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.

TEMPERATURE AND THERMAL EXPANSION

English lesson:
https://hvac-learning.com/base-physics/physics-level-1/temperature-and-thermal-expansion/

French lesson:
https://formation.xpair.com/cours/temperature-dilatation-genie-climatique.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 – Temperature and change of state training – NVQ level

Study the course on-line.

N°2 – Temperature measuring training – NVQ level

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

Question 1:

Convert the following temperatures from [°C] to [K] or vice-versa:

Temperature	Temperature
0 [°C] (32 °F) =	+ 273 [K]
- 25 [°C] (-13 °F) =	[K]
+ 20 [°C] (68 °F)=	[K]
318 [K] =	[°C]

N°3 – Piping thermal expansion training – NVQ level

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

Material	Range of expansion
Steel	0.012 [mm/m°C] or [mm/m.K]
Copper	0.017 [mm/m°C] or [mm/m.K]
Plastic	0.1 [mm/m°C] or [mm/m.K]

Question 1

A copper pipe of 15 [m] long is heated from 0 [°C] (32°F) to 90 [°C] (194°F).
What length is the thermal expansion?

Question 2

A plastic pipe of 15 [m] long is heated from 0 [°C] (32°F) to 50 [°C] (122°F).
What length is the thermal expansion?

N°4 – Thermal expansion of water training – NVQ level

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

Temperature variation (from 0 [°C])	Water volume variation in %	Temperature variation (from 0 [°C])	Water volume variation in %
+ 30 [°C] (ou 30 K)	+ 0.05 %	+ 80 [°C] (ou 80 K)	+ 3 %
+ 50 [°C] (ou 50 K)	+ 1.2 %	+ 90 [°C] (ou 90 K)	+ 3.6 %
+ 70 [°C] (ou 70 K)	+ 2.3 %	+ 100 [°C] (ou 100 K)	+ 4.3 %

Question 1

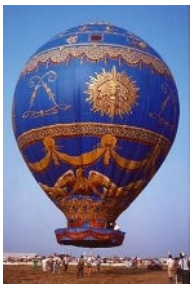
At the end of filling, a domestic heating circuit contains 250 liters of water at 5 [°C] (41°F).
By how much, in liters, will the volume of water increase when raising the temperature to 80 [°C] (176°F)?

Question 2

A switched-off air-conditioning system contains 7.5 [m^3] of water at 30 [°C] (86°F).
By how much volume, in liters, will this water retract when cooled to around 0 [°C] (32°F)?

N°5 – Thermal expansion of air training – A level

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



Question 1

Study and complete the table below, established for moderately moist air (air at 50% humidity).

Air temperature	Mass density [kg/m³]	Specific volume [m³/kg]
0 [°C] (32 °F)	1.3	0.77
10 [°C] (50 °F)	1.25	?
20 [°C] (68 °F)	1.2	0.83
30 [°C] (86 °F)	1.14	?
40 [°C] (104°F)	?	0.92

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Question 2

Air temperature	Mass density [kg/m³]
0 [°C] (32 °F)	1.3
10 [°C] (50 °F)	1.25
20 [°C] (68 °F)	1.2
30 [°C] (86 °F)	1.14
40 [°C] (104 °F)	1.08

What is the air mass in a room of 5 [m] × 6 [m] × 2.5 [m] with an interior temperature of 10 [°C] (50°F)?

Question 3

What is the air mass in a room of 5 [m] × 6 [m] × 2.5 [m] with an interior temperature of 30 [°C] (86°F)?

Question 4

What volume will be taken up by 15 [kg] of moderately moist air at 10 [°C] (50°F), 20 [°C] (68°F), and 30 [°C] (86°F)?
Work exclusively using mass density.

Question 5

What is the volume taken up by 93.75 [kg] of air at 10 [°C] (50°F)?
Work exclusively using mass density.

Question 6

We heat a volume of 20 [m^3] of air from 10 [°C] (50°F) to 40 [°C] (104°F).
What is the new volume?
Work exclusively using mass density.

Question 7

At the inlet of an air-heating plant, we measure a (volume) flow of 5,000 [m³/h] at 0 [°C] (32°F).
What will be the (volume) flow blown at 40 [°C] (104°F) at the outlet of this plant?
Work exclusively using mass density.

Question 8

At the outlet of an air heating plant we measure a flow of 3,500 [m³/h] at 40 [°C] (104°F).
At 10 [°C] (50°F) what is the inlet flow of this plant in [m³/h]?
Work exclusively using mass density.

N°6 – Volume flow rates as detailed in HVAC specifications training – HND level

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

Question 1

A plant must blow 5 [kg/s] of air at 50 [°C] (122°F).
What is the flow in [m³/h] which will be indicated in the specifications?

Question 2

The specifications show that the air treatment plant must move a flow of 12000 [m³/h]. What in [kg/s] is the corresponding mass flow?

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Air temperature	Mass density [kg/m³]
0 [°C] (32 °F)	1.3
10 [°C] (50 °F)	1.25
20 [°C] (68 °F)	1.2
30 [°C] (86 °F)	1.14
40 [°C] (104 °F)	1.08

Question 3

It is shown on the specifications that an air treatment plant has a flow of 15,000 [m³/h]. What should the real flow be at 40 [°C] (104°F) in [m³/h]?
Work exclusively using mass density.

Question 4

It is shown in the specifications that an air treatment plant has a flow of 8,500 [m³/h].
In [m³/h] what should be the corresponding real flow blown at +10 [°C] (50°F)?
Work exclusively using mass density.

Question 5

At the inlet of an air-heating plant, with a cross section of 800 × 1,200 [mm], we measure a speed of 3 [m/s] and a temperature of 0 [°C] (32°F).
What in [m³/h] and in [kg/h] is the real flow at the inlet of the plant?
If this flow is correct what corresponding flow is shown on the specifications?
Work exclusively using mass density.

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