Name : **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.

ENTHALPY IN HVAC – PART 2

English lesson:
https://hvac-learning.com/base-physics/physics-level-2/enthalpy-part-2-properties-of-vapour-hnd-level/

French lesson:
https://formation.xpair.com/cours/enthalpie-partie2.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 – Enthalpy of water and vapour at less than 100 [°C] (212°F) – HND level

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

VAPOUR TABLE dry saturated (absolute pressure)				
Absolute pressure	Temperature	Total heat (vapour enthalpy)	Sensible heat (water enthalpy)	Latent heat
p	t	hv	hl	r
[bar]	[°C/°F]	[Wh/kg]	[Wh/kg]	[Wh/kg]
0.1	45,8 / 114.4	717,9	53,2	664,6
0,2	60 / 140.1	724,9	69,8	655
0.3	69,1 / 156.3	729,2	80,3	648,9
0.4	75,8 / 168.5	732,4	88,2	644,2
0.5	81,3 / 178,3	734,9	94,5	640,3
0.6	85,9 / 186.6	737	99,9	637,1
0.7	89,9 / 193.9	738,8	104,6	634,2
0.8	93,5 / 200.3	740,5	108,7	631,7
0.9	96,7 /206	741,9	112,5	629,3
1.0	99,6 / 211.3	743,1	115,9	627,2

Question 1

According to the above table, at what absolute pressure can water be boiled at 75.87 [°C] (168°F)?

Question 2

According to the above table, what is the specific enthalpy of liquid water at 75.87 [°C] (168°F) ?

Question 3

In [kWh] what is the enthalpy of 25 [kg] of liquid water at 75.87 [°C] (168°F) ?

Question 4

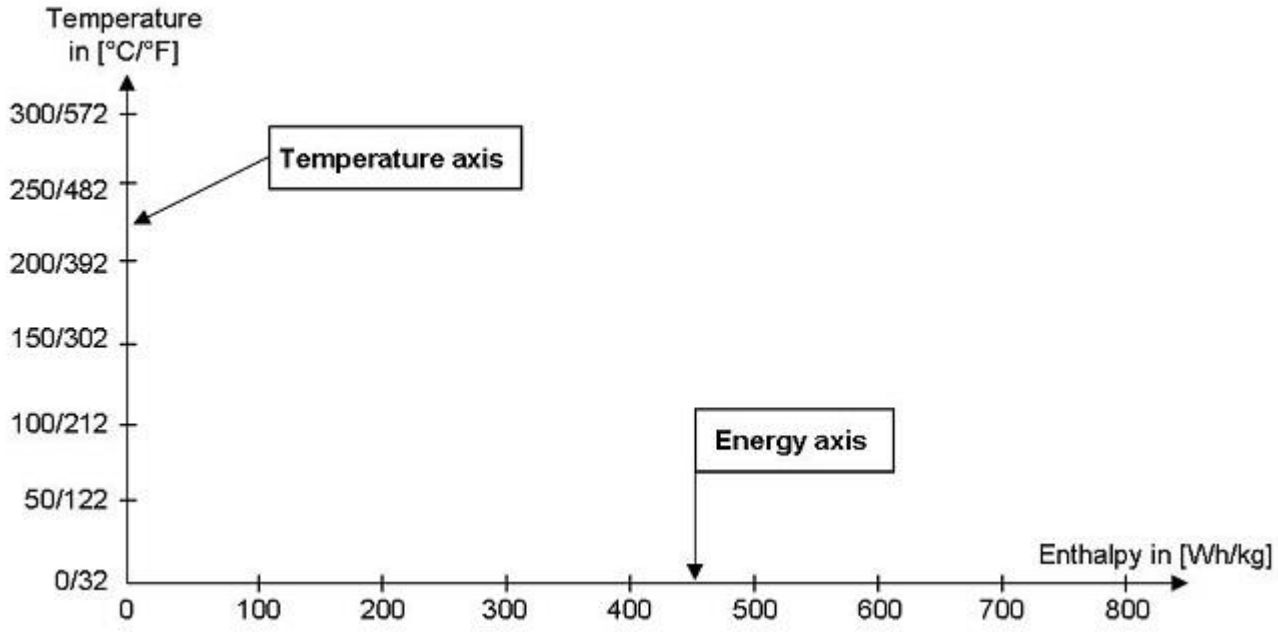
According to the above table, what is the specific enthalpy of vapour at 75.87 [°C] (168°F) ?

Question 5

What is the temperature and enthalpy of 25 [kg] of dry saturated vapour at 0.4 [bar] absolute?

N°2 – Graphic representation of vapour production at 100 [°C] (212°F) – HND level

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



Question 1

In [Wh/kg] what is the specific enthalpy of one [kg] of water at 100 [°C] (212°F)?

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

Question 2

In [Wh/kg] what is the specific enthalpy of one [kg] de vapour at 100 [°C] 212°F) ?

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

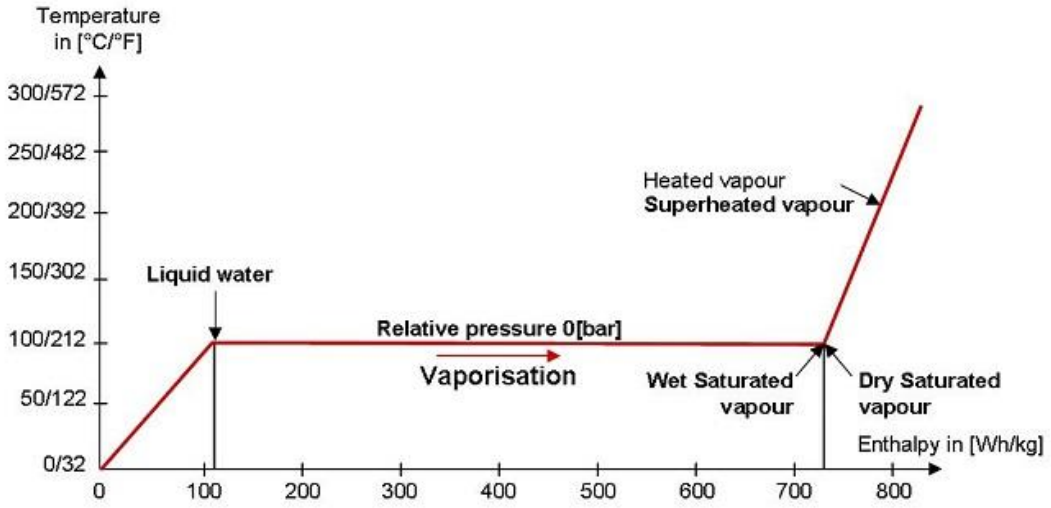
N°3 – Vapour at more than 100 [°C] (212°F) – HND level

Study the course on-line.

Absolute pressure in [bar]	Maximal temperature of water in liquid state in [°C /°F]
1	100 / 212
1,5	111 / 232
2	120 / 248
3	134 / 273
4	144 / 291
5	152 / 305
10	180 / 356
15	198 / 388
20	212 / 413

N°4 – Graphic representation of vapour production at more than 100 [°C] (212°F) – HND level

Study the course on-line.



N°5 – Vapour tables at more than 100 [°C] (212°F) – HND level

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

VAPOUR TABLE dry saturated (relative pressure)				
Relative Pressure	Temp.	Total heat (vapour enthalpy)	Sensible heat (water enthalpy)	Latent heat
p	T	hv	hl	r
[bar]	[°C / °F]	[Wh/kg]	[Wh/kg]	[Wh/kg]
0,0	100,00 / 212	743,33	116,40	626,93
0,2	105,10 / 221.18	745,61	122,44	623,17
0,4	109,55 / 229.19	747,50	127,69	619,81
0,6	113,56 / 236.408	749,11	132,33	616,78
0,8	117,14 / 242.852	750,58	136,56	614,03
1,0	120,42 / 248.756	751,86	140,44	611,42
1,5	127,62 / 261.716	754,75	148,92	605,83
2,0	133,69 / 272.642	757,08	156,17	600,92
2,5	139,02 / 282.236	759,06	162,50	596,56
3,0	143,75 / 290.75	760,75	168,14	592,61
3,5	148,02 / 298.436	762,19	173,22	588,97
4,0	151,96 / 305.528	763,56	177,97	585,58
4,5	155,55 / 311.99	764,72	182,31	582,42

Question 1

A water heating system at 110 [°C] (230 °F) should be maintained at what minimum pressure to prevent risks of boiling?

Question 2

What is the temperature and specific enthalpy of one [kg] of dry saturated vapour at 0.4 bar of relative pressure?

Question 3

In kWh, what is the enthalpy of 25 [kg] of liquid water at 109.55 [°C] (229°F)?

N°6 – Specific volume of vapour – HND level

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

SATURATED VAPOUR TABLE					
Pressure	Temp.	Sensible Heat	vapour enthalpy	Latent Heat	Spécific Volume
p	t	hl	hv	r	v_v
[bar]	[°C / °F]	[Wh/kg]	[Wh/kg]	[Wh/kg]	m^3/kg
0,0	100,00 / 212	116,40	743,33	626,93	**1,673**
0,2	105,10 / 221.18	122,44	745,61	623,17	**1,414**
0,4	109,55 / 229.19	127,69	747,50	619,81	**1,225**
0,6	113,56 / 236.40	132,33	749,11	616,78	**1,083**
0,8	117,14 / 242.85	136,56	750,58	614,03	**0,971**
1,0	120,42 / 248.75	140,44	751,86	611,42	**0,881**
2,0	127,62 / 261.71	156,17	757,08	600,92	**0,603**
3,0	133,69 / 272.64	168,14	760,75	592,61	**0,461**
4,0	139,02 / 282.23	177,97	763,56	585,58	**0,374**
5,0	158,92 / 318.05	186,36	765,81	579,44	**0,315**
10	184,13 / 363.43	217,11	772,69	555,58	**0,177**
15	201,45 / 394.51	238,61	776,11	537,50	**0,124**

Question 1

Complete the table below.

When pressure rises	Increases or decreases ?
The specific volume of dry saturated vapour	
The vapour production temperature	
The specific vapour enthalpy	
The specific latent heat of the vapour	

Question 2

Specify two advantages of producing and distributing vapour at 15 [bar] rather than just at a few bars of pressure.

N°7 – Vapour table – HND level

SATURATED VAPOUR TABLE					
Pressure	Temp.	Sensible Heat	vapour enthalpy	Latent Heat	Specific Volume
p	t	hl	hv	r	v_v
[bar]	[°C / °F]	[Wh/kg]	[Wh/kg]	[Wh/kg]	[m³/kg]
0,1	45,81	53,29	717,97	664,69	14,674
0,2	60,06	69,83	724,92	655,08	7,649
0,3	69,10	80,34	729,25	648,91	5,229
0,4	75,87	88,22	732,44	644,23	3,993
0,5	81,33	94,58	734,97	640,39	3,240
0,6	85,94	99,96	737,08	637,12	2,732
0,7	89,95	104,64	738,89	634,25	2,365
0,8	93,50	108,79	740,50	631,71	2,087
0,9	96,71	112,54	741,92	629,38	1,869
1,0	99,63	115,96	743,19	627,23	1,694
0,0	100,00	116,40	743,33	626,93	1,673
0,2	105,10	122,44	745,61	623,17	1,414
0,4	109,55	127,69	747,50	619,81	1,225
0,6	113,56	132,33	749,11	616,78	1,083
0,8	117,14	136,56	750,58	614,03	0,971
1,0	120,42	140,44	751,86	611,42	0,881
1,5	127,62	148,92	754,75	605,83	0,714
2,0	133,69	156,17	757,08	600,92	0,603
2,5	139,02	162,50	759,06	596,56	0,522
3,0	143,75	168,14	760,75	592,61	0,461
3,5	148,02	173,22	762,19	588,97	0,413
4,0	151,96	177,97	763,56	585,58	0,374
4,5	155,55	182,31	764,72	582,42	0,342
5,0	158,92	186,36	765,81	579,44	0,315
5,5	162,08	190,17	766,75	576,58	0,292
6,0	165,04	193,75	767,64	573,89	0,272
6,5	167,86	197,14	768,47	571,33	0,255
7,0	170,50	200,39	769,19	568,81	0,240
7,5	173,02	203,47	769,92	566,44	0,227
8,0	175,43	206,42	770,56	564,14	0,215
8,5	177,75	209,25	771,17	561,92	0,204
9,0	179,97	211,94	771,69	559,75	0,194
9,5	182,10	214,58	772,22	557,64	0,185
10	184,13	217,11	772,69	555,58	0,177
11	188,02	221,89	773,56	551,67	0,163
12	191,68	226,42	774,33	547,92	0,151
13	195,10	230,67	775,00	544,33	0,141
14	198,35	234,75	775,61	540,86	0,132
15	201,45	238,61	776,11	537,50	0,124
16	204,38	242,31	776,58	534,28	0,117
17	207,17	245,83	776,97	531,14	0,110
18	209,90	249,22	777,36	528,14	0,105
19	212,47	252,50	777,64	525,14	0,100
20	214,96	255,64	777,92	522,28	0,0949
22	219,65	261,64	778,33	516,69	0,0868
24	224,02	264,50	778,64	514,14	0,0797
26	228,15	272,67	778,83	506,17	0,0740
28	232,05	277,89	778,92	501,22	0,0689
30	235,78	282,53	778,92	496,39	0,0645

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English lesson:
https://hvac-learning.com/base-physics/physics-level-2/enthalpy-part-2-properties-of-vapour-hnd-level/
French lesson:
https://formation.xpair.com/cours/enthalpie-partie2.htm