2.4 Energy Changes: Test Pack

AQA 8462 · Calculator allowed · about 35 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Give the name used for a reaction that takes in heat from the surroundings.

(Total for Question 1 is 1 mark)

---

2 Chemical reactions can be exothermic or endothermic, depending on the direction of energy transfer between the reacting chemicals and the surroundings.

(a) Which one of these is an example of an exothermic reaction? **(1)**

- ☐ A) photosynthesis
- ☐ B) thermal decomposition of calcium carbonate
- ☐ C) combustion of methane
- ☐ D) dissolving ammonium nitrate in water

(b) State the direction of energy transfer between the reacting chemicals and the surroundings during an endothermic reaction. **(1)**

(c) Give one everyday example of an exothermic reaction and one everyday example of an endothermic reaction, other than combustion. **(2)**

(Total for Question 2 is 4 marks)

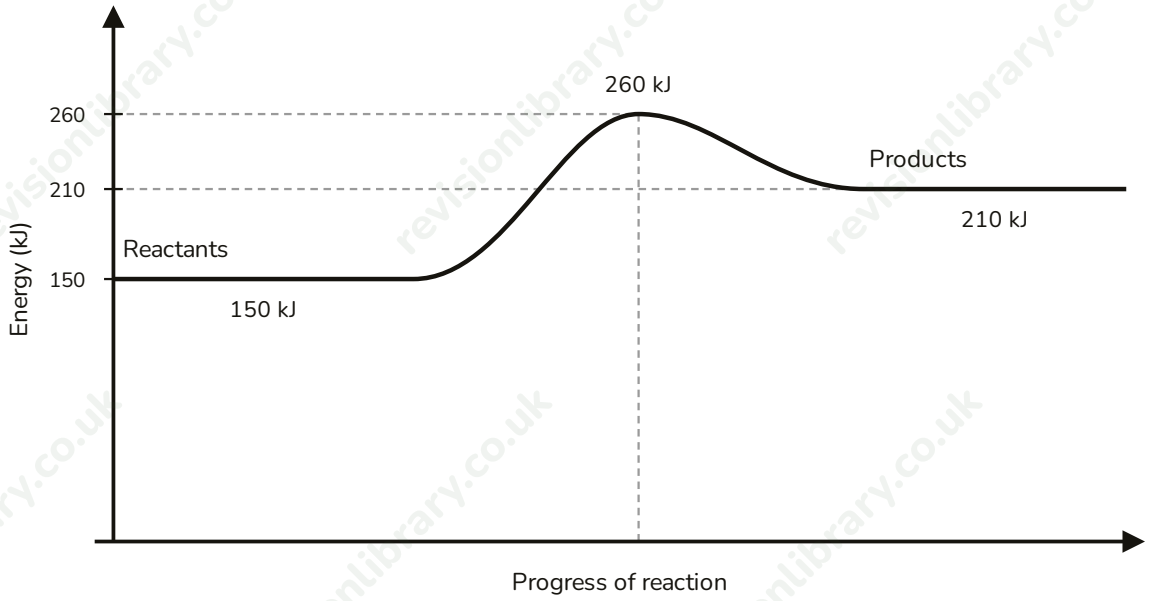
© Revision Library | revisionlibrary.co.uk

3 Tick two correct statements from the list: A: Forming bonds absorbs energy. B: Breaking bonds absorbs energy. C: Forming bonds releases energy. D: Breaking bonds releases energy.

(Total for Question 3 is 2 marks)

---

4 A different reaction has the following reaction profile.



(a) State whether this reaction is exothermic or endothermic. **(1)**

(b) Calculate the activation energy for this reaction. **(2)**

.....

(c) A catalyst is added to this reaction. State the effect, if any, that the catalyst has on the activation energy and on the overall energy change. **(1)**

(Total for Question 4 is 4 marks)

© Revision Library | revisionlibrary.co.uk

5 Hydrogen reacts with fluorine: $H_2 + F_2 \rightarrow 2HF$. The overall energy change for this reaction is -540 kJ/mol. Bond energies: H-H = 436 kJ/mol, F-F = 158 kJ/mol.

(a) Calculate the total energy needed to break the bonds in the reactants. **(1)**

.....

(b) Show that the mean bond energy of the H-F bond is 567 kJ/mol. **(3)**

(Total for Question 5 is 4 marks)

---

6 Calculate the energy change for the neutralisation. Show substitution in q = m x c x deltaT and state whether the reaction is exothermic or endothermic.

(Total for Question 6 is 4 marks)

© Revision Library | revisionlibrary.co.uk

7 A student investigates the combustion of ethanol. The bond energies relevant are: C-H 410 kJ mol-1, C-C 347 kJ mol-1, C-O 358 kJ mol-1, O-H 463 kJ mol-1, O=O 498 kJ mol-1, C=O 799 kJ mol-1. Ethanol formula CH_3CH_2OH. Use bond energy values to estimate the enthalpy change for combustion of one mole of ethanol:

(a) Calculate an estimate of deltaH for $C_2H_5OH + 3\ O_2 \rightarrow 2\ CO_2 + 3\ H_2O$ using the bond energies above. Give your answer in kJ mol-1 (to 3 significant figures). **(3)**

(Total for Question 7 is 3 marks)

---

8 A reversible reaction has a forward activation energy of 95 kJ/mol. Taking the energy level of the reactants as 0 kJ, the overall energy change for the forward reaction is -55 kJ/mol.

(a) State the energy level of the products, relative to the reactants. **(1)**

(b) Calculate the activation energy for the reverse reaction. **(2)**

.....

(c) State the effect that adding a catalyst would have on the activation energy calculated in part (b). **(1)**

(Total for Question 8 is 4 marks)

© Revision Library | revisionlibrary.co.uk

Mark scheme · 2.4 Energy Changes: Test Pack

Question 1

endothermic cao **B1**

Answer: Endothermic

Question 2

(a) C - combustion of methane cao **B1**

(a) Answer: C

(b) energy transferred from the surroundings to the chemicals (energy taken in) oe **B1**

(b) Answer: Energy is transferred from the surroundings to the reacting chemicals.

(c) exothermic example, e.g. hand warmer / neutralisation / respiration / setting of an exothermic adhesive oe **B1**

(c) endothermic example, e.g. sports cold pack / thermal decomposition of a metal carbonate / citric acid with sodium hydrogencarbonate oe **B1**

(c) Answer: Exothermic: a self-heating hand warmer (or neutralisation, respiration). Endothermic: a sports cold pack (or thermal decomposition of a metal carbonate).

Question 3

B: Breaking bonds absorbs energy **B1**

C: Forming bonds releases energy **B1**

Answer: B and C

Question 4

(a) endothermic **B1**

(a) Answer: Endothermic

(b) 260 - 150 oe **M1**

(b) 110 kJ cao **A1**

(b) Answer: 110 kJ

(c) activation energy decreases; overall energy change is unaffected oe **B1**

(c) Answer: The activation energy decreases (the catalyst provides a pathway with a lower activation energy); the overall energy change is unaffected.

Question 5

(a) 594 kJ/mol (436 + 158) cao **B1**

(a) Answer: 594 kJ/mol

(b) sets up overall energy change = energy to break bonds - energy released forming bonds: -540 = 594 - (2 x H-F) oe **M1**

(b) rearranges to 2 x H-F = 594 + 540 (= 1134), ft from a oe **M1**

(b) H-F = 567 kJ/mol cso (answer given; working must be shown) **A1**

(b) Answer: 567 kJ/mol (as given)

Question 6

substitutes into q = m x c x deltaT, e.g. q = 50.0 x 4.2 x 2.0 **M1**

evaluates multiplication correctly to 420 **M1**

gives unit J with answer **M1**

states exothermic because temperature increased cao **A1**

Answer: 420 J; exothermic

Question 7

(a) counts bonds broken and formed and sets up sum: deltaH = sum(bonds broken) - sum(bonds formed) **M1**

(a) substitutes numbers correctly: bonds broken = 5 C-H + 1 C-C + 1 C-O + 1 O-H + 3 O=O; bonds formed = 4 C=O + 6 O-H **M1**

(a) -1260 kJ mol-1 cao (accept -1262 kJ mol-1 before rounding) **A1**

(a) Answer: -1260 kJ mol-1

Question 8

(a) -55 kJ (i.e. 55 kJ below the reactants) cao **B1**

(a) Answer: -55 kJ (55 kJ below the reactants)

(b) peak energy (95) - products energy (-55), ft from a oe **M1**

(b) 150 kJ/mol cao **A1**

(b) Answer: 150 kJ/mol

(c) it would decrease (lower) the activation energy oe **B1**

(c) Answer: It would decrease (lower) the activation energy for the reverse reaction, as the catalyst provides an alternative reaction pathway.

© Revision Library | revisionlibrary.co.uk