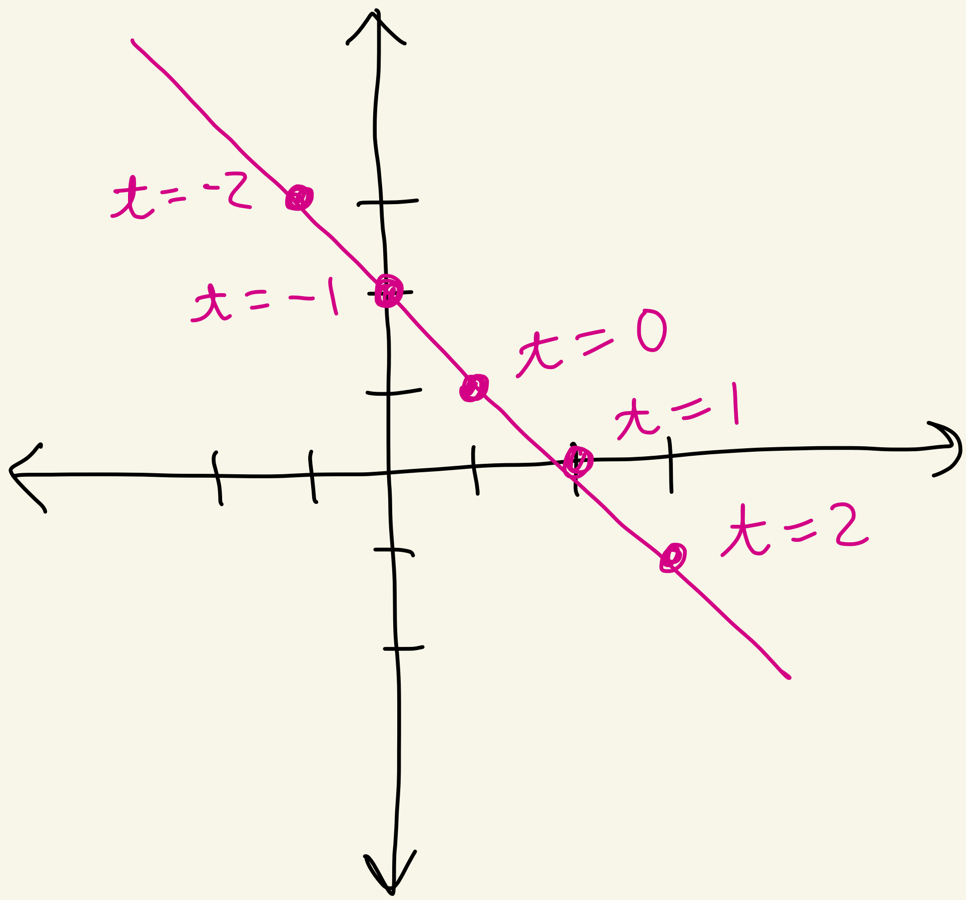
① $L_{AB} = \{ A + t(B-A) \mid t \in \mathbb{R} \}$

$= \{ (1,1) + t(1,-1) \mid t \in \mathbb{R} \}$

$= \{ (1+t, 1-t) \mid t \in \mathbb{R} \}$

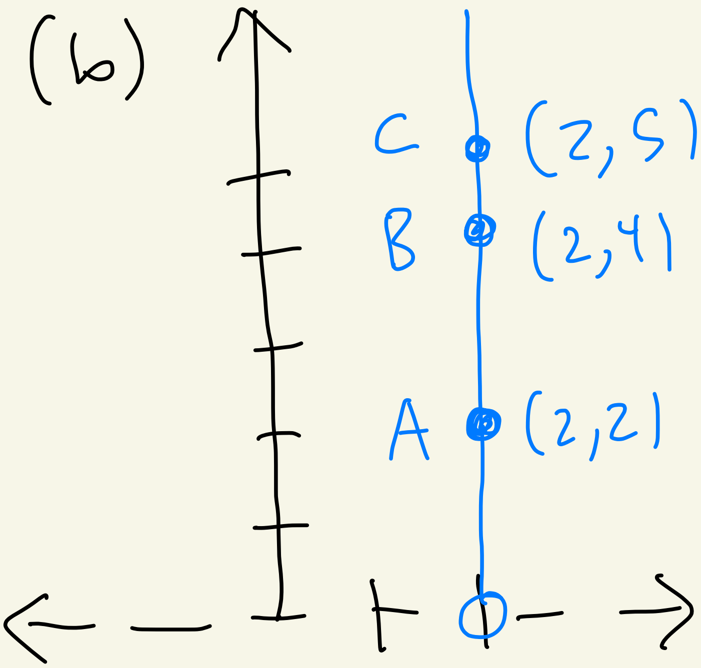
t	$(1+t, (1-t)$
-2	$(-1, 3)$
-1	$(0, 2)$
0	$(1, 1)$
1	$(2, 0)$
2	$(3, -1)$



(2)

(a) $A, B, C \in {}_2L$ so they are collinear.

(b)



$\boxed{\text{Method 1}}$:

$$d_H(A,B) + d_H(B,C) = \left|\ln\left(\tfrac{4}{2}\right)\right| + \left|\ln\left(\tfrac{5}{4}\right)\right|$$

$$= |\ln(2)| + \left|\ln\left(\tfrac{5}{4}\right)\right|$$

$$= \ln(2) + \ln\left(\tfrac{5}{4}\right)$$

$$= \ln\left(2 \cdot \tfrac{5}{4}\right) = \ln\left(\tfrac{5}{2}\right) = d_H(A,C)$$

Since A, B, C are collinear and
$d_H(A,B) + d_H(B,C) = d_H(A,C)$
we know that $A - B - C$.

$\boxed{\text{Method 2:}}$ $f : {}_2L \to \mathbb{R}$ given
by $f(2,y) = \ln(y)$ is the
standard ruler.

We have that

$$f(A) = \ln(2)$$
$$f(B) = \ln(4)$$
$$f(C) = \ln(5)$$

So, $f(A) < f(B) < f(C)$.

Thus, since A, B, C are collinear
and $f(A) < f(B) < f(C)$
we know that $A - B - C$.

3

$$\overrightarrow{AB} = \{ A + t(B-A) \mid t \geq 0 \}$$
$$= \{ (0,0) + t(1,3) \mid t \geq 0 \}$$
$$= \{ (t, 3t) \mid t \geq 0 \}$$

We have that

$$PQ = d_E(P,Q) = \sqrt{(2-1)^2 + (2-1)^2} = \sqrt{2}$$

We must find $C \in \overrightarrow{AB}$ where $AC = \sqrt{2}$.

Let $C = (t, 3t)$ where $t \geq 0$.

Then, $AC = d_E(A, C) = \sqrt{(t-0)^2 + (3t-0)^2}$
$$= \sqrt{t^2 + 9t^2}$$
$$= \sqrt{10t^2} = \sqrt{10}\, t$$

$\boxed{\text{since } t \geq 0}$

We need $\sqrt{10}\, t = \sqrt{2}$.

So, $t = \frac{\sqrt{2}}{\sqrt{10}} = \sqrt{\frac{2}{10}} = \frac{1}{\sqrt{5}}$

Thus, $C = (t, 3t) = \left(\frac{1}{\sqrt{5}}, \frac{3}{\sqrt{5}}\right)$

---

④ (a)

$(0-c)^2 + 1^2 = r^2$ ← from A

$(2-c)^2 + 1^2 = r^2$ ← from B

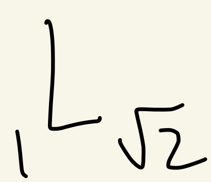
So, $c^2 + 1 = r^2 = 4 - 4c + c^2 + 1$

Thus, $0 = 4 - 4c$

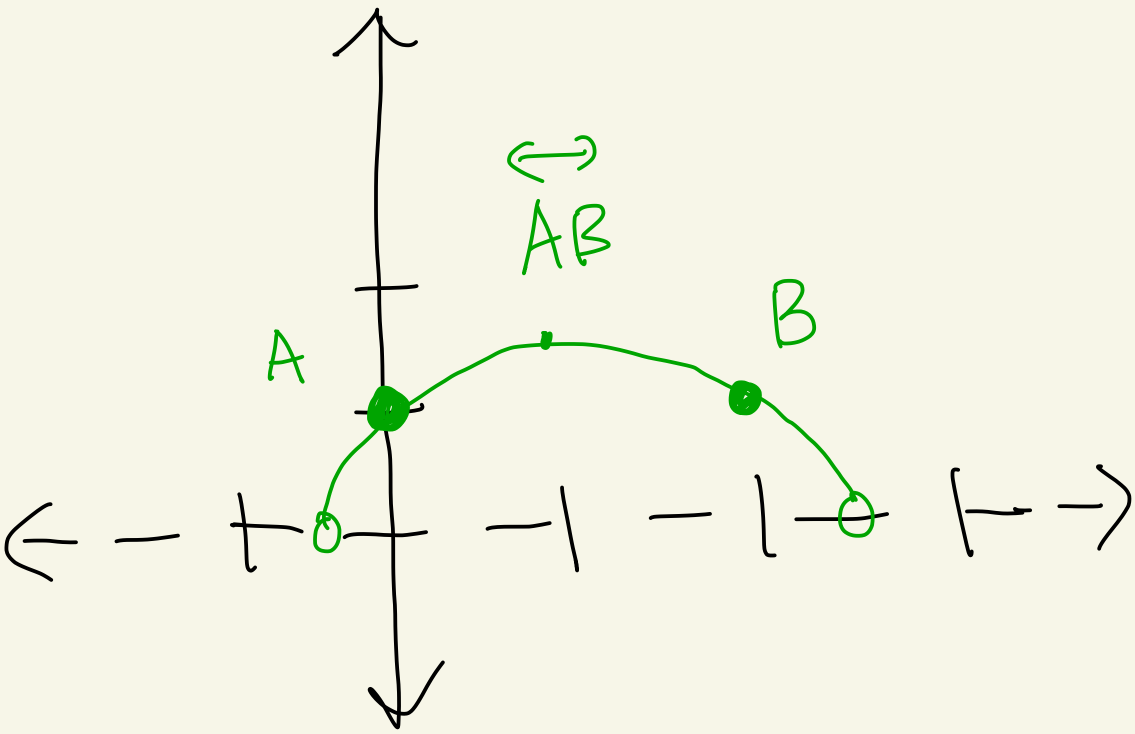
So, $c = 1$.

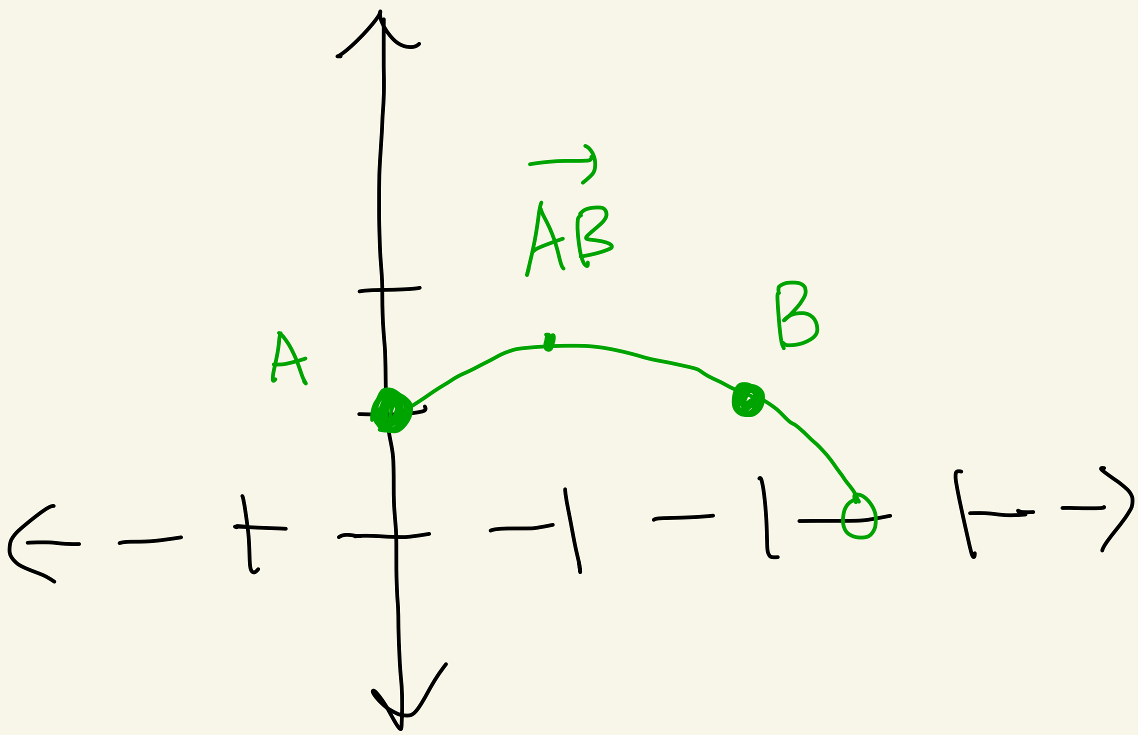
Thus, $r^2 = 1 + c^2 = 2$

So, $r = \sqrt{2}$.

Thus, $\overleftrightarrow{AB} =$ 

pictures for (a) and (b):





(5) See HW 3 problem 2.

(6) See HW 4 problem 6