16.2 Activation Energy

Question Paper

Course	DP IB Chemistry
Section	16. Chemical Kinetics (HL only)
Topic	16.2 Activation Energy
Difficulty	Easy

Time allowed: 30

Score: /20

Percentage: /100

Question 1a

a)
The Arrhenius equation can be written as:

$$k = Ae^{\frac{-E_a}{RT}}$$

State what each of the following terms represents, including units where applicable.

- A
- E_a
- R
- T

[5]

[5 marks]

Question 1b

b)
Rearrange the Arrhenius equation given in part (a) to make *A* the subject.

[1]

[1 mark]

Question 1c

c)
State how the rate constant, *k* varies with temperature, *T*.

[1]

[1 mark]

Question 1d

d)
State how the activation energy, *Ea*, varies with rate constant, *k*.

[1]

[1 mark]

Question 2a

a)
The Arrhenius equation can also be written in natural logarithmic forms.

$$\ln k = \ln A - \frac{Ea}{RT}$$

A plot of ln *k* against $\frac{1}{T}$ gives a straight-line graph of the type y = mx + c.

Complete the table below which relates the terms from the natural logarithmic Arrhenius equation to the equation of a straight line.

Straight-line term	Arrhenius term
y	ln *k*
m	
x	
c	

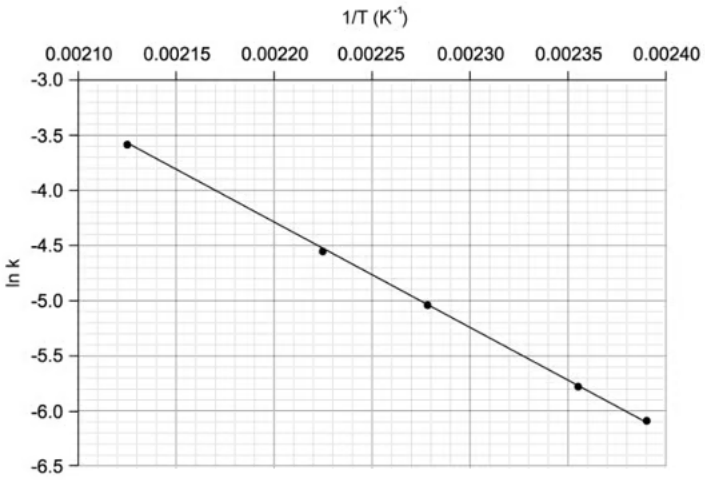
[3]

[3 marks]

Question 2b

b)

A graph of ln *k* against $\frac{1}{T}$ is shown below.



Calculate the gradient of the straight line.

[2]

[2 marks]

Question 2c

c)

Using section 2 of the data booklet, calculate the activation energy, *Ea* for the graph in part b).

[1]

[1 mark]

Question 2d

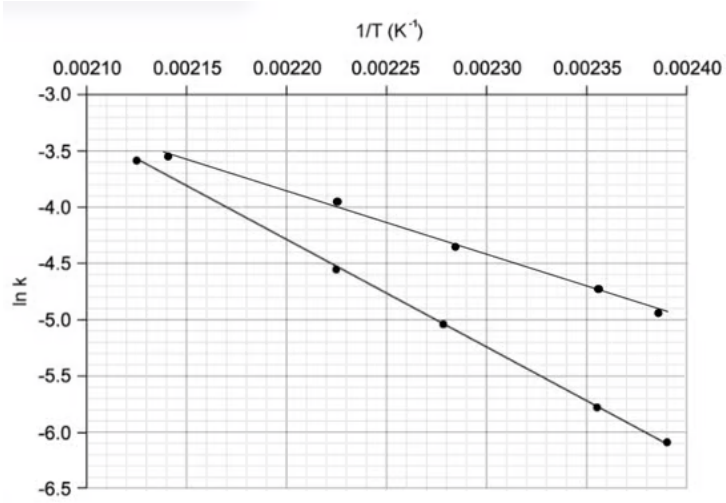
d)
Calculate the frequency factor, A, for the graph in part b) to 2 decimal places.

[2]

[2 marks]

Question 3a

a)
Arrhenius plots for two reactions with different activation energies are shown below.



State which plot shows the reaction with the greatest activation energy.

[1]

[1 mark]

Question 3b

b)
The temperature of both reactions from part a) is increased from 20° to 45°.
Using section 1 of the data booklet, determine which of the reactions will experience the largest change in the rate of reaction.

[1]

[1 mark]

Question 3c

c)

The decomposition of hydrogen peroxide into water and oxygen occurs at a slow rate with a rate constant of $k = 6.42 \times 10^{-4}$ mol dm^{-3} s^{-1} and at a temperature of 290 K.

When the temperature is increased to 340 K the rate constant $k = 6.47 \times 10^{-2}$ mol dm^{-3} s^{-1}.

Using sections 1 and 2 of the data booklet, calculate the activation energy for this reaction.

[2]

[2 marks]