



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2019/2020**

COURSE NAME : SOLAR PV INSTALLATION &
MAINTENANCE
COURSE CODE : BBJ 10405
PROGRAMME CODE : BBJ
EXAMINATION DATE : JULY 2020
DURATION : 1 HOUR
INSTRUCTION : ANSWER ALL QUESTIONS

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THIS QUESTION PAPER CONSISTS OF NINE (9) PAGES

Answer all questions

- Q1. Which of these options will be the factor that influence maximum power output of a solar panel?
- A. dirt
 - B. time of the year
 - C. direction and angle of a roof
 - D. all of the above
- Q2. What is the range of efficiency of a solar cell?
- A. 2 to 5%
 - B. 15 to 20%
 - C. 40 to 50%
 - D. 70 to 80%
- Q3. What is the typical output power (peak) of a single solar cell 4-inch square?
- A. 0.1 W
 - B. 0.26 W
 - C. 1.1 W
 - D. 1.5 W
- Q4. Which of these following statements is correct?
- A. Monocrystalline solar has better efficiency but expensive
 - B. Thin-film silicon based solar has a low lifespan but expensive
 - C. Concentrated PV cell (CPV) relatively low cost and low efficiency
 - D. Polycrystalline solar relatively low cost but has the lowest efficiency
- Q5. What would be happening if battery charging rate is too high?
- A. excessive gassing will occur
 - B. temperature rise will occur
 - C. bulging and buckling of plates we occur
 - D. all of the above
- Q6. Calculate the load for the 50W refrigerator run 24 hours per day with compressor 8 hour On and 16 hours Off.
- A. 200W
 - B. 300W
 - C. 400W
 - D. 500W

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- Q7. What will be the approximation of the power from the sun intercepted by the earth?
- A. 1.8×10^8 MW
 - B. 1.8×10^{11} MW
 - C. 1.8×10^{14} MW
 - D. 1.8×10^{17} MW
- Q8. The ratio of the beam radiation flux falling on a tilted surface to that falling on a horizontal surface is called the
- A. slope
 - B. tilt factor
 - C. radiation shape factor
 - D. none of the above
- Q9. How would be the maximum efficiency is obtained?
- A. flat plate collector
 - B. evacuated tube collector
 - C. line focusing collector
 - D. paraboloid dish collector
- Q10. What is the maximum possible output of a solar array?
- A. 300 W/m^2
 - B. 100 W/m^2
 - C. 250 W/m^2
 - D. 500 W/m^2
- Q11. Why lead Li-Ion battery can be a safe battery for domestic used?
- A. Li-Ion is a low maintenance battery type
 - B. Li-Ion is a longest capacity lifespan battery
 - C. Li-Ion is a small capacity and power battery
 - D. Li-Ion is a low chance of developing fire battery type
- Q12. When the source of light is not sun light then the photo voltaic cell is used as _____
- A. photo diode
 - B. photo voltaic cell
 - C. photo detector
 - D. photo transmitter
- Q13. What is the typical type of inverter for residential purpose?
- A. central inverter
 - B. string inverter
 - C. micro-inverter
 - D. hybrid inverter

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- Q14. What is the range of the solar radiation received on the earth surface?
- A. 0.25 to 0.4 micron
 - B. 0.4 to 0.8 microns
 - C. 0.6 to 0.95 microns
 - D. 0.1 to 0.25 microns
- Q15. Given a standard irradiance at the module surface: $S = 1000 \text{ W/m}^2$ and the power input and output: $P_{in} = S \times \text{Area} = 1000 \text{ W/m}^2 \times \text{Area}$ $P_{out} = E \times I / \text{Area} = 112.5 \text{ W/m}^2$. Determine the efficiency of the PV module.
- A. 10.00%
 - B. 11.25%
 - C. 12.25%
 - D. 15.50%
- Q16. A DC load is connected to 24 V and the current is 2 A. What is the power of the load?
- A. 24 W
 - B. 48 W
 - C. 12 W
 - D. 26 W
- Q17. The system you are installing includes an MPPT and the solar array will comprise five (5) 60 cell solar modules in series. Each solar module has an open circuit voltage of 35V and short circuit current of 7A. What is the electrical danger with this system?
- A. The MPPT must be wired correctly.
 - B. The MPPT must be connected to a battery bank
 - C. There are 5 modules that must be lifted onto the roof.
 - D. The solar array is rated at 175V DC open circuit and hence LV
- Q18. On site, your colleague has battery acid in his eyes, what would be your prompt action?
- A. Call the boss.
 - B. Call for friends
 - C. Run away so you don't get acid on you.
 - D. Rinse his eyes with plenty of water
- Q19. A LED lamp rated 9 W is on for 40 minutes and TV of 60 W is on for 2 hours. How much energy has been used?
- A. 69 Wh
 - B. 360 Wh
 - C. 126 Wh
 - D. 960 Wh

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- Q20. The energy received at the site for a photovoltaic installation is 22.14 MJ/m^2 . What is the number of peak sun hours at the site?
- A. 79.7
 - B. 6.15
 - C. 25.74
 - D. 4.94
- Q21. As the temperature of a solar cell decreases, how do the current and the voltage change?
- A. Current decreases and voltage increases
 - B. Current increases and voltage increases
 - C. Current decreases and voltage decreases
 - D. Current increases and voltage decreases
- Q22. What is the voltage and current measured at the output of the array in **Figure 22**?

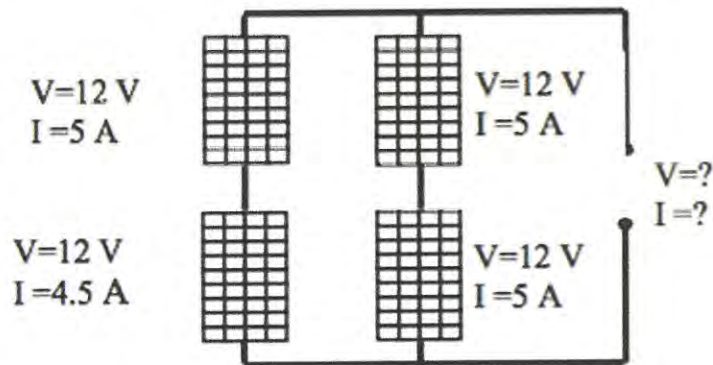


Figure 22. Solar Array

- A. 12 V 5A
- B. 12V 19.5A
- C. 24V 9.5A
- D. 24V 19.5A

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Q23. The following is the hourly irradiation readings for a site where a solar array will be installed.

Time	Irradiation recorded for Wh/m ²
7.00 am - 8.00 am	150
8.00 am - 9.00 am	300
9.00 am - 10.00 am	400
10.00 am - 11.00 am	600
11.00 am - 12.00 am	800
12.00 noon - 1.00 pm	800
1.00 pm - 2.00 pm	600
2.00 pm - 3.00 pm	400
3.00 pm - 4.00 pm	300
4.00 pm - 5.00 pm	150
Total Irradiation (kWh/m ²)	4.5 kWh/m ²

If the site is shaded from 11 AM to 2.00 PM, what is the total available daily irradiation for the site?

- A. 3.00 kWh/m²
 - B. 2.30 kWh/m²
 - C. 4.50 kWh/m²
 - D. 3.30 kWh/m²
- Q24. I have a 230 V AC appliance that is rated 600 Watts however it requires a surge current of 4 amps and the inverter we are selecting is rated at unity power factor. You have four inverters with surge ratings below to choose from, which inverter you would select to operate this appliance?
- A. 600 Watts (600VA)
 - B. 2400 Watts (2400VA)
 - C. 300 Watts (300VA)
 - D. 1000 Watts (1000 VA)
- Q25. Which one out of the following is a potential safety hazard?
- A. The roof is rusted.
 - B. A car parked underneath
 - C. A small tree shading the roof
 - D. A flat roof with a sound structure

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- Q26. Which one of the following is an overcurrent protection device?
- A. Isolator
 - B. gPV fuse
 - C. Combiner box
 - D. Terminal block
- Q27. When lifting a tall wet lead acid battery to the site how should the battery be handled?
- A. In an upright position
 - B. Carried on the shoulder
 - C. Using hooks through the battery terminals.
 - D. With two installers at each end when it is on its side then tipped up.
- Q28. A string cable requires overcurrent protection, what should be the maximum rating of the protective device if the short circuit current for the module in the string is 6.8 A and the reverse current is 14 A?
- A. 13.6 A
 - B. 8.75 A
 - C. 6.8A
 - D. 14A
- Q29. Cables terminated on the flooded lead acid battery banks should be?
- A. Bare wire wrapped around the terminals and covered in grease.
 - B. Run via the shortest route over the filler/inspection caps.
 - C. Connected with crocodile /alligator clips for easy disconnection.
 - D. Bolted to the battery terminals using suitable lugs with insulation covers over the terminals.
- Q30. The system is 24 V DC with a standard solar charge controller. Which of the following is NOT what you do first when disconnecting the system for maintenance purposes?
- A. Turn off the loads in the house.
 - B. Turn off the AC isolator on the inverter
 - C. Turn off or open the PV array isolating device.
 - D. Undo the cable connection to the battery positive or battery negative terminal first.
- Q31. The system comprises a large wet lead acid battery bank containing twenty-four (24) 2 V cells. The batteries are mounted in an outside shed but the batteries have had their cases broken by vandals. What would be one potential environmental risk from the damaged batteries?
- A. The damaged cases are sharp.
 - B. The lead is now exposed to the atmosphere.
 - C. The battery cannot supply power to the system.
 - D. The electrolyte has spilled into the soil and into the water table.

- Q32. What is the power factor?
- A. Ratio of voltage to the current
 - B. Ratio of energy to the power
 - C. Ratio of peak to rms value
 - D. Ratio of real power to apparent power
- Q33. The yearly average insolation in a given locality is 6500 Wh/m²/day, what would be the peak sun value?
- A. 6500
 - B. 650
 - C. 65
 - D. 6.5
- Q34. If the magnitude of I_{sc} for certain cell at 1000 W/sq.m is 2 A, determine the I_{sc} for that cell at the light intensity of 800 W/sq.m.
- A. 1.6 A
 - B. 0.5 A
 - C. 6.5 A
 - D. 16.5 A
- Q35. Let say a solar system need an autonomy to operate without sunshine within 3 days, charging efficiency of 0.8, DOD is 50%, how much capacity of battery should we get?
- A. 50 Ah
 - B. 60 Ah
 - C. 150 Ah
 - D. 180 Ah

Questions Q36 to Q37 based on the following situation:

If a house has the following electrical appliance usage:

- One 18 Watt fluorescent lamp with electronic ballast used for 4 hours per day
- One 60 watt fan used for 2 hours per day
- One 75 watt refrigerator that runs 24 hours per day with compressor run 12 hours and off 12 hours.

The system will be powered by 12 V dc, 110 Wp PV Module, and solar generation factor is 3.43, with 25-35% of inverter rating.

- Q36. Determine power consumption demands
- A. 1130 KW
 - B. 1.4 KW
 - C. 1.6 KW
 - D. 400 W

Q37. Determine the number of the PV panel

- A. 2 Modules
- B. 4 Modules
- C. 6 Modules
- D. 8 Modules

Q38. Determine the inverter sizing

- A. 60 W
- B. 190 W
- C. 500 W
- D. 1 KW

Q39. Determine the battery sizing

- A. 12 V 400 Ah
- B. 12 V 600 Ah
- C. 12 V 800 Ah
- D. 12 V 1.2 KAh

Q40. Determine solar charge controller sizing

- A. 15 A at 12 V
- B. 20 A at 12 V
- C. 30 A at 12 V
- D. 40 A at 12 V

-END OF QUESTIONS-