

A. Energy Changes part 1 – Exothermic And Endothermic Reactions

1. How do we describe energy conservation in reactions? (2)

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2. What is an exothermic reaction? (2)

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3. Give two examples of exothermic reactions. (2)

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4. What is an endothermic reaction? (2)

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5. Give one example of an endothermic reaction. (1)

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6. **Extended response question:**

A student wishes to investigate which of three metals will give the largest exothermic reaction when they react with hydrochloric acid. Describe how she would carry out the experiment making sure it was a fair test. (6)

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B. Energy Changes part 2 – Reaction profiles

7. What is activation energy? (1)

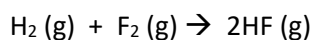
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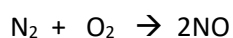
8. Extended response question:

The following reaction is exothermic:



Draw a reaction profile to show this reaction, to include the relative energies of the reactants and products, the activation energy and the overall energy change. (6)

9. (HT only) Below is a balanced chemical reaction between nitrogen gas and oxygen gas to produce nitrogen monoxide. The bond energy between two nitrogen atoms is 942kJ/mol, between two oxygen atoms is 494 KJ/mol and between a nitrogen atom and an oxygen atom is 607kJ/mol. Calculate the overall energy change for this reaction. (4)



10. (HT only) Draw a reaction profile for the above reaction. (4)

11. Describe the energy release in an exothermic reaction in terms of bond energies. (2)

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C. Energy Changes part 3 – Cells, Batteries and Fuel Cells

12. A student has a number of cells all with a potential difference of 1.5V. Explain how they could construct a battery with a potential difference of 12V. (2)

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13. Below is a table of standard electrode potentials.

Metal electrode	Standard electrode potential E^{\ominus} in volts
Calcium	-2.76
Magnesium	-2.38
Aluminium	-1.66
Zinc	-0.76
Iron	-0.41
Lead	-0.13

When a cell contains an aluminium electrode and a zinc electrode the potential difference of the cell is 0.90 Volts.

Calculate the potential difference of a cell with magnesium and iron electrodes. (2)

14. How would you increase the potential difference of this cell? (1)

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15. (HT only) Write the half equations for the electrode reactions in a hydrogen fuel cell.

Cathode (2)

Anode (2)

16. Hydrogen fuel cells are used on space craft to produce electricity. Give an advantage and a disadvantage of using hydrogen fuel cells on a space craft. (2)

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