|z_1 \cdot z_2| = |\omega| = \sqrt{(-3)^2 + (16)^2}$

$= \sqrt{9 + 256}$

$\boxed{= \sqrt{265}}$

#3

$$\frac{2+5i}{-9+2i} = \left(\frac{2+5i}{-9+2i}\right) \cdot \left(\frac{-9-2i}{-9-2i}\right) = \gamma$$

complex conjugate of

$\bar{z} \cdot z = |z|^2$ THEREFORE $\Rightarrow$

Numerator $\Rightarrow = (2+5i) \cdot (-9-2i)$
(normal)

$= -18 - 4i + -49i - 10i^2$

$= -18 + 10 - 53i$

$= -8 - 53i$

Denominator $\Rightarrow |-9+2i|^2 = \left(\sqrt{(-9)^2 + 2^2}\right)^2$

$= 81 + 4$

$= 85$

$\therefore \rightarrow$ $\boxed{\gamma = \frac{-8-53i}{85}}$

$= -\frac{8}{85} - \frac{53}{85}i$

#4

(a) $(5-2i)+(5-6i)=$
$\boxed{10-8i}$

(b) $(2-3i)\cdot(-2+5i)=$
$=-4+10i+6i-15i^2$
$=-4+16i+15$
$=\boxed{11+16i}$

(c) $\frac{1-8i}{-2+4i}$ multiply by 1, but with complex conjugate, where complex conjugate of
$a+bi$ is $a-bi$

$$\left(\frac{1-8i}{-2+4i}\right)\left(\frac{-2-4i}{-2-4i}\right)=\frac{(1-8i)(-2-4i)}{\left(\sqrt{(-2)^2+(4)^2}\right)^2}=\frac{1}{20}(1-8i)(-2-4i)$$

$$=\frac{1}{20}(-2-4i+16i+32i^2)=\frac{1}{20}(-34+12i)$$

$$=\boxed{-\frac{9}{5}+\frac{3}{5}i}$$

(d) $|5-6i|=\sqrt{5^2+(-6)^2}$
$=\sqrt{25+36}$
$=\boxed{\sqrt{61}}$

#5 (a)
$(a+bi)^2=(a^2-b^2)+2abi$

$(-3+8i)^2=(-3+8i)(-3+8i)$
$=(9-24i-24i+64i^2)$
$=(9-64-48i)$
$\boxed{=-55-48i}$

#5

(b) $\begin{cases} a^2 - b^2 = 33 \\ 2ab = -56 \end{cases}$

$b = -28a$ $\qquad\qquad b = -28\left(\sqrt{\frac{33}{785}}\right)$

$a^2 + (-28a)^2 = 33$

$a^2 + 784a^2 = 33$

$785a^2 = 33$

$a = \pm\sqrt{\frac{33}{785}}$

$\cancel{b = \frac{-28 \cdot \sqrt{25905}}{785}}$

This one is confusing, skipping ahead.

CONTINUED ON PAGE #11

#6

if $z \in \mathbb{C}$ with $|z| = r$ then $z = r \cdot (\cos(\theta) + \sin(\theta) i)$

(a) $\theta = 64.316352819504°$

$r = 7.2680809021364$

$z = r \cdot (\cos(\theta) + \sin(\theta) i)$

$z = r \cdot (0.433402 + (0.901201)i)$

$\boxed{z = 3.15 + 6.55i}$

(b) $z = 10 + 4i \rightarrow$ TO POLAR $\therefore$ $r = |z| = \sqrt{(10)^2 + (4)^2}$

$= \sqrt{116}$

$\boxed{\approx 10.7703}$

~~tan~~

$\tan(\theta) = \frac{Im(z)}{Re(z)}$

$\tan(\theta) = \frac{4}{10} = \frac{2}{5}$

$\theta = \arctan\left(\frac{2}{5}\right)$

$\boxed{\approx 21.8014}$

PAUL HAZEN

MAT250 HOMEWORK #1 2021-01-09

#7

(a)

$\theta = \mathrm{Arg}(4+10i)$

For $z = a+bi$, $\mathrm{Arg}(z) = \tan^{-1}(b/a)$ if $a \neq 0$

$\boxed{\theta = \tan^{-1}\left(\frac{5}{2}\right)}$

$r = |4+10i| = \sqrt{(4)^2 + (10)^2} = \sqrt{116}$

$\boxed{r = \sqrt{116}}$

(b)

$\bar{\theta} = \mathrm{Arg}(4+10i)/2 = \boxed{\dfrac{\arctan\left(\frac{5}{2}\right)}{2}}$

$\bar{r} = \sqrt{|4+10i|} = \sqrt{\sqrt{116}} = \boxed{29^{\frac{1}{4}}\sqrt{2}} = \sqrt[4]{116}$

(c)

$\sqrt{z} = \bar{r} \cdot (\cos(\bar{\theta}) + \sin(\bar{\theta})i)$

$\boxed{\sqrt{z} = 2.71757 + 1.83988i}$

#8

(a) $\begin{bmatrix}(9-8i) & (5-9i)\\(1-8i) & (-4+6i)\end{bmatrix} + \begin{bmatrix}(1-3i) & (-2+3i)\\(3+6i) & (8+i)\end{bmatrix}$

$\boxed{= \begin{bmatrix}(10-11i) & (3-6i)\\(4-2i) & (4+7i)\end{bmatrix}}$

(b)

$(1+4i) \cdot \begin{bmatrix}5-9i & 3+8i\\-2+3i & 1-8i\end{bmatrix} = M_{2\times 2}$

$$\begin{aligned}M_{1,1} &= (1+4i)(5-9i)\\ &= 5 - 9i + 20i - 36i^2\\ &= 5 + 36 + 11i\\ &= 41 + 11i\end{aligned}$$

CONTINUED ON PAGE #7 ⟹

#8 Cont.

b Cont.

$$M_{1,2} = (1+4i)\cdot(3+6i) = 3 + 6i + 12i + 24i^2 = 3 - 24 + 18i = -21 + 18i$$

$$M_{2,1} = (1+4i)\cdot(-2+3i) = -2 + 3i - 8i + 12i^2 = -14 + - 5i$$

$$M_{2,2} = (1+4i)\cdot(1-8i) = 1 - 8i + 4i - 32i^2 = 1 + 32 - 4i = 33 - 4i$$

$$M = \begin{bmatrix} (41 + 11i) & (-21 + 18i) \\ (-14 - 5i) & (33 - 4i) \end{bmatrix}$$

#9

In $M_{2\times 2}(\mathbb{F}_4)$:

+	0	1	a	b
0	0	1	a	b
1	1	0	b	a
a	a	b	0	1
b	b	a	1	0

·	0	1	a	b
0	0	0	0	0
1	0	1	a	b
a	0	a	b	1
b	0	b	1	a

a $\begin{bmatrix} 1 & 0 \\ b & a \end{bmatrix} + \begin{bmatrix} b & 1 \\ b & a \end{bmatrix} = \boxed{\begin{bmatrix} a & 1 \\ 0 & 0 \end{bmatrix}}$

b $a \cdot \begin{bmatrix} 1 & 0 \\ b & a \end{bmatrix} = \boxed{\begin{bmatrix} a & 0 \\ 1 & b \end{bmatrix}}$

$\mathbb{F}_7$: multiply normally, mod 7

: add normally. If ≥ 7 then subtract 7

#10

a In $M_{2\times 2}(\mathbb{F}_7)$

+	0	1	2	3	4	5	6
0	0	1	2	3	4	5	6
1	1	2	3	4	5	6	0
2	2	3	4	5	6	0	1
3	3	4	5	6	0	1	2
4	4	5	6	0	1	2	3
5	5	6	0	1	2	3	4
6	6	0	1	2	3	4	5

·	0	1	2	3	4	5	6
0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6
2	0	2	4	6	1	3	5
3	0	3	6	2	5	1	4
4	0	4	1	5	2	6	3
5	0	5	3	1	6	4	2
6	0	6	5	4	3	2	1

$$\begin{bmatrix} 6 & 2 \\ 4 & 3 \end{bmatrix} + \begin{bmatrix} 6 & 3 \\ 6 & 2 \end{bmatrix} = \boxed{\begin{bmatrix} 5 & 5 \\ 3 & 5 \end{bmatrix}}$$

CONTINUED ON PAGE #8 ⇒

#10

(b) In $\mathbb{F}_7$:

$$5 \cdot \begin{bmatrix} 6 & 3 \\ 4 & 5 \end{bmatrix} = \boxed{\begin{bmatrix} 2 & 1 \\ 6 & 4 \end{bmatrix}}$$

#11

In $\mathbb{F}_4$:

(a) $$\begin{bmatrix} 1 \\ 0 \\ b \end{bmatrix} + \begin{bmatrix} a \\ 1 \\ b \end{bmatrix} = \boxed{\begin{bmatrix} b \\ 1 \\ 0 \end{bmatrix}}$$

In $\mathbb{F}_4$, a value added to itself is zero.

(b) $$a \cdot \begin{bmatrix} 1 \\ b \\ a \end{bmatrix} = \boxed{\begin{bmatrix} a \\ 1 \\ b \end{bmatrix}}$$

In $\mathbb{F}_4$, $a \cdot a = b$, $b \cdot b = a$, and $0, 1$ behave normally

#12 In $\mathbb{F}_7$:

(a) $$\begin{bmatrix} 3 \\ 5 \\ 1 \end{bmatrix} + \begin{bmatrix} 5 \\ 6 \\ 4 \end{bmatrix} = \boxed{\begin{bmatrix} 1 \\ 4 \\ 5 \end{bmatrix}}$$

(b) $$6 \cdot \begin{bmatrix} 4 \\ 3 \\ 5 \end{bmatrix} = \boxed{\begin{bmatrix} 3 \\ 4 \\ 2 \end{bmatrix}}$$

#13 In $\mathbb{F}_4$:

(a) Find all $x \in \mathbb{F}_4$ such that $b + x = 0$ (otherwise known as the opposite(s) of b)

$x = b$ (the opp. of b in $\mathbb{F}_4$ is b)

(b) Find all $x \in \mathbb{F}_4$ such that $b \cdot x = 1$ (aka reciprocal of b)

$x = a$ (the reciprocal of b in $\mathbb{F}_4$ is a)

CONTINUED ON PAGE #9 ⇒

PAUL HAZEN

#13 CONTINUED

ⓒ Find all $x \in \mathbb{F}_4$ such that $x^2 = b$ (aka square root of b)

$x = a$ (meaning $\sqrt{b} = a$) or "a is the square root of b")

ⓓ Do all elements of $\mathbb{F}_4$ have square roots? Yes

Are square roots unique in $\mathbb{F}_4$? ~~(put another way, does any number in $\mathbb{F}_4$ have more than~~

Yes

Can this be rephrased to be "all values in $\mathbb{F}_4$ have one and only one square root"?

ⓔ Find all $x \in \mathbb{F}_4$ such that $x^3 = 1$ (aka cube root)

try a: $a \cdot a \cdot a =$
$b \cdot a = 1$
1

try b: $b \cdot b \cdot b =$
$a \cdot b =$
1

$\Rightarrow$ $a^3 = 1,\ b^3 = 1,\ 1^3 = 1$

$x = a,\ b,$ or 1

This doesn't match the site...

$$\boxed{x = \{1, a, b\}}$$

ⓕ-ⓖ on later pages, skipping for now.

CONTINUED ON PAGE #13

#15 In $\mathbb{F}_4$:

ⓐ $(bt^3 + at^2 + t + b) + (t^3 + at^2 + t + b)$

$(b+1)t^3 + (a+a)t^2 + (1+1)t + b + b$

$at^3 + 0 \cdot t^2 + 0t + 0$

$$\boxed{at^3}$$

ⓑ $b \cdot (t^3 + at^2 + at + b) =$

$(b \cdot 1)t^3 + (b \cdot a)t^2 + (b \cdot a)t + (b \cdot b) =$

$bt^3 + 1t^2 + t + 0$

$$\boxed{bt^3 + t^2 + t}$$

PAUL HAZEN

MAT250 HOMEWORK #1 2021-01-10 #10

#16 In $\mathbb{F}_7$

(a) $(6t^3 + 5t^2 + 2t + 3) + (6t^3 + 5t^2 + 4t + 3) =$

$(6+6)t^3 + (5+5)t^2 + (2+4)t + (3+3) =$

$\boxed{5t^3 + 3t^2 + 6t + 6}$

(b) $3 \cdot (5t^3 + 3t^2 + 4t + 6)$

$(3 \cdot 5)t^3 + (3 \cdot 3)t^2 + (3 \cdot 4)t + (3 \cdot 6)$

$\boxed{t^3 + 2t^2 + 5t + 4}$

PAUL HAZEN

MAT250 HOMEWORK #1 | 2021-01-10 | #11

#5 CONTINUED

(b) $\begin{cases} a^2 - b^2 = 33 \\ 2ab = -56 \end{cases}$ $\quad 2ab = -56$, $a = -\frac{28}{b}$

$\left(-\frac{28}{b}\right)^2 - b^2 = 33$

$\frac{784}{b^2} - b^2 = 33$

$\frac{784 - b^4}{b^2} = 33 \rightarrow b \neq 0$

$784 - b^4 = 33b^2$

$0 = -b^4 - 33b^2 + 784$

substitute $u = b^2 \therefore u^2 = b^4$ } → Substitution

$0 = -u^2 - 33u + 784$ → use quadratic formula $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$u = \frac{33 \pm \sqrt{(-33)^2 + 4(784)}}{-2}$

$u = \frac{33 \pm 65}{-2}$ $\quad u = -49,\ u = 16$ reverse substitution

$b^2 = -49$
$= 7i, -7i$

$b^2 = 16$
$= 4, -4$

$b = \{-7i, -4, 4, 7i\}$

QUESTION ASKS FOR 1 SOLUTION. ARBITRARILY CHOOSE $b = 7i$

$2(a)(7i) = -56$

$14ai = -56$

$a = -\frac{56}{14}i$

$\boxed{a = -4i}$, $\boxed{b = 7i}$

CONTINUED ON PAGE #12 ⇒

PAUL HAZEN

#5 CONTINUED

(c)

$\sqrt{-32i} = a + bi$

SQUARE BOTH SIDES

$-32i = (a + bi)^2$
$-32i = a^2 + 2abi + b^2i^2$
$-32i = a^2 + 2abi - b^2$
$(-32i - 2abi) = a^2 - b^2$
$-(32 + 2ab)i = a^2 - b^2$

REWRITE $(-32 - 2ab)i = a^2 - b^2$ IN STANDARD COMPLEX FORM

$$0 + (-32 - 2ab)i = (a^2 - b^2) + 0i$$

REWRITE AS A SYSTEM OF EQUATIONS

$0 = a^2 - b^2$
$0 = -32 - 2ab \rightarrow$ ISOLATE A

$32 = -2ab$
$a = -\frac{16}{b}$

$0 = \left(-\frac{16}{b}\right)^2 - b^2$

$0 = \frac{256}{b^2} - b^2$

MULTIPLY BOTH SIDES BY b^2

$0 = 256 - b^4$

$b = \{-4, 4\}$

$\rightarrow \quad a = -\frac{16}{-4} = 4$

$a = -\frac{16}{4} = -4$

$\therefore \rightarrow$ $\boxed{\begin{cases} a = 4 \\ b = -4 \end{cases} \text{ OR } \begin{cases} a = -4 \\ b = 4 \end{cases}}$

#13 CONTINUED

(f) Do all elements $\mathbb{F}_4$ have cube roots?

$0 \rightarrow$ has cube root of 0 AND $0^3 = 0$
$1 \rightarrow$ has cube root of 1 AND $1^3 = 1$

$$a^3 = a \cdot a \cdot a \qquad b^3 = b \cdot b \cdot a$$
$$= b \cdot a \qquad = a \cdot a$$
$$= 1 \qquad = b$$

THEREFORE ALL ELEMENTS HAVE CUBE ROOTS, BUT THEY ARE NOT UNIQUE BECAUSE IN $\mathbb{F}_4$, $\sqrt[3]{1} = 1$ AND $\sqrt[3]{a} = 1$

(g) How many solutions does the equation $x^4 + x = 0$ have in $\mathbb{F}_4$?

0 is a solution
1 is not a solution

a: $a^4 + a = 0$
$a \cdot a \cdot a \cdot a + a = 0$
$b \cdot b + a = 0$
$a + a = 0$
$0 = 0$
a is a solution

b: $b^4 + b = 0$
$b \cdot b \cdot b \cdot b + b = 0$
$a \cdot a + b = 0$
$b + b = 0$
$0 = 0$
b is a solution

Solutions: $\{0, a, b\}$, so there are 3 solutions

CONTINUED ON PAGE #14 ⇨

PAUL HAZEN

MAT250 HOMEWORK #1 | 2021-01-11

#13 CONTINUED

(h) $x^5 + x = a$ ⇒ How many solutions in $\mathbb{F}_4$?

0 is not a solution

1 is not a solution

$a^5 + a = a$

$a \cdot a \cdot a \cdot a \cdot a + a = a$

$b \cdot b \cdot a + a = a$

$a \cdot a + a = a$

$b + a = a$

$1 = a$

a is not a solution

$b^5 + b = a$

$b \cdot b \cdot b \cdot b \cdot b + b = a$

$a \cdot a \cdot b + b = a$

$b \cdot b + b = 0$

$a + a = 0$

$0 = 0$

$\boxed{\text{b is the only solution}}$

#14

(a) Find all $x \in \mathbb{F}_7$ such that $5 + x = 0$

$x = 2$

(b) Find all $x \in \mathbb{F}_7$ such that $3 \cdot x = 1$

$x = 5$

(c) Find all $x \in \mathbb{F}_7$ such that $x^2 = 1$

$x = \{1, 6\}$

(d) Do all elements of $\mathbb{F}_7$ have square roots? No. Only $\{0, 1, 2, 4\}$ in $\mathbb{F}_7$ have square roots

0 only has 1 square root, $\{1, 2, 4\}$ all have 2

3, 5, 6 have no square roots CONTINUED ON PAGE #15 ⇒

PAUL HAZEN

MAT250 HOMEWORK #1 2021-01-11

#14 CONTINUED

(e) Find all $x \in \mathbb{F}_7$ such that $x^3 = 6$

0, 1, 3, 6 can be excluded, because 0 and 1 won't work and 3 & 7 are given.

2: $2 \cdot 2 \cdot 2 = 6$

$4 \cdot 2 = 6$

$1 = 6$ 2 is not a solution

~~3~~ 4: $4 \cdot 4 \cdot 4 = 6$

$2 \cdot 4 = 6$

$1 = 6$ 4 is not a solution

5: $5 \cdot 5 \cdot 5 = 6$

$4 \cdot 5 = 6$

$6 = 6$ $\boxed{\text{5 is a solution}}$

(f) ~~From part~~ e Do all elements of $\mathbb{F}_7$ have cube roots?

From part e above; and common sense:

$$\left.\begin{aligned} 0^3 &= 0 \\ 1^3 &= 1 \\ 2^3 &= 1 \\ 3^3 &= 6 \\ 4^3 &= 1 \\ 5^3 &= 6 \\ 6^3 &= 6 \end{aligned}\right\}$$

Only 0, 1, and 6 have cube roots

In $\mathbb{F}_7$ the following have no cube roots:

$\{2, 3, 4, 5\}$

(g) Solutions for $x^4 + x = 0$ in $\mathbb{F}_7$:

0 is a solution. ~~Actually the only solution.~~

1: $1^4 = 1^3 \cdot 1 = 1 + 1 = 2$, not a solution

2: $2^4 = 2^3 \cdot 2 = 1 \cdot 2 = 2$, $2 + 2 = 4$ not a solution

3: $3^4 = 3^3 \cdot 3 = 6 \cdot 3 = 4$, $3 + 4 = 0 \therefore \rightarrow$ 3 is a solution

4: $4^4 = 4^3 \cdot 4 = 1 \cdot 4 = 4$, $4 + 4 = 1$ not a solution

5: $5^4 = 5^3 \cdot 5 = 6 \cdot 5 = 2$, $2 + 5 = 0 \therefore$ 5 is a solution

6: $6^4 = 6^3 \cdot 6 = 6 \cdot 6 = 1$, $6 + 1 = 0 \therefore$ 6 is a solution

CONTINUED ON PAGE #16 ⇒

PAUL HAZEN

#14 CONTINUED

(h) How many solutions are there in $\mathbb{F}_7$ for equation $x^5 + x = 2$?

0: Not a solution

1: Is a solution

2: $(2^5) + 2 = 2$
$2^4 \cdot 2 + 2 = 2$
$2 + 2 = 2$
$4 \neq 2$ not a solution

3: $3^5 + 3 = 2$
$3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 + 3 = 2$
$2 \cdot 2 \cdot 3 + 3 = 2$
$4 \cdot 3 + 3 = 2$
$5 + 3 = 2$
$1 \neq 2$ not a solution

4: $4^5 + 4 = 2$
$4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 + 4 = 2$
$2 \cdot 2 \cdot 4 + 4 = 2$
$4 \cdot 4 + 4 = 2$
$2 + 4 = 2$
$6 \neq 2$ not a solution

5: $5^5 + 5 = 2$
$5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 + 5 = 2$
$4 \cdot 4 \cdot 5 + 5 = 2$
$2 \cdot 5 + 5 = 2$
$3 + 5 = 2$
$1 \neq 2$ not a solution

6: $6^5 + 6 = 2$
$6 \cdot 6 \cdot 6 \cdot 6 \cdot 6 + 6 = 2$
$1 \cdot 1 \cdot 6 + 6 = 2$
$1 \cdot 6 + 6 = 2$
$6 + 6 = 2$
$5 \neq 2$ not a solution.

$\therefore \rightarrow$ $\boxed{\text{Only 1 solution}}$