(i)

	Number	Binary	Decimal.
(a)	0	0 00000 0000000000	0
(b)	-1.6×10^{-19}		

Since -1.6×10^{-19} has a fraction precision i.e. greater than 10 bits, that is why the ~~precision~~ fraction would be 0 and exponent is 0

-1.6×10^{-19}

Binary representation : 0 00000 00000 00000

(c) Smallest positive normalised number.

Binary 0 00001 00000 00000

Decimal. Exponent = $1-15=-14$ Significand = $1.000000\ldots \approx 1$

value in decimal = 2^{-14}. = 6.103515×10^{-5}

(d) Largest positive normalised number.

Binary: 0 11110 1111111111

Decimal:

Exponent − bias = $30-15=15$

~~fraction~~ significand = $(1.1111111111) \approx 2$

$\therefore$ Value in decimal = $2\times2^{15} \sim 2^{16} = 65536$

$= 6.5536\times10^{4}$

Smallest denormalised number and largest denormalised number at end of the Ans 4.

2. ISA A:

IPC : 10 $\Rightarrow \frac{1}{10} = CPI$

frequency = 500MHz clock

ISA B:

IPC : 2 $\Rightarrow CPI = \frac{1}{2}$

frequency = 600MHz clock.

(iii)

(i) Total instructions : 1 million

: 10^6 instruction

$\therefore$ Execution time (ISA A) $= \left[\frac{1}{10} * \cancel{10^6}\right] * \frac{1}{500 \times \cancel{10^6}}$

$= \frac{1}{10} * \frac{1}{500}$ sec

$= \frac{1}{5000}$ second

$=$ 0.0002 seconds. $= 2 \times 10^{-4}$ secs

$\therefore$ In 2×10^{-3} seconds it evaluates 1 million ops. $\therefore$ In 1 s, it can evaluate 5×10^{3} instr $=$ 5000 Million inst

(ii) Execution Time (ISA B) $= \left[\frac{1}{2} \cancel{\times 10^6}\right] * \frac{1}{600 \times \cancel{10^6}}$

$= \frac{1}{1200}$ seconds

$= 8.33 \times 10^{-4}$ seconds.

In 8.33×10^{-4} seconds it can evaluate 1 million ins

$8.33 \times 10^{-4} \longrightarrow$ 1 million

$1 \longrightarrow \frac{1}{8.33 \times 10^{-4}}$ million instr

$\approx$ 1200 MIPS

3.

(iii) Since on ISA A, more no. of instructions get executed in 1 sec
Hence ISA A is better.
This is assuming instructions in both ISA handle similar complexity.

3. Nor and Nand instructions

Nor can be thought of as a combination of or operation followed by xor operation

Nand can be thought of as a combination of and operation followed by xor operation

XOR operation is used to invest the ~~ops~~ results of and/or operation.

NOR		**NAND**	
or	x10, x8, x9	and	x7, x5, x6
xori	x10, x10, -1	xori	x7, x7, -1

4.

$g \to x5$

$h \to x6$

(i)
```
if (g>h)
    g = g+1 ;
else
    h = h-1 ;
```

Rough:

$(x5 > x6) \Rightarrow x6 < x5$

```
bge h, g, COND2
    add. x5, x5, 1
COND2 : add x6, x6, -1
```

Solution:
```
        bge   x6, x5, COND2
        add   x5, x5, 1
COND2 : add   x6, x6, -1
```
→ check if h becomes greater than or equal to g then go to COND2

(ii)
```
if (g<=h)
    g=0;
else
    h=0;
```
⇒ h<g then loop

```
blt   x6, x5, COND2
addi  x5, x0, 0
COND2: addi  x6, x0, 0
```
check when h<g then go to COND2

g=0

h=0

1.

(e) Largest positive denormalised number

Binary 0 00000 1111111111

Decimal $\Rightarrow 2^{-1}+2^{-2}+2^{-3}+\dots+2^{-10}$

≈ 1

(f) Smallest positive denormalised number

Binary:

0 00000 0000000001

Decimal :

$2^{-10} = \frac{1}{2^{10}} = \frac{1}{1024} \approx 9\times10^{-4}$

(g) Distance b/w Earth and Neptune = 171,072,000,000,000

This exceeds the range of representation.

Hence cannot be represented.