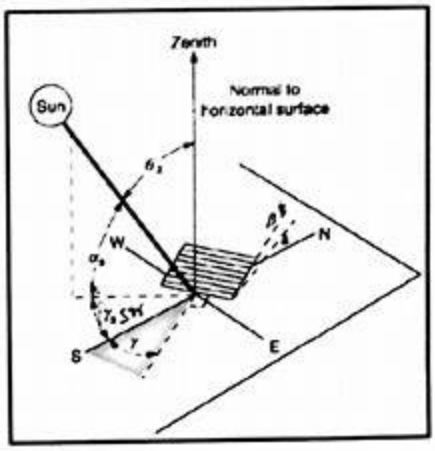
Problem 1: **(30 Points)**

Choose the best correct answer for 31 questions & then fill the table:

1. Which of the following is a non-renewable energy resource?
   a. Solar
   b. Wind
   c. Hydroelectric
   d. Natural gas
   e. None of the above

2. If solar altitude increases, the Air Mass (AM) will:
   a. Increase
   b. Decrease
   c. Remain constant
   d. None of the above.

3. In this graph, the angles $\gamma_s, \alpha_s, \theta_z$ are respectively:



   a. Surface Azimuth, Zenith, Altitude
   b. Surface Azimuth, Altitude, Zenith
   c. Solar Azimuth, Altitude, Zenith
   d. Solar Azimuth, Altitude, Incidence angle
   e. None of the above

4. For achieving maximum energy production in Amman (Latitude 32 degree), in the process of designing a system, the best angle of the PV panels and orientation should be
   a. North orientation at an angle of 25-30
   b. South orientation at an angle of 25-30
   c. South orientation at an angle of 45-50
   d. East or West orientation at an angle of 32
   e. None of the above

5. The less number of panels required to electrify a load of 20 kWh/day in Amman using PV system, peak hours in Amman: 5.5 kWh/day, use 250 Wp modules, is :
   a. 5
   b. 3
   c. 15
   d. 80
   e. None of the above

5.5 ⇒ 1 — kw
1kw → 5.5kw 1

6. The PV system that use a Charge Controller units is

a. Off-grid system
b. On-grid system
c. Thermosyphon system
d. None of the above

7. Which categories that decide the size of PV power plant?

a. Needed power
b. Available space
c. Cost
d. All of them
e. None of the above

8. The purpose of an inverter is to:

a. convert DC of one voltage to an AC at the same or another voltage.
b. convert AC of one voltage to an DC at the same or another voltage.
c. convert DC of one voltage to an AC at another voltage.
d. convert AC of one voltage to an DC at the same or another voltage.
e. None of the above

9. If you combine solar and wind energy in an off-grid system, it is:

a. bimodal
b. indirect
c. sinusoidal
d. hybrid
e. None of the above

10. Irradiance proportionally effects:

a. Current
b. Voltage
c. Air mass
d. NOCT (nominal operating cell Temp.)
e. None of the above

11. When wiring PV modules in series, we increase:

a. Voltage
b. Current
c. Power
d. Irradiance
e. None of the above

12. What are the factor(s) that inhibit higher voltages in PV?

a. Cloud cover
b. Increased irradiance
c. Hot weather
d. Cold weather
e. None of the above

13. If the zenith angle= 60, then the air mass AM would be:

a. 1
b. 1.16
c. 1.5
d. 2
e. None of the above

14. One of the following is incorrect for PV cells:

a. The output current is directly proportional with solar radiation.
b. The output voltage is inversely proportional with temperature.
c. The output power doesn't depend on temperature.
d. The output power depends on solar radiation.
e. None of the above

15. .....is used to prevent hot-spot occurrence in case of shading:

a. Bypass diode
b. Inverter
c. DC chopper
d. Capacitor
e. None of the above

16. The largest sector that consumes electricity in Jordan is

a. Industrial
b. Commercial
c. Domestic
d. Water pumping and street lighting
e. None of the above

17. The current energy mix in Jordan shows that only 4% is supplied from local sources and according to the national energy strategy, the local content should increase in 2020 to be

a. 39%
b. 20%
c. 10%
d. 7%
e. None of the above

18. Jordan is Promoting Renewable Energy to share ..... in the primary energy mix in 2020.

a. 7%
b. 10%
c. 20%
d. 39%
e. None of the above

X

19. Full sunlight (1000 W/m^2) is falling on a 15% efficiency solar cell of 1 kWp at a tilt angle of 25 degrees. What is the output power of the cell (in Amman)?

a. 270 W
b. 135 W
c. 1 kW
d. 150 W
e. None of the above

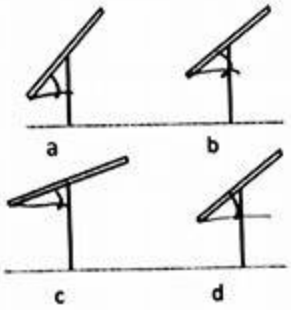
Assume we have 1m2
So 1000 x 0.15 = 150W

20. The annual value of global solar radiation on horizontal surface in Jordan (Ma'an) is:

a. 5.6 kWh/m2/a
b. 2.2 MWh/m2/a
c. 150 kWh/m2/a
d. 2200 Wh/m2/a
e. None of the above

2.044 MW

21. The following picture shows the optimal tilt angle of a PV module during the four seasons: a, b , c and d respectively represents:



a. Summer, spring, winter, fall.
b. Winter, spring, summer, fall.
c. Spring, summer, fall, winter.
d. Fall, winter, summer, spring.
e. None of the above

22. The Air mass factor when the sun is in the vertical position is:

a. One
b. Zero
c. 1/2
d. 2.0
e. None of them

23. The declination angle at fall Equinox (الاعتدال) is:

a. -23.45 °
b. 23.45 °
c. Zero °
d. 90 °
e. None of the above

X

24. Due to the difference of efficiency, 1 m2 monocrystalline silicon will have .....productivity compared to a polycrystalline

a. Higher
b. Lower
c. Similar
d. None of the above

25. In Amman, one square meter of PV modules (15% efficiency) can produce an average of .....during the year.

a. 0.7-0.8 kWh/day
b. 7.0-8.0 kWh/day
c. 150 kWh/day
d. 150 Wh/day
e. None of the above

26. Tests on PV cells productivity are carried out in standard test conditions (STC) that correspond to the following values:

a. Solar Radiation of 1000 W/m2
b. Operating temperature of 25 °C
c. Air Mass AM = 1:5, and Wind: 0 m / s
d. All of the above

27. Imagine you stand next to a PV plant and you are supposed to determine the power output. Your measurements have the following result. What is the power output of one module? Voltage of one module: 24 V, Electric current of one module is 8 A, size of one Module is 0.8 m2, Time of the day 10 a.m., tilt angle of the module: 30 degree. Select the right answer below.

a. 250.4 W
b. 192 W
c. 153.6 W
d. 240 W
e. None of the above

28. Select the correct statement

a. High temperature of the PV cell will increase the power output
b. The temperature of the PV cell affects the voltage of the cell
c. The power output temperature coefficient of a PV module is positive.
d. Shading of a PV cell does not affect the power output.
e. None of the above

29. Select the false statement. The performance ratio PR
   a. Is calculated as the ratio of the final energy yield and the theoretically available energy yield.
   b. is calculated as the ratio of the global irradiance on tilted plane divided by the reference irradiance G (1 kW/m2).
   c. its value is reduced due to losses caused by high module temperatures, incomplete use of irradiance by reflection form the module front surface, soling, component failures and other reasons.
   d. is a relevant information to estimate the yield of a solar PV plant.
   e. None of the above

30. In a given location with 2,200 peak sun hours per year, what will be the estimated yield of a solar PV with 10 kWp installed with a yearly performance ratio of 75%? Select the correct answer.
   a. 2,000 kWh/year
   b. 10,000 kWh/year
   c. 16,500 kWh/year
   d. 30,000 kWh/year
   e. None of the above

10 KWP = 0.75 * 2200

31. A typical 5 kWp PV system in Cyprus costs €7500. The O&M are typically €500 every year. The typical annual yield of a 1 kWp system in Cyprus is 1600 kWh/yr/kWp. If the payback time is expected to be 20 years what is the electricity cost from this system.
   a. 0.075 €/kWh
   b. 0.085 €/kWh
   c. 0.11 €/kWh
   d. 0.185 €/kWh
   e. None of the above

5 * 1600 = 8000

8000 kWh * → 160000 kWh

$\frac{8000 * cost}{8000} = 20$

Good luck

8000 kWh / year

160000 * 5 kWh / year

cost : 9500

$\frac{8000 * cost}{9500} = 20$ year

17500 cost system

$\frac{8000\ kWh}{year} * \frac{cost}{9500€} = 20$ y

$\frac{160000 * cost}{17500} = 20$

$\frac{1}{8000\ kWh} * 365$

20 €/y *