Topic Skills Practice 3.1

1. Planning the Unit Skills Test

1.1 Research PV Cells & Module Characteristics

1.1.1 Research reference material, such as *Photovoltaic Power Systems – Resource Book, Commonwealth of Australia and Brisbane Institute of TAFE*, to identify the equivalent circuit of a PV cell.

1.1.2 Research manufacturer's data sheets including typical ratings and performance characteristics (I-V curves) of various commercially available PV modules.

1.1.3 Once you feel you have sufficient knowledge of the subject matter, obtain the following materials to assist you with carrying out this skills practice:

- Pens/pencils
- Ruler

2. Carrying Out the Skills Practice

2.1 PV Cell Equivalent Circuit

2.1.1 In the space provided on this page, draw the equivalent circuit of a PV cell, and label each circuit element. Circuit must include ,Diode Resistor/supply.

PV Cell – Equivalent Circuit

Topic Skills Practice 3.1

2.2 PV Module Performance Characteristics

2.2.1 On the template provided on this page, draw the family of I-V curves for **NUSOE3E** PV module for a minimum of three variations in irradiance. Label each axis and curve, and indicate maximum power points, and maximum power currents and voltages.

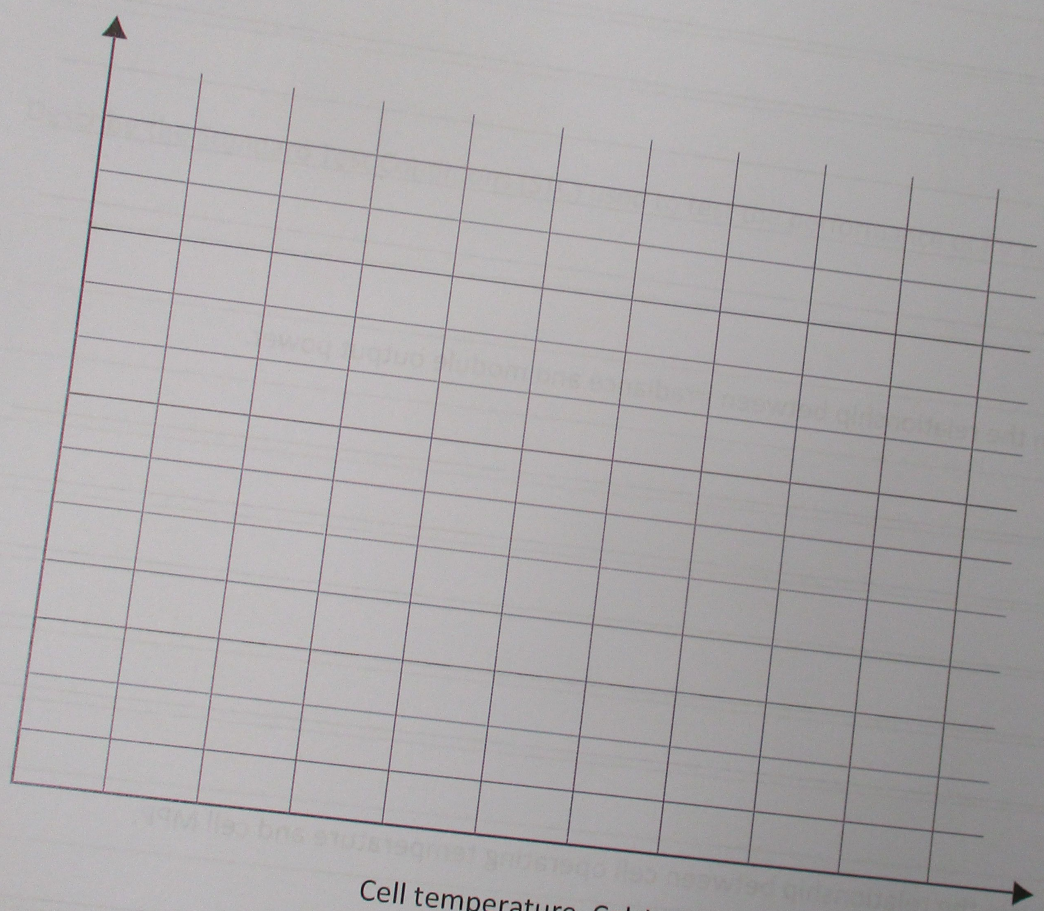
PV Characteristics - Irradiance

Topic Skills Practice 3.1

2.2.2 On the template provided on this page, draw the family of I-V curves for a given PV module for a minimum of three variations in cell operating temperature. Label each axis and curve, and indicate maximum power points, and open circuit voltage(VOC) short circuit current (ISC)

USE catalogue characteristics.

PV Characteristics - Operating Temperature



	Feedback	**Have your teacher/trainer check your work**	**Teacher/Trainer Initials and Date**
			✓

Topic Skills Practice 3.1

3. Completing the Skills Practice

3.1 Skills Practice Review Questions

3.1.1 Complete this section after successfully drawing and labelling each diagram in the skills practice.

1. Explain the term 'fill factor' in relation to PV module performance.

2. Explain the relationship between irradiance and module output power.

3. Explain the relationship between cell operating temperature and cell MPP.

ETC Topic Skills Practice Cover Sheet

Unit Name:	UEERE0022 Solve basic problems in photovoltaic energy apparatus and systems
Topic Title:	Photovoltaic modules

Skill Practice Number:	2.1
Skill Practice Name:	Photovoltaic cell structure

Student Name:	
Student ID:	
College/Campus:	
Group:	

Topic Skills Practice 2.1

UEERE0022 Solve basic problems in photovoltaic energy apparatus and systems

KS01-EK125A Photovoltaic power systems

Topic 2. Photovoltaic modules

Skills Practice 2.1: Photovoltaic cell structure

Task:

To draw and label a diagram showing the structure of a basic crystalline PV cell.

Objectives:

At the completion of this skills practice, you should be able to:

- Draw a diagram showing the structure of a crystalline PV cell.
- Label the major components of a crystalline PV cell.

1. Planning the Unit Skills Test

1.1 Research Crystalline PV Cell Construction

1.1.1 Research reference material, such as *Photovoltaic Power Systems – Resource Book, Commonwealth of Australia and Brisbane Institute of TAFE*, to identify the basic structure of a crystalline PV cell.

1.1.2 Once you feel you have sufficient knowledge of the subject matter, obtain the following materials to assist you with carrying out this skills practice:

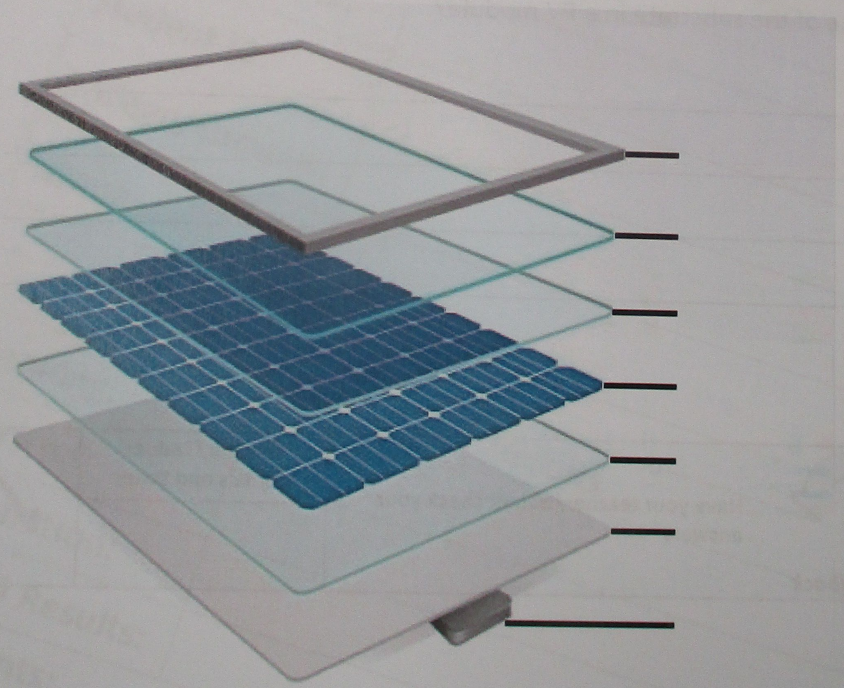
- Pens/pencils
- Ruler

2. Carrying Out the Skills Practice

2.1 Crystalline PV Cell Structure

2.1.1 In the space provided on this page, draw the structure of a basic crystalline PV cell, indicating and labelling the following components:

a) Cover film
b) Encapsulant
c) PV unit (cell)
d) Substrate
e) Frame



		Teacher/Trainer Initials and Date	

ETC Topic Skills Practice Cover Sheet

Unit Name:	UEERE0022 Solve basic problems in photovoltaic energy apparatus and systems
Topic Title:	Solar radiation

Skill Practice Number:	1.1
Skill Practice Name:	Solar irradiance

Student Name:	
Student ID:	
College/Campus:	
Group:	

Results	
Planning:	
Carryout:	
Completion:	
Overall Results:	

Comments:

Topic Skills Practice 1.1

1. Planning the Unit Skills Test

1.1 Equipment

- Solarimeter
- Sun path diagram
- Computer

1.2 Suggested Materials

- Solar configuration software

1.3 Miscellaneous Items

- Pens/pencils
- Calculator
- Internet access

1.4 Risk Assessment

Risk assessment procedure:

- Identify any hazards that may exist with this skills practice below
- List the supervision level you will be working under - Direct (D), General (G) or Broad (B)
- List the risk classification – High Risk (H), Medium Risk (M) or Low Risk (L)
- List the control measures required for each identified hazard that you need to implement.

Hazard/s Identified	Supervision Level (D, G or B)	Risk Classification (H, M or L)	Control Measure/s
- SUN BURN	G	M	use appropriate sun cover / lotion
FALL HAZARD	G	M	Do not climb without necessary

	Feedback	Have your teacher/trainer check your risk assessment	Teacher/Trainer Initials and Date

Topic Skills Practice 1.1

2. Carrying Out the Skills Practice

2.1 Solar Exposure Data

2.1.1 Use an internet site, such as www.latlong.net to determine your current latitude and record your result below:

Location	Latitude/ Longitude

2.1.2 Go the Bureau of Meteorology website at http://www.bom.gov.au to locate the latest solar exposure map (yesterday). Daily solar exposure maps can be located by clicking on the links:

- 'Climate and past weather', then
- 'Maps – recent conditions', and then
- 'Solar exposure'

2.1.3 Interpret the map data to determine the highest colour daily solar exposure for your Sydney in MJ/m^2. Then use this value to calculate the daily irradiation in kWh/m^2, showing your working and answers in the space provided below:

Remember: 1 Joule is equal to 1 watt for 1 second.

Solar Exposure
Working:

2. Carrying Out the Skills Practice

2.1 Solar Exposure Data

2.1.1 Use an internet site, such as www.latlong.net to determine your current latitude and record your result below:

Location	Latitude/ Longitude

2.1.2 Go the Bureau of Meteorology website at http://www.bom.gov.au to locate the latest solar exposure map (yesterday). Daily solar exposure maps can be located by clicking on the links:

- 'Climate and past weather', then
- 'Maps – recent conditions', and then
- 'Solar exposure'

2.1.3 Interpret the map data to determine the highest colour daily solar exposure for your Sydney in MJ/m^2. Then use this value to calculate the daily irradiation in kWh/m^2, showing your working and answers in the space provided below:

Remember: 1 Joule is equal to 1 watt for 1 second.

Solar Exposure					
Working:					
Date:		**Solar Exposure:**		**Daily Irradiation:**	

Topic Skills Practice 1.1

2.2 Determine Solar Exposure

2.2.1 Use a solarimeter to measure the solar irradiance at your location. Record your results below:

Date	Time	Irradiance

2.2.2 Return to the Bureau of Meteorology website to obtain the sunshine hour data for Sydney. Maps indicating average sunshine hours can be located by clicking on the links:

- 'Home page', then
- 'Climate and past weather', then
- 'Maps – average conditions', and then
- 'Sunshine duration'

2.2.3 Use the sunshine hour data to determine the yearly and monthly average irradiation in **Sydney**. Record your values in the table below:

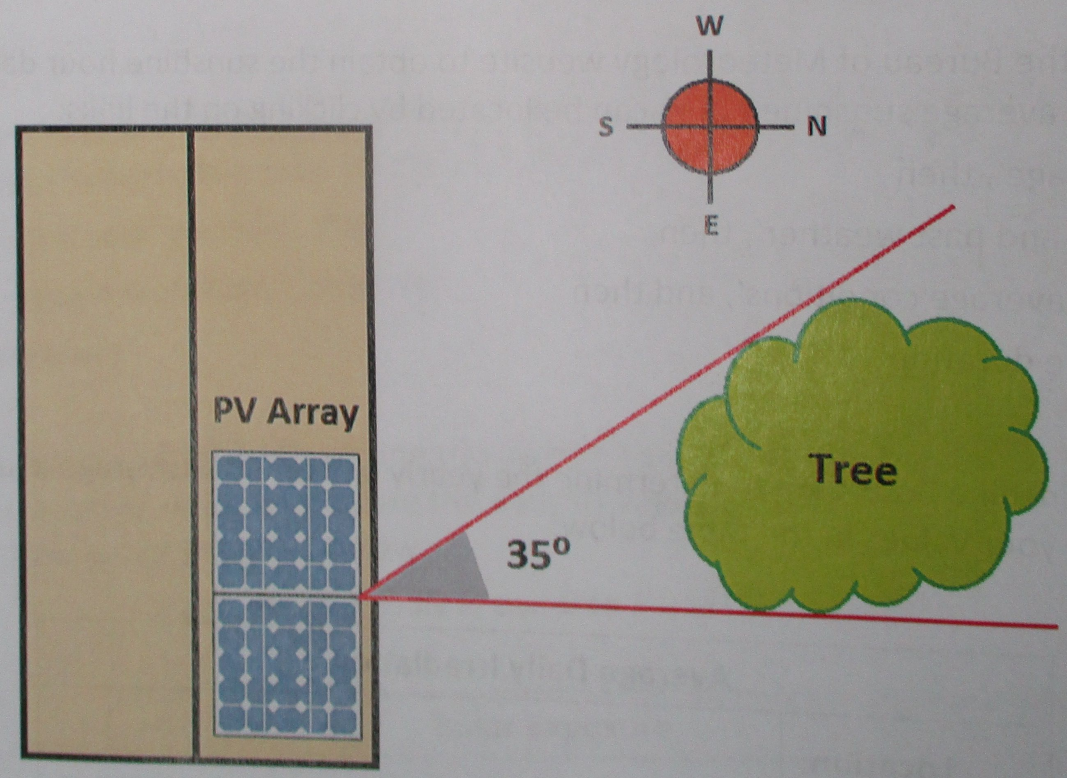
Average Daily Irradiation			
Location:			
Yearly:			
January:		July:	
February:		August:	
March:		September:	
April:		October:	
May:		November:	
June:		December:	

Topic Skills Practice 1.1

		Teacher/Trainer Initials and Date	
	Feedback — Have your teacher/trainer check your answers		✓

2.3 Shading of PV Arrays

2.3.1 Examine the PV array, pictured below in figures 2.3.1(a) and 2.3.1(b). Assuming the array is installed at your location, use the data you have collected so far, the measured angles indicated, and the appropriate sun path diagram, to identify the times and dates when the PV array will become shaded.



Topic Skills Practice 1.1

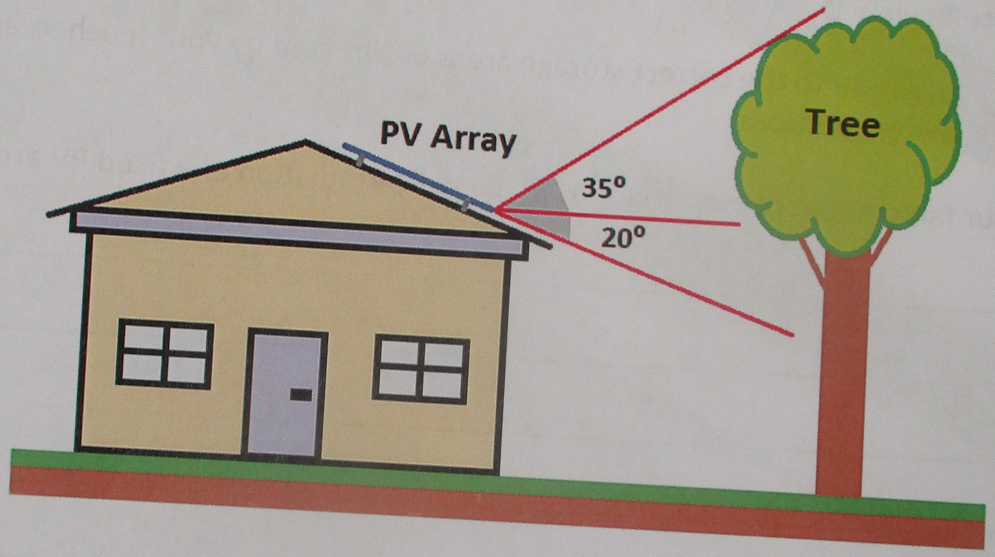


Figure 2.3.1(b) - Elevation

2.3.2 Record the times and dates of shading in the space provided below:

_____

_____

_____

_____

_____

_____

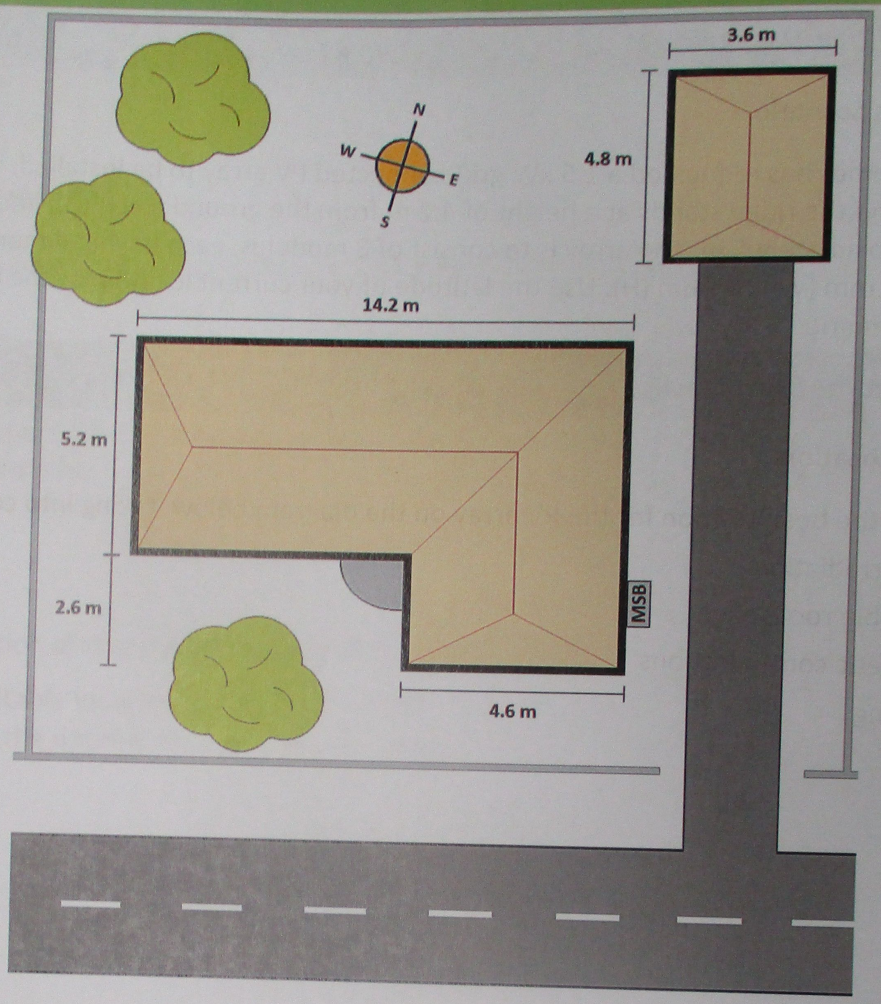
ETC Topic Skills Practice Cover Sheet

Unit Name:	UEERE0022 Solve basic problems in photovoltaic energy apparatus and systems
Topic Title:	Solar radiation

Skill Practice Number:	1.2
Skill Practice Name:	Determine suitable locations and tilt angles for PV arrays

Student Name:	
Student ID:	
College/Campus:	
Group:	

Topic Skills Practice 1.2



2.1.2 Identify the tilt angle for the array that will achieve optimal irradiation for the location you have selected.

Tilt Angle	
Latitude	**Tilt Angle**
33.936670	

	Feedback **Have your teacher/trainer check your answers**	**Teacher/Trainer Initials and Date**	✓

3. Completing the Skills Practice

3.1 Skills Practice Review Questions

Complete this section after completing section 2.

1. Explain the reasons why the array location you selected was the best choice for the installation.

2. Briefly explain the 'rule of thumb' for selecting PV panel tilt angles.

ETC Topic Skills Practice Cover Sheet

Unit Name:	UEERE0022 Solve basic problems in photovoltaic energy apparatus and systems
Topic Title:	PV module characteristics

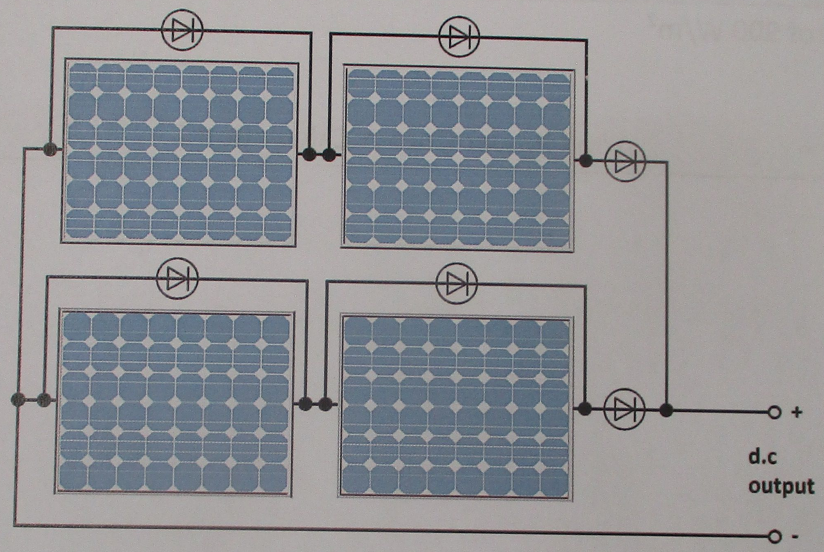
Skill Practice Number:	3.3.2
Skill Practice Name:	PV module operating point, MPP and daily output

Student Name:	
Student ID:	
College/Campus:	
Group:	

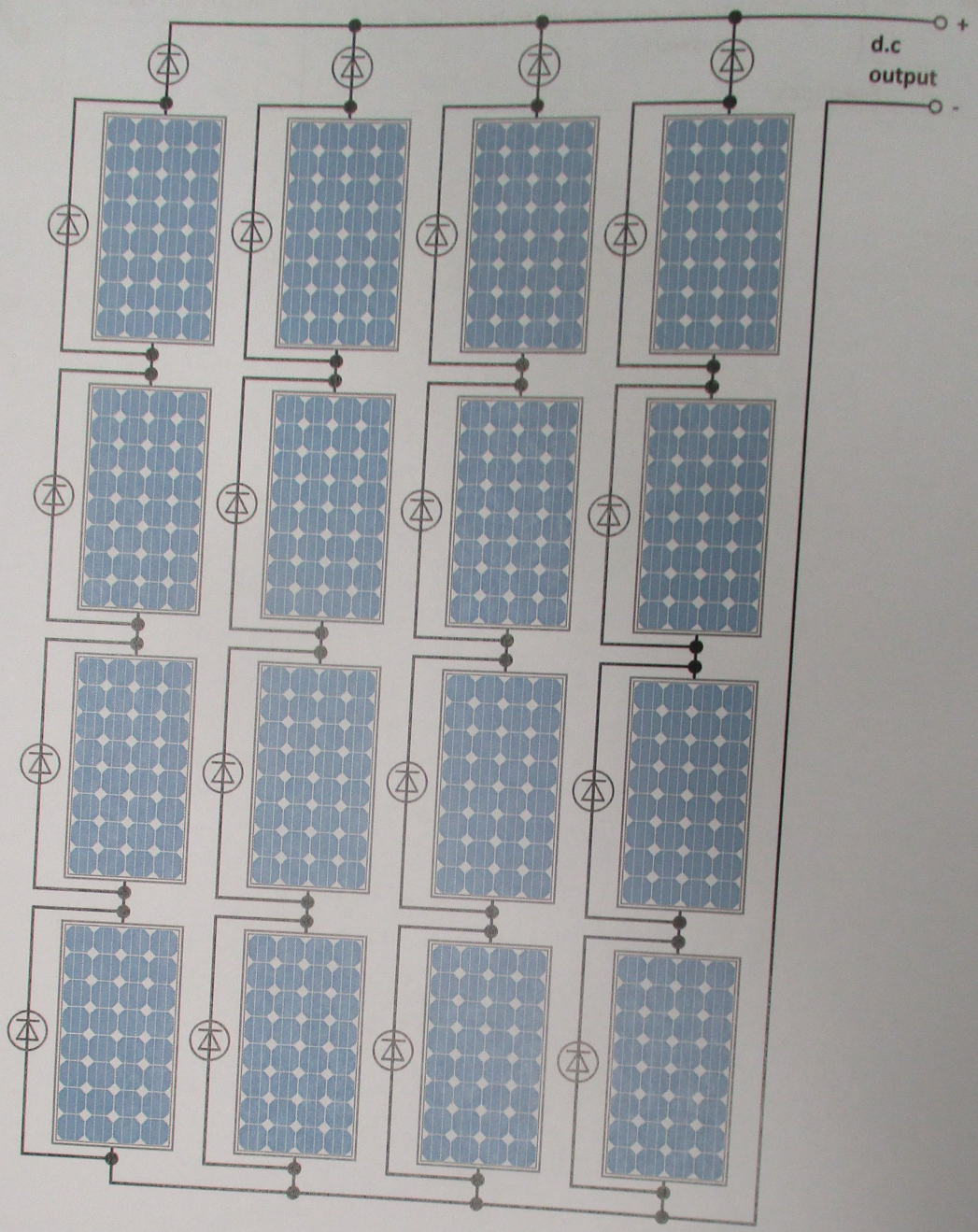
2. Carrying Out the Skills Practice

2.1 PV Array Maximum Power Output

2.1.1 Examine the PV array diagram and module specifications sheet below.



Module Specifications			
Number & Type of Cells:	48 x Monocrystalline	MPP	180 W
Temperature Coefficient:	-0.487 W/°C	V_{oc}	30.1 V
Voltage Coefficient:	-0.112 V/°C	V_{MP}	23.8 V
Current Coefficient:	0.047 %/°C	I_{sc}	8.4 A
NOCT:	46°C	I_{MP}	7.5 A



Module Specifications

Number & Type of Cells:	32 x Monocrystalline	P_{MP}	76 W
Temperature Coefficient:	-0.46 W/°C	V_{oc}	20.2 V
Voltage Coefficient:	-0.31 V/°C	V_{MP}	15.9 V
Current Coefficient:	0.045 %/°C	I_{sc}	5.2 A
NOCT:	45°C	I_{MP}	4.8 A