1. Enzymes
are only used industrially to make chiral molecules

- ○ There
are no examples of enzymes as catalysts in chemical processes in an industrial setting
- ○ Yes,
enzymes are only useful more the manufacture of chiral products such as valuable pharmaceutical intermediates
- ◉ Enzymes are often used to make chiral products,
but can be successfully used in some cases for achiral products
- ○ Enzymes
cannot make chiral products, they are only used to make products which do not possess chirality

2. Which of the following can
a transaminase be employed to achieve?

- ○ Reduction of ketones to chiral alcohols
- ○ Hydroxylation of aromatic molecules
- ○ Synthesis of sugars from carbohydrates
- ◉ The synthesis of chiral
primary amines

3. An
IB manufacturing process is always a more sustainable option than a pure chemical process

- ○ IB processes are not scalable as manufacturing routes and so cannot be used for the production of bulk or commodity chemicals
- ◉ IB is not always, but in some circumstances, can be more sustainable than a chemical process for a given product
- ○ IB processes are always more sustainable than any traditional chemical methods employed in industry
- ○ IB can never compete with chemical processes which boast higher productivity and better cost efficiency

4. In
reducing the environmental impact of a process, what is one of the biggest benefits of moving to an IB process?

- ○ Reducing the amount of water used as most enzymes work in the absence of water
- ◉ Reducing/ removing the use of organic solvents and hazardous reagents
- ○ Providing an alternative route
- ○ Reducing space the time yields (throughput) and cost efficiency of a process

5. IB/biocatalysed
processes can be used for ...

- ○ Only
for foodstuffs such as dietary supplements, nutraceuticals and flavour compounds
- ○ Only for the manufacture of complex high value
products like pharmaceuticals
- ○ Only
for the manufacture of biofuels which are more sustainably resourced than current fuels
- ◉ A wide range of functional molecules including
pharmaceuticals, personal care products and bulk chemicals

6.

When screening for a given
transformation to design a new process, you need to start with a hit from a known enzyme on the given substrate of choice

- ○ Yes, this is correct
- ○ An
enzyme evolution study needs to start with really simple models
- ○ If
screening commercially available enzymes
does not produce a hit on the substrate of choice, then it is not possible to develop an IB process
- ◉ No, in silico design, modelling understanding
the reactivity of related simple
substrates and can help us design a bespoke enzyme

7. Enzymes
that use complex and expensive co-factors like NADPH or PLP cannot be used in economically viable commercial processes.

- Enzymes
that use co-factors are generally not used in IB processes as they do not perform synthetically useful reactions of interest to industry
- A number of different ways are known to recycle
co-factors like NADH, and these can be scaled up to give viable large scale processes
-

Yes, this is generally true as they cannot be sourced
sustainably or regenerated during the reaction

- We
can add stoichiometric co-factors as this is very cost efficient

8. When
designing a manufacturing process, safe operation is a top consideration

- All
enzyme reactions are endothermic and this must be taken into account in the design of all IB processes
- Most IB processes occur in
water at near neutral pH, near ambient temperature, and are not exothermic
- Enzymes
work at very low temperatures and so cooling systems are often required
- Most
enzymes work at high pressures so safety needs to be a high priority

9. Enzymes
are only useful for the manipulation of functional groups like ketones and alcohols

- ○ Enzymes
are not useful catalysts for functional group manipulation and are employed mostly in forming bonds between molecules
- ○ Enzymes
are not useful catalysts for functional group manipulation and those that are, are not selective for similar groups at different positions
- ◉ Enzymes are useful catalysts for the
manipulation of functional groups, but also for carbon-carbon and carbon-heteroatom bond synthesis
- ○ Generally
this is true as enzymes do not work on more complex or unactivated chemical groups

10. Enzymes
are very useful catalysts but only for natural substrates

- ○ No, but it takes many years to evolve an enzyme for a
given substrate
- ○ It is not possible to change the substrate for a given
enzyme
- ◉ Enzyme mutants can now be
quickly evolved to accept a wide range of unnatural substrates
- ○ Yes, this is true

11. If
you wanted to prepare an ester using an enzyme catalysed process, which enzyme would you use?

- ○ An Aldolase
- ○ An oxidoreductase like a ketoreductase
- ○ An oxidoreductase like an amino acid oxidase
- ◉ A hydrolase like a lipase

12. What
will a nitrile hydratase transform a nitrile group into?

- ○ A primary amine only
- ○ A mixture of products
- ◉ A primary amide only
- ○ Carboxylic acid only