1.B

1. $-v$ is the additive inverse of v, so $v+(-v)=0$. Add the additive inverse of $-v$ to both side, we get $v+(-v)+(-(-v))=-(-v)$. So $v+0=-(-v)$. Because of addictive identity, we get $v=-(-v)$.

2. $av=0=av+(-av)$(additive inverse) . Add av to both sides we get $av+av=av$, i.e , $2av=av$. If $v\neq 0$ then $2a=a$, so $a=0$. Else $v=0$. So $a=0$ or $v=0$.

3. Suppose the answer is not unique, set them to x and x' , then $3x=w-v$ and $3x'=x-v$. So $3x=3x'$, then $3x-3x'=0$,then $3(x-x')=0$(distributive properties). According to q.2, $x-x'=0$, so $x=x'$.

4. Additive identity

1.C

- 1(a)
  Additive identity: $0=(0,0,0)$, $0+2\cdot 0+3\cdot 0=0$, so $0\in U$.
  Closed under addition: For $u,w\in U$,let $u=(x_1^u,x_2^u,x_3^u)$, $w=(x_1^w,x_2^w,x_3^w)$, then $u+w=(x_1^u+x_1^w,x_2^u+x_2^w,x_3^u+x_3^w)$.
  $(x_1^u+x_1^w)+2(x_2^u+x_2^w)+3(x_3^u+x_3^w)=(x_1^u+2x_2^u+3x_3^u)+(x_1^w+2x_2^w+3x_3^w)=0+0=0$, so $u+w\in U$.
  Closed under scalar multiplication:Let $u=(x_1,x_2,x_3)$, then $au=(ax_1,ax_2,ax_3)$.
  $ax_1+ax_2+ax_3=a(x_1+x_2+x_3)=a\cdot 0=0$.
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  Additive identity:$0\in U_1$ and $0\in U_2$, so $0\in U_1\cap U_2$.
  Closed under addition: $u,w\in U_1\cap U_2$,then $u,w\in U_1$ and $u,w\in U_2$, then $u+w\in U_1$ and $u+w\in U_2$,so $u+w\in U_1\cap U_2$.
  Closed under scalar multiplication: $au\in U_1$ and $au\in U_2$, so $au\in U_2\cap U_2$.
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  Yes. $U+W=\{u+w:u\in U,w\in W\}$, $W+U=\{w+u:w\in W,u\in U\}$. So $U+W=W+U$.
- 18
  Yes,$\{0\}$ is additive identity. Only $\{0\}$ has additive inverse.