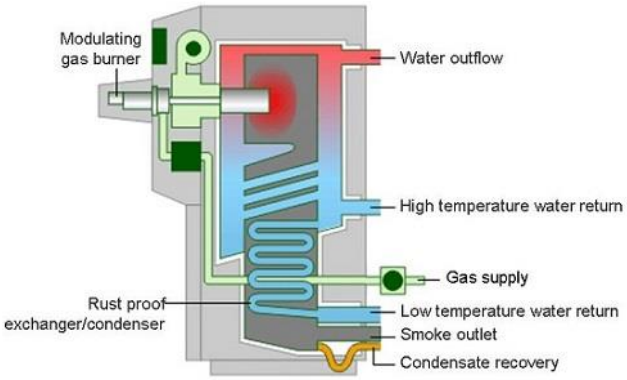
Nom: **Date:**

HVAC Learning.com

Exercise Booklet

Print this exercise booklet before studying the lesson on-line. It will enable you to write your answers to the HVAC learning exercises. You will thus be able to switch between reading or listening to the file on-line and writing in the booklet.



CONDENSING BOILERS

English lesson
https://hvac-learning.com/heating/heat-emitters-and-boilers-training/condensing-boilers/

French version:
https://formation.xpair.com/cours/chaudieres-condensation.htm

For each exercise, you will write your answer, then you will study its correction on-line before going to the next exercise.
*If you cannot do an exercise, you will be able to study its correction directly, but **force yourself to write your answer** as often as possible.*

Note that between 2 exercises, you will find it necessary to study the course. As a warning, in the booklet, you will sometimes find the following indication:

- *" **Study the course on-line before doing the next exercise**" or*
- *" **Study the course on-line before going to the next paragraph**"*

Only study the paragraphs or the exercises which have an equal or a lower level than the one your training requires.
NVQ Level = Vocational Certificate
A Level = High school Diploma
HND Level = Associate's Degree
MSC Level = Engineering Schools

Then, when you have completed a file, you will be able to assess your level on-line through a Multiple Choice Questionnaire in which you will only answer the questions related to the themes you have studied.
So now off you go and work well!
Good luck!
The Authors.

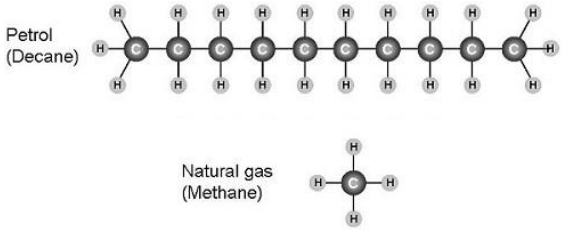
N°1 – A reminder about combustion training – A level

Study the course on-line before treating the next exercise.

Question 1

Which very well-known combustibles contain a lot of carbon?

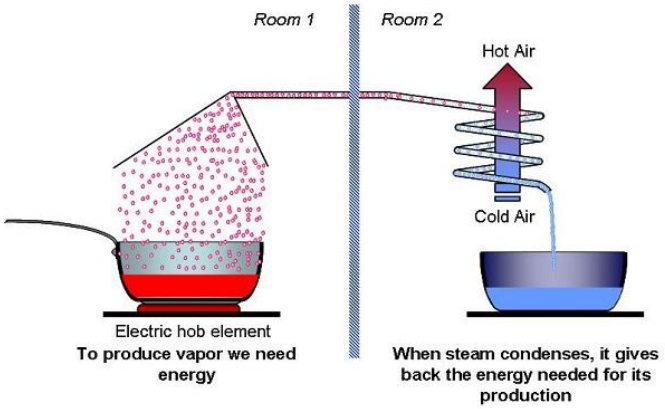
Study the course on-line before treating the next exercise.



Question 2

$CH_4 + 2\ O_2 = CO_2 + 2\ H_2O$ + heat.
Indicate the molecules present in the above chemical formula which correspond to:
– Oxygen
– Carbonic gas
– Natural gas
– Water vapour

In the end, a reminder of the changes of state linked to vapor :



Question 3

Ignoring « line losses », if the heat supplied above (room 1) by the electric hob element is 1 [kWh] (3412 btu), what quantity of heat is supplied to the air of room 2?

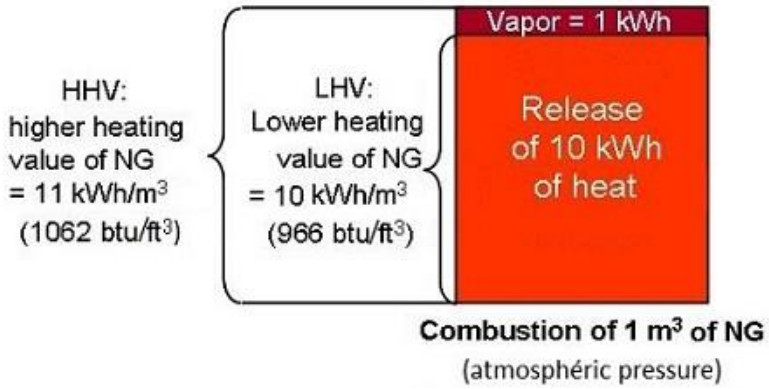
N°2 – The calorific capacity of combustible fuels training – A level

*The **calorific capacity** indicates the quantity of energy released by the combustion of a unit of combustible fuel in heat form.*

Question 1

What is the professional unit usually used to quantify energy amounts, amounts of heat, and electric consumption?

Study the course on-line before treating the next exercise.



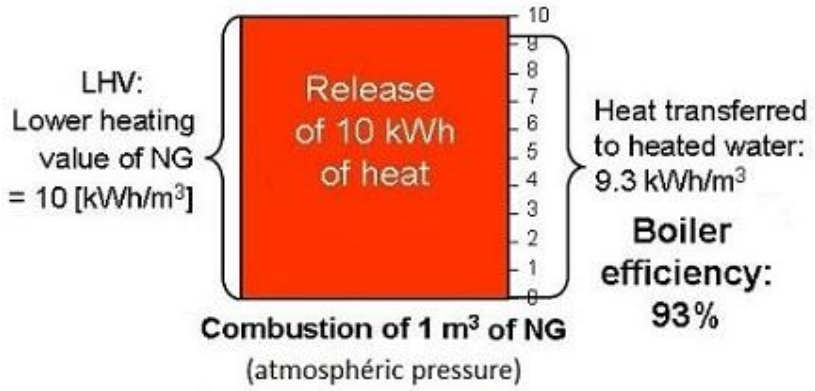
Question 2

Complete the table:

Quantity of sensible heat released in [kWh] (btu), by the combustion of 1 [m^3] (3.3 ft^3) of natural gas?	
Quantity of total energy released in [kWh] (btu), by the combustion of 1 [m^3] (3.3 ft^3) of natural gas?	
Quantity of energy released in [kWh] (btu), in vapor form, by the combustion of 1 [m^3] (3.3 ft^3) of natural gas?	
HHV of NG?	
LHV of NG ?	

N°3 – Boiler efficiency – A level

Study the course on-line.



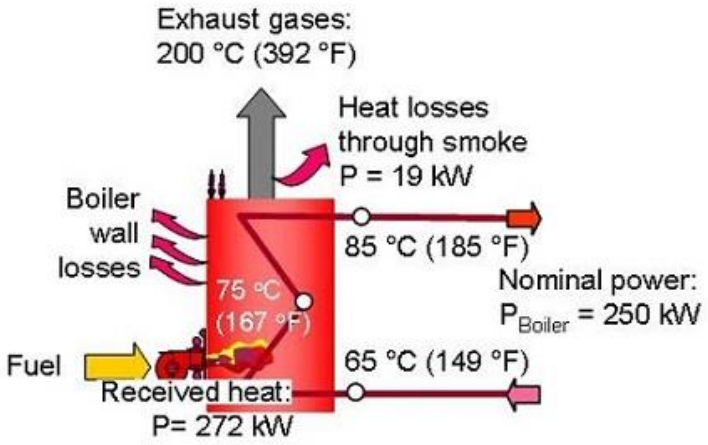
N°4 – Nominal power and boiler efficiency training – A level

Study the course on-line before treating the next exercise.

$$\eta_{c=} \frac{\text{Energy supplied}}{\text{Thermal energy received}} \times 100$$

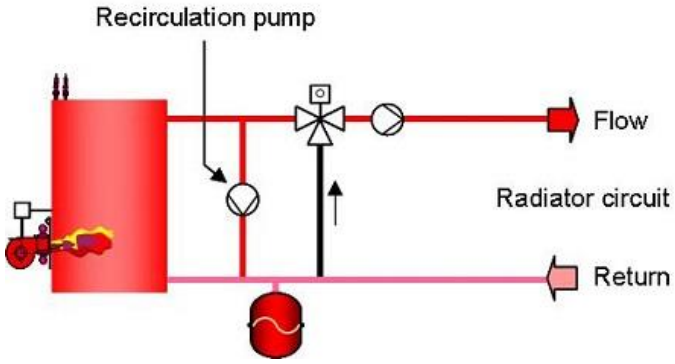
Question 1

What is the power lost by the boiler walls, below, in [kW]?
What is the efficiency of the boiler?



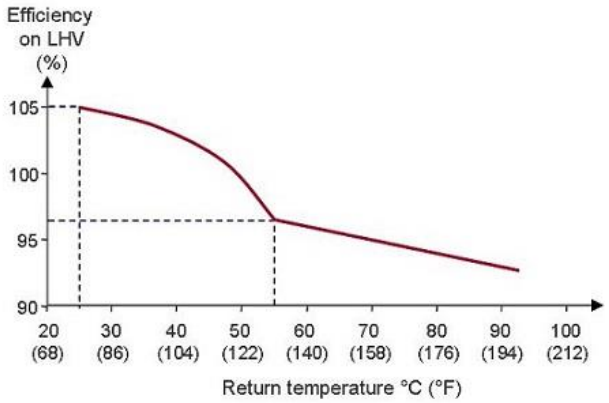
N°5 – The three generations of boilers training – A level

Study the course on-line.



N°6 – Condensing boiler efficiency training – A level

Study the course on-line before treating the next exercise.

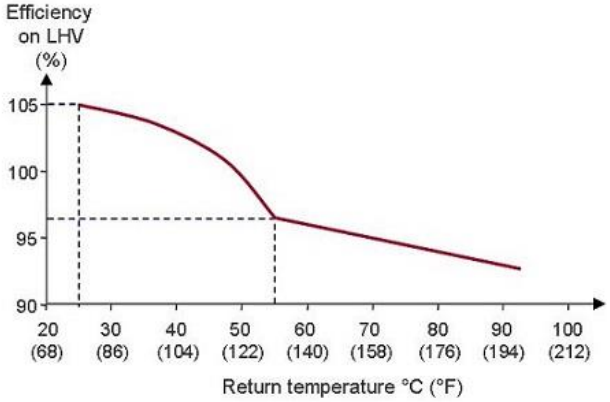


Question 1

What is the efficiency of a condensation boiler when the water return temperature is 70 [°C] (158 °F)?
Is there condensation of the water vapor contained in the combustion gas?

Question 2

What is the efficiency of a condensation boiler when the water return temperature is 40 [°C] (104 °F)?



Question 3

When the exterior temperature drops, how does condensing boiler efficiency evolve?

Question 4

Let us compare:
– A traditional gas boiler of 30 [kW] called n°1 (in a house n°1)
– A high-efficiency gas boiler of 30 [kW] called n°2 (in a house n°2)
– A gas-fired condensing boiler of 30 [kW] called n°3 (in a house n°3)
The 3 houses are, in all ways, identical; as much in the construction as in the heating installation (with the exception of the boilers).

Question	Answer	Explanation
Which is the most powerful boiler ?		
Can the houses, each heated by their boilers, have the same interior temperature?		
Which boiler has the highest efficiency?		
Which boiler has the lowest efficiency?		
Which house will consume the most gas?		
Which house will consume the least gas?		
Which boilers can withstand, without problem, water returns at 45 [°C] (113 °F)		
Give an efficiency value for boiler n° 1		
Give an efficiency value for boiler n° 2		
Give an efficiency value for boiler n° 3		

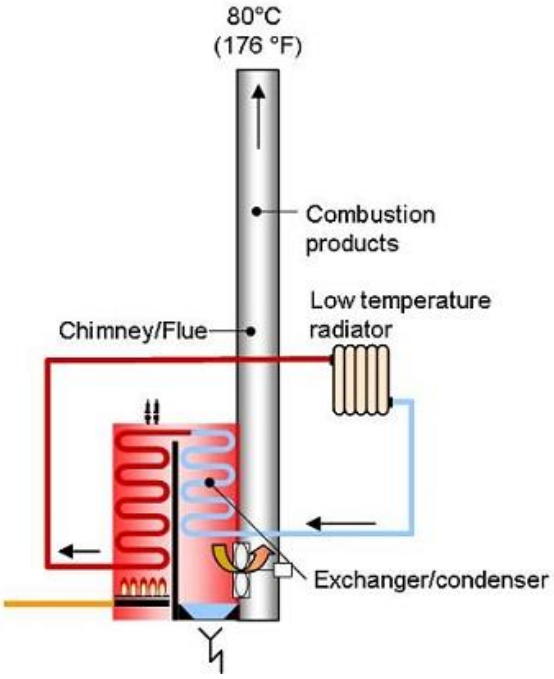
Note:
The power of a condensing boiler varies a few with its temperature. However, the indicated nominal power for an average temperature of 70 [°C] (158 °F) is, in general, that corresponding to the effectively useful power in extreme cold (high return temperatures). The increase in power due to lower return temperatures (in mid-season) will not therefore be really useful (except to accelerate the temperature gains after slack periods). The interest of condensing boilers is not really in terms of power but in terms of efficiency and therefore reduced gas consumption.

Question 5

What type of emitter (radiator, convector, under-floor heating) is most suitable for condensing boilers? Why?

N°7 – Condensing boiler technology training – A level

Study the course on-line.



N°8 – Condensate drainage training – A level

Study the course on-line.

Neutralisation system using granules for condensate flows in gas boilers up to 70 l/h or 500 kW power approx.

Neutralization system using granules with a lifting pump for condensates of gas boilers up to 210 l/h or 1500 kW power approx.

N°9 : Smoke exhaust training – A level

Study the course on-line.

N°10 : Classification of boilers, evolution of power and efficiency of condensing boilers training – HND level

Study the course on-line.

Minimum efficiency of boilers up to 400 [kW]				
Type of boiler	**Efficiency at nominal power (NP)**		**Efficiency at partial load (30 % NP)**	
	Ave. Temp. water	Min. efficiency	Ave. Temp. water	Min. efficiency
Standard	**70 [°C]** (158 °F)	84 + 2 log NP	**> 50 [°C]** (122 °F)	80 + 3 log NP
Low temperature	**70 [°C]** (158 °F)	87,5 + 1,5 log NP	**40 [°C]** (104 °F)	87,5 + 1,5 log NP
Condensation	**70 [°C]** (158 °F)	91 + log NP	**30 [°C]** (86 °F) **(starter)**	97 + log NP

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