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.

Technical data

			EWI 091 H CWI 091 H	EWI 121 H CWI 121 H
Cooling capacity	nominal	W	2640	3500
	min. - max.	W	900 - 3000	900 - 3800
Energy Efficiency			A^{++}	A
SEER		W/W	6,1	5,4
Input power	nominal	W	780	1090
	min. - max.	W	200 - 960	210 - 1300
Input current	nominal	A	3,7	5,0
Moisture removed	max. speed	l/h	0,7	1,2
Indoor unit air flow rate	max.	m³/h	516	588
	med.	m³/h	438	510
	min.	m³/h	330	414
Heating capacity	nominale	W	3100	4000
	min. - max.	W	900 - 4800	1000 - 6000
Energy Efficiency			A^{+}	A
SCOP		W/W	4,3	3,9
Input power	nominale	W	730	1030
	min. - max.	W	160 - 1400	180 - 1900
Input current	nominale	A	3,5	4,8

SELECTING AIR CONDITIONERS – PART 2

English lesson
https://hvac-learning.com/air-conditioning-cooling/air-conditioners-training/selecting-air-conditioners-part-2/

French version:
https://formation.xpair.com/cours/selection-climatiseurs-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 – Limits of air conditioner use in cooling mode – A to HND level

Study the course on-line.

Question 1

What type of premises may require cooling even though outside temperatures are low?

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

Features

- Motorized louver controllable from remote handset for vertical adjustment of outlet air flow direction
- Very quiet operation
- Infrared remote handset with LCD display for full control of all functions of the appliance
- Microprocessor control
- Local control facility
- Timer for programming On/Off times
- Programs for cooling only, heating only, dehumidification and automatic operation (heating/cooling)
- Self-diagnostics function
- Easily removable, washable air filter with anti-mould treatment
- Defrost control
- **Condensation control device for operation in cooling mode with an external temperature up to -10°C**
- Refrigerant lines with flared ends
- Refrigerant lines up to 15m for (091H - 121H), up to 20m for (EWI 182H) and up to 30m for(EWI 242H)

Question 2

According to the specification extract for the Aermec air conditioner above, is the model equipped with an “all seasons kit”?
To which temperature will it be possible to operate the unit in cooling mode?

N°2 – Heating power of an air conditioner in heating mode – A to HND level

Study the course on-line.

Let us look at the performance indicators shown for an Aermec air conditioner.

Technical data

			EWI 091 H CWI 091 H	EWI 121 H CWI 121 H
Cooling capacity	nominal	W	2640	3500
	min. - max.	W	900 - 3000	900 - 3800
Energy Efficiency			A^{++}	A
SEER		W/W	6,3	5,4
Input power	nominal	W	780	1090
	min. - max.	W	200 - 960	210 - 1300
Input current	nominal	A	3,7	5,0
Moisture removed	max. speed	l/h	0,7	1,2
Indoor unit air flow rate	max.	m³/h	516	588
	med.	m³/h	438	510
	min.	m³/h	330	414
Heating capacity	nominale	W	3100	4000
	min. - max.	W	900 - 4800	1000 - 6000
Energy Efficiency			A^{+}	A
SCOP		W/W	4,3	3,9
Input power	nominale	W	730	1030
	min. - max.	W	160 - 1400	180 - 1900
Input current	nominale	A	3,5	4,8

Question 1

For the model EWI 121 H / CWI 121 H above, what is the nominal heating power value indicated by the manufacturer?
These values are indicated for which operating conditions?

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

Question 2

For the model EWI 091 H / CWI 091 H, specifications as above, what heating power might be expected in extreme cold conditions?

N°3 – Limits of air conditioner use in heating mode – A to HND level

Study the course on-line.

Question 1

Explain why the exterior unit of a reversible air conditioner might become “frosted up” when outside temperatures fall below +5 [°C] (41°F).

Let us look at the documentation extract below for a reversible Aermec air conditioner.

Features

- Front panel display showing operating modes and temperature. The display can be activated or deactivated from the remote controller (LIGHT)
- A handy timer allows you to set up and program the startup and shutdown within a time span of 24 hours, the hours you select, and even in your absence.
- Function Night Comfort (SLEEP)
  The function adjusts the room temperature by reproducing the curve of body temperature during the night, thus ensuring an adequate physical and mental rest, whose benefi translate into increased productivity and efficiency.
- Extended Ventilation (X-FAN) function prevents the growth of mould in the internal unit during Cooling and Dehumidification Modes
- Intelligent pre-heat function to prevent jets of cold air (Heating Mode)
- Auto-diagnostic function
- Auto-Restart function after a power cut
- External unit defrost function
- External unit with condensate connection
- Cleanable air filter
- Horizontally adjustable air discharge louvres
- Motorised deflector louvres controlled by the remote controller to vertically adjust the discharge air, with 5 fixed positions or floating (SWING)
- Flare type refrigerant connections
- Simple installation and maintenance

Question 2

According to the documentation extract above for an AERMEC air conditioner, is it capable of operating in extreme cold conditions and why ?

N°4 – Energy performance of air conditioners in cooling mode – HND level

Study the course on-line.

Technical data

			EWI 091 H CWI 091 H	EWI 121 H CWI 121 H
Cooling capacity	nominal	W	2640	3500
	min. - max.	W	900 - 3000	900 - 3800
Energy Efficiency			A^{++}	A
SEER		W/W	6,3	5,4
Input power	nominal	W	780	1090
	min. - max.	W	200 - 960	210 - 1300
Input current	nominal	A	3,7	5,0
Moisture removed	max. speed	l/h	0,7	1,2
Indoor unit air flow rate	max.	m^3/h	516	588
	med.	m^3/h	438	510
	min.	m^3/h	330	414
Heating capacity	nominale	W	3100	4000
	min. - max.	W	900 - 4800	1000 - 6000
Energy Efficiency			A^{+}	A
SCOP		W/W	4,3	3,9
Input power	nominale	W	730	1030
	min. - max.	W	160 - 1400	180 - 1900
Input current	nominale	A	3,5	4,8

Question 1

What is the SEER of a EWI 091 H / CWI 091 H model air conditioner according to the specifications above?

Question 2

Let us suppose that the air conditioner model EWI 121 H / CWI 121 H (see data above) is used each year in cooling mode 600 [h] at full nominal power.
Estimate in [kWh] its cooling supply value and its electricity consumption.
Calculate the cost of its electricity consumption based on a unit tarif of 0.12 [€ /kWh]

N°5 – Energy performance of air conditioners in heating mode – HND level

Study the course on-line.

Technical data

			EWI 091 H CWI 091 H	EWI 121 H CWI 121 H
Cooling capacity	nominal	W	2640	3500
	min. - max.	W	900 - 3000	900 - 3800
Energy Efficiency			A^{++}	A
SEER		W/W	6,3	5,4
Input power	nominal	W	780	1090
	min. - max.	W	200 - 960	210 - 1300
Input current	nominal	A	3,7	5,0
Moisture removed	max. speed	l/h	0,7	1,2
Indoor unit air flow rate	max.	m³/h	516	588
	med.	m³/h	438	510
	min.	m³/h	330	414
Heating capacity	nominale	W	3100	4000
	min. - max.	W	900 - 4800	1000 - 6000
Energy Efficiency			A^{+}	A
SCOP		W/W	4,3	3,9
Input power	nominale	W	730	1030
	min. - max.	W	160 - 1400	180 - 1900
Input current	nominale	A	3,5	4,8

Question 1

What is the SCOP of the air conditioner model EWI-091-H / CWI-091-H, as per the data above?

Question 2

At how many [kW] can we prudently estimate the calorific power of the air conditioner model EWI-091-H / CWI-091-H in extreme cold weather conditions?

Question 3

Let us suppose that the air conditioner model EWI-091-H / CWI-091-H (see data above) is used each year in heating mode 1,400 [h] at full nominal power, (-7 [°C] (19.4°F)) Estimate in [kWh] its heating output value and its electricity consumption.
Calculate the cost of its electricity consumption based on a unit tariff of 0.12 [€/kWh]

Question 4

The air conditioner model EWI-091-H / CWI-091-H is considered used each year in heating mode 1,400 [h] at power given at -7 [°C] (19.4°F), which avoids having to use a gas boiler with an output efficiency of 80%.
Calculate in [€] the savings obtained for gas unit price of 0.05 [€ /kWh].
Taking into account the estimated electricity consumption in heating mode from the previous exercise, calculate the final annual financial savings.

Question 5

The air conditioner model EWI-121-H / CWI-121-H is considered used each year in heating mode 1,400 [h] at power given at -7 [°C] (19.4°F).
For a boiler with 80% output, estimate in € the annual savings obtained with an electricity price at 0.12 [€ /kWh] and a gas unit price at 0.05 [€ /kWh].

N°6 – Development of sensible power and latent power – HND level

Study the course on-line.

N°7 – Integrating actual interior and exterior conditions – HND level

Study the course on-line.

Question 1

For air to air conditioners, cooling performance is generally indicated for the following conditions:
– To the evaporator Dry temp. = 27 [°C] (80.6°F), Humid temp. = 19 [°C] (66.2°F)
– To the condenser Dry temp. = 35 [°C] (95°F)
– Interior unit fan at high speed
Indicate with an arrow how the performance of the air conditioner varies for conditions which are different to the operating conditions referred to in the catalogue.

Outside temperature is higher than the 35°C (95°F) indicated in the catalogue	Cooling power: ↓ or ↑ EER coefficient: ↓ or ↑
Planned inside temperature is lower than the 27°C (80.6°F) indicated in the catalogue	Cooling power: ↓ or ↑ EER coefficient: ↓ or ↑

Very generally speaking, for conditions which are not so different from the nominal conditions we can use the following calculations based on those indicated by the manufacturer.

- *– 2% of cooling power per 1 [°C] fall in interior temperature*
- *1.5% of cooling power per de 1 [°C] rise in interior temperature*
- *– 1% of cooling power per 1 [°C] rise in exterior temperature*
- *1% of cooling power per 1 [°C] fall in exterior temperature*

We will see that such modifications are not necessary in France for normal interior and exterior temperature conditions, as they will both more or less cancel each other out.

Question 2

What is the modification to be made to the cooling power indicated in the catalogue for an air conditioner used in an ambient temperature of 25 [°C] (77°F) (instead of 27 [°C] (80.6°F) in the catalogue)?
What is the modification to be made to the cooling power indicated in the catalogue for an air conditioner used with an outside temperature of + 32 [°C] (90°F) (instead of + 35 [°C] (95°F) in the catalogue)?
Check that the two estimated modifications compensate each other.

In our temperate climates, for comfort air conditioning, it is not really necessary to adjust power based on inside or outside temperatures.
If air conditioners are to be installed in particularly hot climates, it will obviously be desirable to obtain the actual performance values of each model from the manufacturer.
The manufacturer, Wesper, proposes the following formula:
$\boldsymbol{P_t = k_1 \times k_2 \times P_{t0}}$

With:
Pt: total corrected power
P_{t0}*: total nominal power*
k_1 *: coefficient of interior corrections*
k_2 *: coefficient of exterior corrections*
With:
$k_1 = 1 - 0.035 \times (19 - \text{Interior Humid temp.})$
And :
$k_2 = 1 + (35 - \text{Exterior dry temp.})/100$

English lesson
https://hvac-learning.com/air-conditioning-cooling/air-conditioners-training/selecting-air-conditioners-part-2/

French version:
https://formation.xpair.com/cours/selection-climatiseurs-partie2.htm