Page No.
Date : / /201

In-Class Questions 1.1

$\boxed{1}$

(a)

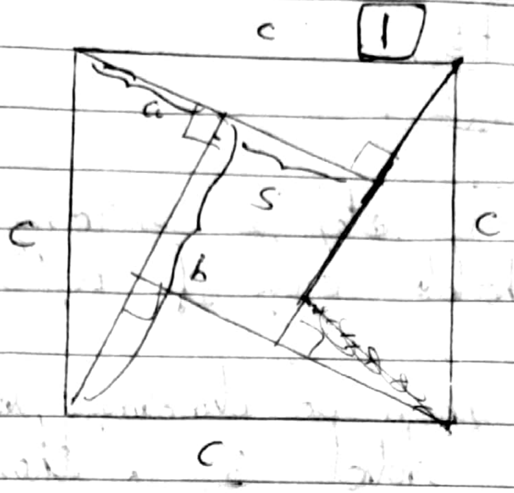
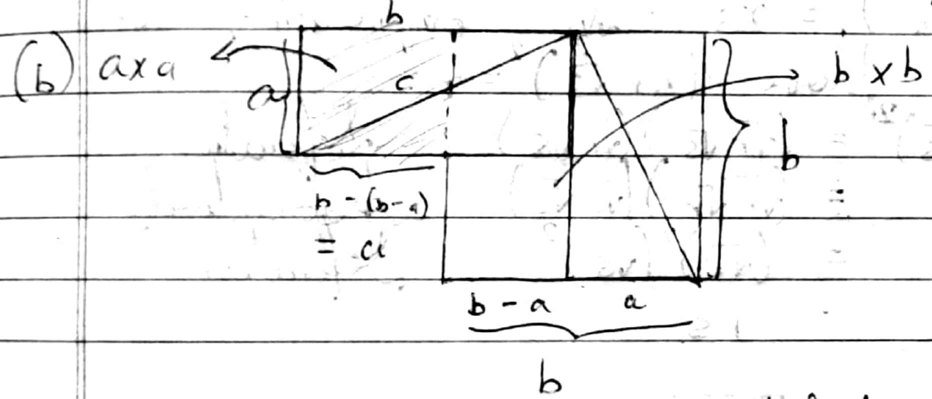


Figure not to scale and angles shown may be incorrect

Since ~~S=~~ $a + s = b \Rightarrow s = b - a$
s is the side of the square

(b)



(c) The rearrangement is justified because we have only used facts like the sum of non-right angles of a right triangle is 90°. The case $a = b$ has no problem, in which the square would have side 0 ~~or~~, i.e. just a point.

(d)
- Sum of non-right angles of a right triangle is 90°.
- Length of a line segment is equal to sum of lengths of two parts in which it is divided.
- Sum of angles on a line is 180°.

Page No.
Date : / /201

$\boxed{\cancel{2}}$

$\boxed{2}$

(a) $\sqrt{(-1)(-1)} = \sqrt{-1}\sqrt{-1}$ step is wrong.
as $\sqrt{ab} = \sqrt{a}\sqrt{b}$ holds only if $a, b \in \mathbb{R}^+ \cup \{0\}$

(b) Assume $1 = -1$. Then on dividing both sides by 2,
$\frac{1}{2} = -\frac{1}{2}$ Add $\frac{3}{2}$, then

$2 = 1$.

(c) Since $(\sqrt{rs})^2 = rs$ by definition, we ~~m~~ need to prove $(\sqrt{r}\sqrt{s})^2 = rs$

$$\begin{aligned}(\sqrt{r}\sqrt{s})^2 &= (\sqrt{r}\sqrt{s})(\sqrt{r}\sqrt{s}) && \text{Definition}\\ &= (\sqrt{r}\sqrt{r})(\sqrt{s}\sqrt{s}) && \text{Associativity}\\ &= (\sqrt{r})^2(\sqrt{s})^2 && \text{Definition}\\ &= rs\end{aligned}$$

~~(d)~~

$\boxed{3}$

(a) The error is $3\log_{10}(1/2) > 2\log_{10}(1/2)$
because $\log_{10}(1/2) < 0$ as $\frac{1}{2} < 1$, and multiplication by negative numbers inverts the inequality.

(b) The error is $\$0.01 = (\$0.1)^2$ as the units of $(\$0.1)^2$ are $\$^2$ but the LHS has units $\$$.
Also $(10¢)^2 = 100¢$ is wrong.

~~(c)~~

(c) The step ~~(a-b)(a~~ $a+b = b$ is wrong because since $a = b$, $a-b = 0$ and 0 can't be cancelled from both sides of inequality.

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Page No.

Date: / /201

$\boxed{4}$

The problem is that the proof proves that if $\frac{a+b}{2} \geq \sqrt{ab}$ then $(a-b)^2 \geq 0$ while this is not what we wanted. In fact, the proof should be in reverse order.

$$(a-b)^2 \geq 0 \text{ so,}$$
$$a^2 - 2ab + b^2 \geq 0 \text{ so,}$$
$$a^2 + 2ab + b^2 \geq 4ab \text{ so, } (\text{as } a, b \geq 0)$$
$$(a+b)^2 \geq (2\sqrt{ab})^2 \text{ so}$$
$$a+b \geq 2\sqrt{ab} \text{ so.}$$
$$\frac{a+b}{2} \geq \sqrt{ab}.$$

$\boxed{5}$

The problem is with the word "surprise" and its precise mathematical implication.

For a good discussion, refer:

The surprise examination or unexpected hanging paradox, by Timothy Y. Chow.