In an operon, elements A, B, C, and D represent the repressor gene, the operator, the structural gene, and the promoter, but not necessarily in that order. This operon is concerned with the synthesis and metabolism of a compound X. From the data provided in the accompanying table (AE=active enzyme, IE= inactive enzyme, NE=no enzyme), please answer the following questions:

|  |  |  |
| --- | --- | --- |
| *Genotype* | *Compound X present* | *Compound X absent* |
| A+B+C+D+ | AE | NE |
| A-B+C+D+ | NE | NE |
| A+B-C+D+ | AE | AE |
| A+B+C-D+ | IE | NE |
| A+B+C+D- | AE | AE |
| A-B+C+D+/ A+B+C+D+ | AE | NE |
| A+B-C+D+/ A+B+C+D+ | AE | NE |
| A+B+C-D+/ A+B+C+D+ | AE+IE | NE |
| A+B+C+D-/ A+B+C+D+ | AE | AE |

**1) Which of the following statements accurately describes this operon?**

1. This operon is inducible and under positive control.
2. This operon is inducible and under negative control.
3. This operon is repressible and under positive control.
4. This operon is repressible and under negative control.

**2) Which of the following elements encodes the repressor?**

1. A.
2. B.
3. C.
4. D.

**3) Which of the following elements encodes the operator?**

1. A.
2. B.
3. C.
4. D.

**4) Which of the following elements encodes the structural gene?**

1. A.
2. B.
3. C.
4. D.

In the table below, “+” represents the production of active enzyme, whereas “-“ represents no production of active enzyme. The first one has been done as an example.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Genotype | *β-Galactosidase* | | *Permease* | |
| No lactose | Lactose | No lactose | Lactose |
| I+P+O+Z+Y+ | - | + | - | + |
| I+P+OCZ-Y+ |  |  |  |  |
| I-P+O+Z+Y-/I+P-OCZ-Y+ |  |  |  |  |
| I+P+OCZ+Y-/I-P+O+Z-Y+ |  |  |  |  |

**5) Which of the following statements accurately describes the *lac* operon regulation in** I+P+OCZ-Y+**?**

1. The production of both β-galactosidase and permease is always on.
2. The production of β-galactosidase is always off and the production of permease is always on.
3. The production of β-galactosidase is always on and the production of permease is always off.
4. The production of β-galactosidase is inducible and the production of permease is always off.
5. The production of β-galactosidase is always on and the production of permease is inducible.

**6) Which of the following statements accurately describes the lac operon regulation in** I-P+O+Z+Y-/I+P-OCZ-Y+**?**

1. The production of β-galactosidase is always on and the production of permease is always off.
2. The production of β-galactosidase is inducible and the production of permease is always off.
3. The production of β-galactosidase is always on and the production of permease is inducible.
4. The production of both β-galactosidase and permease is always on.
5. The production of both β-galactosidase and permease is always off.

**7) Which of the following statements accurately describes the lac operon regulation in** I+P+OCZ+Y-/I-P+O+Z-Y+**?**

1. The production of both β-galactosidase and permease is always on.
2. The production of both β-galactosidase and permease is always off.
3. The production of β-galactosidase is always on and the production of permease is always off.
4. The production of β-galactosidase is inducible and the production of permease is always off.
5. The production of β-galactosidase is always on and the production of permease is inducible.

In the table below, “+” represents the transcription of trpE, whereas “-“ represents no transcription of trpE.

|  |  |  |
| --- | --- | --- |
| Genotype | when tryptophan level is low | when tryptophan level is high |
| Wild type | + | - |
| Mutation deleting the AUG of trpE |  |  |
| Mutation deleting the AUG of trpL |  |  |
| Mutation deleting region 2 |  |  |

**8) Which of the following statements accurately describes the transcription of *trpE* region in a mutant, in which the AUG of trpE is deleted?**

1. TrpE is transcribed when tryptophan level is high, and not transcribed when tryptophan level is low.
2. TrpE is transcribed when tryptophan level is low, and not transcribed when tryptophan level is high.
3. TrpE is transcribed in both conditions (high and low levels tryptophan).
4. No TrpE is transcribed in either condition.

**9) Which of the following statements accurately describes the transcription of *trpE* region in a mutant, in which the AUG of trpL is deleted?**

1. TrpE is transcribed when tryptophan level is high, and not transcribed when tryptophan level is low.
2. TrpE is transcribed when tryptophan level is low, and not transcribed when tryptophan level is high.
3. TrpE is transcribed in both conditions (high and low levels tryptophan).
4. No TrpE is transcribed in either condition.

**10) Which of the following statements accurately describes the transcription of *trpE* region in a mutant, in which the region 2 of trpL is deleted?**

1. TrpE is transcribed when tryptophan level is high, and not transcribed when tryptophan level is low.
2. TrpE is transcribed when tryptophan level is low, and not transcribed when tryptophan level is high.
3. TrpE is transcribed in both conditions (high and low levels tryptophan).
4. No TrpE is transcribed in either condition.