Searching through the diagrams.

All the problems below are about Abelian groups and/or modules over a commutative ring k

1◇1. Which of the following statements about an commutative triangle
$$\begin{tikzcd} U \arrow[rr, "\gamma"] \arrow[dr, "\alpha"'] & & W \\ & V \arrow[ur, "\beta"'] & \end{tikzcd}$$
are true?

a) α, β are epi $\Rightarrow \gamma$ is epi **b)** α, β are mono $\Rightarrow \gamma$ is mono **c)** γ is epi $\Rightarrow \alpha$ is epi
d) γ is epi $\Rightarrow \beta$ is epi **e)** γ is mono $\Rightarrow \alpha$ is mono **f)** γ is mono $\Rightarrow \beta$ is mono
g) if α is epi, then γ is epi $\iff \beta$ is epi **h)** if α is epi, then γ is mono $\iff \beta$ is mono
i) if β is epi, then γ is epi $\iff \alpha$ is epi **j)** if β is epi, then γ is mono $\iff \alpha$ is mono
k) if γ is an isomorphism, then α is mono and β is epi.

1◇2. Consider a commutative diagram with exact rows:

$$\begin{tikzcd} 0 \arrow[r] & V' \arrow[r] \arrow[d, "\varphi'"] & V \arrow[r] \arrow[d, "\varphi"] & V'' \arrow[r] \arrow[d, "\varphi''"] & 0 \\ 0 \arrow[r] & W' \arrow[r] & W \arrow[r] & W'' \arrow[r] & 0 \end{tikzcd} \tag{1}$$

Which of the implications below are true?
a) φ is an isomorphism $\iff \varphi'$ is mono and φ'' is epi
b) φ', φ'' are isomorphisms $\Rightarrow \varphi$ is an isomorphism

1◇3 (5 morphisms lemma). Consider commutative diagram with exact rows

$$\begin{tikzcd} V_1' \arrow[r] \arrow[d, "\varphi_1'"'] & V_2' \arrow[r] \arrow[d, "\varphi_2'"'] & V \arrow[r] \arrow[d, "\varphi"] & V_2'' \arrow[r] \arrow[d, "\varphi_2''"] & V_1'' \arrow[d, "\varphi_1''"] \\ W_1' \arrow[r] & W_2' \arrow[r] & W \arrow[r] & W_2'' \arrow[r] & W_1'' \end{tikzcd}$$

Does bijectivity (accord. injectivity, surjectivity) of 4 flank arrows φ_1', φ_1'', φ_2', φ_2'' imply the same property of the middle arrow φ ?

1◇4. Show that there is a unique morphism $V' \xrightarrow{\varphi'} W'$ fitted commutatively in the following commutative diagram with exact rows:

$$\begin{tikzcd} 0 \arrow[r] & V' \arrow[r] & V \arrow[r] \arrow[d, "\varphi"] & V'' \arrow[r] \arrow[d, "\varphi''"] & 0 \\ 0 \arrow[r] & W' \arrow[r] & W \arrow[r] & W'' \arrow[r] & 0 \end{tikzcd}$$

Find sufficient conditions implying injectivity of φ'.

1◇5. Do the same for the diagram

$$\begin{tikzcd} 0 \arrow[r] & V' \arrow[r] \arrow[d, "\varphi'"'] & V \arrow[r] \arrow[d, "\varphi"'] & V'' \arrow[r] & 0 \\ 0 \arrow[r] & W' \arrow[r] & W \arrow[r] & W'' \arrow[r] & 0 \end{tikzcd}$$

but find sufficient conditions for surjectivity of φ''.

1◇6 (snake lemma). Show that the commutative diagram (1) (with exact rows) induces a long exact sequence: $0 \longrightarrow \ker\varphi' \longrightarrow \ker\varphi \longrightarrow \ker\varphi'' \longrightarrow \operatorname{coker}\varphi' \longrightarrow \operatorname{coker}\varphi \longrightarrow \operatorname{coker}\varphi'' \longrightarrow 0.$