1. An effective collision is one that:

   ☐ has enough energy and the correct orientation, so a reaction happens

   ☐ has any amount of energy, whatever the orientation

   ☐ happens at the wrong angle but with high energy

   ☐ has the correct orientation, whatever its energy

2. The activation energy is:

   ☐ the average energy of the molecules

   ☐ always zero

   ☐ the energy released by the reaction

   ☐ the minimum energy a collision needs to be effective

3. A catalyst speeds up a reaction by:

   ☐ raising the activation energy so fewer collisions succeed

   ☐ providing a different route with a lower activation energy

   ☐ being used up in the reaction to make extra product

   ☐ increasing the temperature of the reaction mixture

4. The rate of reaction depends on the:

   ☐ frequency of effective collisions

   ☐ mass of the container

   ☐ number of non-effective collisions only

   ☐ colour of the reactants

5. On the Boltzmann distribution, the molecules that can react are those:

   ☐ at the peak

   ☐ to the right of the activation energy

   ☐ at zero energy

   ☐ to the left of the activation energy

6. A catalyst speeds up a reaction by giving the molecules more energy.

   ☐ True ☐ False

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8. A small rise in temperature can give a large rise in reaction rate.

   ☐ True ☐ False

9. An endothermic reaction has $\Delta H = +40\ \frac{\text{kJ}}{\text{mol}}$ and a forward activation energy of $120\ \frac{\text{kJ}}{\text{mol}}$. What is the activation energy of the reverse reaction, in $\frac{\text{kJ}}{\text{mol}}$?

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10. A reaction loses 0.36 g of mass in its first 120 s. What is the mean rate of mass loss, in grams per second?

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1. **has enough energy and the correct orientation, so a reaction happens**

   A collision only reacts with sufficient energy and the right orientation.

2. **the minimum energy a collision needs to be effective**

   Only collisions with at least the activation energy can react.

3. **providing a different route with a lower activation energy**

   A catalyst offers a new mechanism with a lower E_a, so more molecules can react; it is not used up.

4. **frequency of effective collisions**

   More effective collisions per second means a faster rate.

5. **to the right of the activation energy**

   Molecules with energy greater than E_a (right of the line) have enough energy to react.

6. **False**

   False. A catalyst provides an alternative route with a lower activation energy, so more collisions succeed at the same temperature. It is not used up.

7. **gradient**

   A steeper gradient means a faster rate.

8. **True**

   Because the reacting fraction grows sharply with temperature, even a small increase greatly speeds the reaction.

9. **80**

   The products sit 40 above the reactants, so the climb back to the top of the hump is $120 - 40 = 80$.

10. **0.003**

    $\frac{0.36}{120} = 0.0030$ g each second.

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