1. In the absence of lactose (disregarding the presence or absence of glucose):

* There is a negative regulation because lactose is not the carbohydrate source that is preferred. This causes the lac operon to turn off.
* RNA polymerase is prevented from transcription of the operator because the repressor binds to the operator region.

1. In the presence of lactose (disregarding the presence or absence of glucose):

* This has a positive regulation due to the lac operon being turned on when glucose is absent.

1. In the absence of glucose (disregarding the presence or absence of lactose):

* With glucose absent there is a high cAMP. For transcription of the Lac Operon, it is required that CAP-cAMP complex binds to the promoter site.
* Catabolite activator proteins (CAP proteins) bid to cAMP, which in this state contains high concentrations in the cell in the absence of glucose. This process allows the CAP to bind with the CAP binding site and begin recruiting RNA polymerase to the Lac promoter.

1. In the absence of glucose and the presence of lactose:

* When there is an absence of lactose and glucose CAP binds to the CAP binding site, causing the Lac operon by the LacI to be repressed. The LacI (Lac Repressor molecule) is then bound by Allolactose, a lactose stereoisomer.
* This allows transcription for the lac operon to continue by preventing Lac Repressors from binding to their Lac Operator.

1. Finally, describe the part of gene expression (transcription, post-transcription, translation, post-

translation) where this regulation takes place:

* Gene expression regulation occurs during transcription, which is the process of synthesizing RNA from the DNA template.