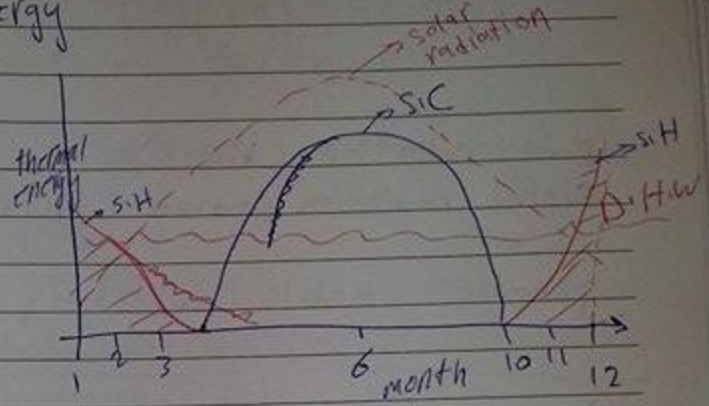
Energy
- capital (any think inside the atmosphere)
- incoming (solar, Tidal (المد والجزر))

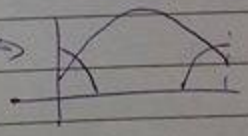
Kwh : J : unit for energy



Domestic hot water : D.H.W
Space heating : S.H
cooling load : C.L (S.C)

solar fraction : نسبة الاستفادة الشمسية (في تشغيل نظام معين) (solar energy / solar + convenential)

space heating we need large area so we combensate the miss



solar constant 1367 w/m^2

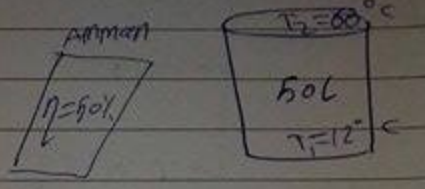
in Amman average solar radiation daily = 5.6 kwh/m^2

" " " " per year = 2044 $\frac{kwh}{m^2}$

PV GIS

Ex:-

$E = 2.78$ kwh



$E = A * G * \eta$

G: solar radiation at m^2

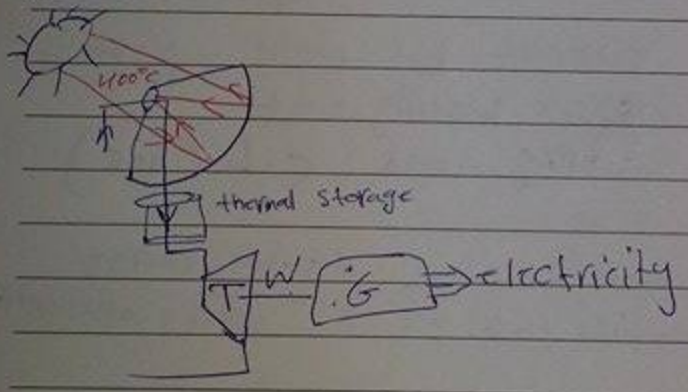
$2.78 = A(5.6)(\frac{50}{100})$

$A = 1\ m^2$

Beam radiation (direct)

Global radiation (totall : Difuse radiation + Beam radiat

photovolatic modulr effeciancy 12-14%



$\eta_{overall} = \eta_{collector} * \eta_{Tur} * \eta_{Gen}$

Equinax: الاعتدال الربيعي او الخريفي

26° زاوية south اتجاه الـ collectors افضل اتجاه

في الشتاء الـ slope angle (tilt) كبيرة

في الصيف الـ // صغيرة

Latitude: دائرة العرض

photo sphere
Temperature = 5800 K

$$\lambda = \frac{c}{v}$$

λ: wave length
V: frequancy
c: speed of light (3×10^8 m/s)

waves carries ~~heat~~ thermal energy (
1- Infrared
2- visible
3- ultraviolet

0.1 — 100 μm thermal radiation
0.3 — 3 μm solar radiation

heat ↑, frequancy ↑, wave length ↓

largest energy comes from sun is in the visible Range
solar collector All wave lengths
PV modules (ultraviolet

T = [~~5800~~ 10000 5800 2500]

Ex: 0.38 — 0.76 (visible light)
find the fraction of the visible light
$f_{0-0.38} = 0.064$
$f_{0-0.76} = 0.527$
$f_{0.38-0.76} = 0.527 - 0.064 = 0.463$

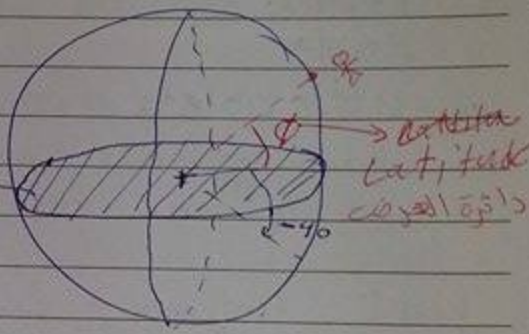
Five Apple

find the fraction of the infrared
$= 160.463 = 0.537$

Blackbody $\alpha = 1$
$\rho = 0$
$\tau = 0$
(الجسم الأسود) $\epsilon = 1$

Direction of solar Beam
① Latitude ϕ $\quad -90 < \phi < 90^\circ$

② Longitude



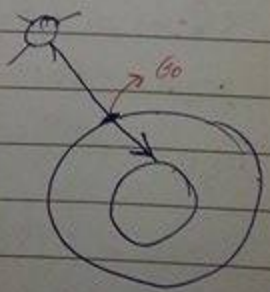
W/m^2) Irradiance : the rate at which radiant energy is incident on a surface per unit area of surface. (G)

Irradiation (J/m^2) : energy per Incident energy per unit area on a surface by integrating the irradiance over time

Insolation : is a term applying specifically to solar energy irradiation (J/m^2)

H: daily Integration
I : hourly Integration

G_o: Irradiance out the atmosphere (W/m^2)

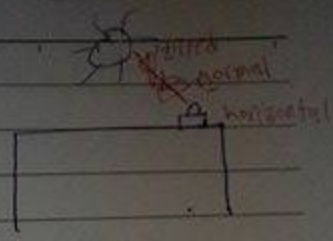


pyranometer

1- tilted (subscript c)

2- normal subscript n

3- horizontal (nothing)



G: solar irradiance in horizontal surface

G_{bn}: for tracking system

G: Global in horizontal surface

$H = 5.6$ KWh/m²

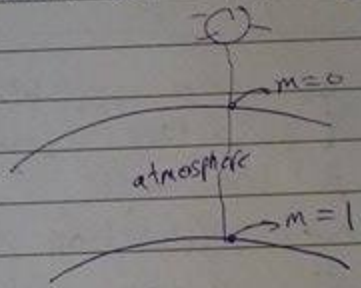
(m) Air mass: the ratio of the mass of atmosphere through which beam radiation passes to the mass it would pass through if the sun were at the zenith (directly overhead).

~~Air mass: the ratio~~

meridian:

$L_{stand} = 330°$

$L_{local} = 324°$



ترتيب اليوم خلال السنة

Solar noon

اليوم

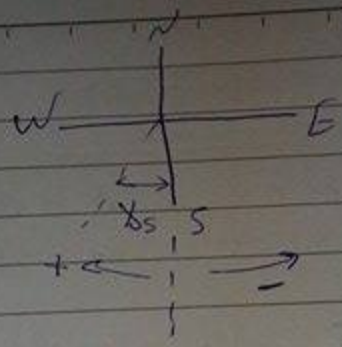
1st January (15 Jan)

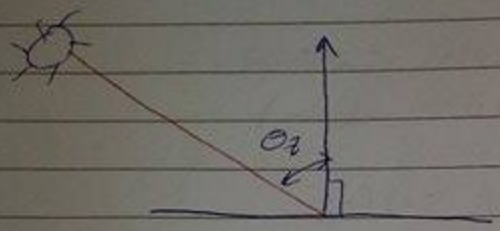
1st Jan

1st Occim

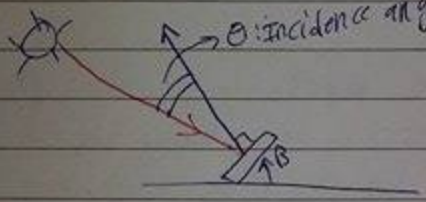
(Solar noon at standard time) الظهر وقت قراءة

γ_s : solar Azimuth angle

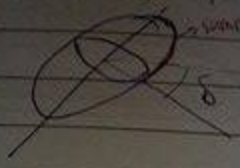




$\theta_z = \theta$ at $\beta = 0$



γ_s : solar azimuth angle
γ : surface azimuth angle
β : tilt angle
α : elevation (altitude)
θ_z : zenith angle
θ : Incident angle (should be minimized)
ϕ : Latitude 32 N
L : Longitude 324° (36° E)
δ : declination angle
$-23.45° < \delta < 23.45°$
$\delta = 0$ (21/3 ~~9/23~~ 21-23/9)



~~reflective~~ reflectivity for ground roof.

$$\cos\theta = \cos(\phi-\beta)\cos\delta\cos w + \sin(\phi-\beta)\sin\delta$$

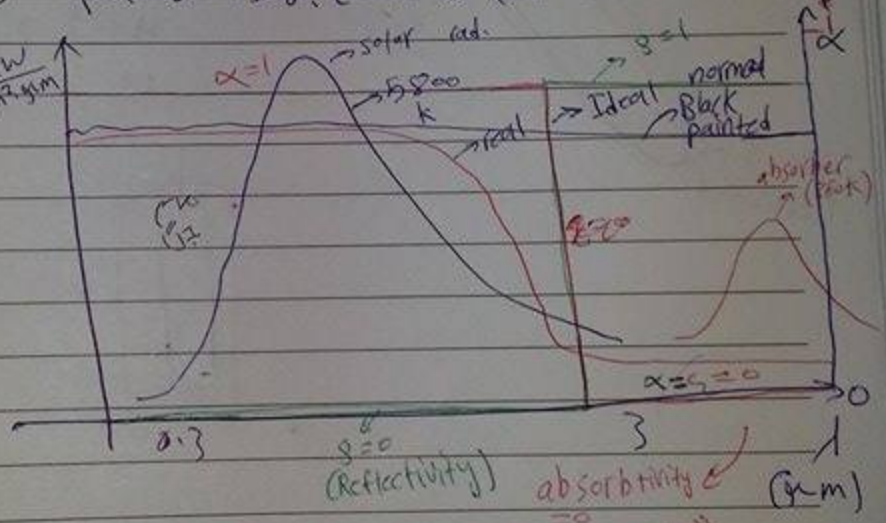
~~the~~ the ultraviolet waves causes the damage in the plastic material.

الأشعة التي تصل لنا إشعاع من السطح الشمسي في الأشعة تحت الحمراء لا تؤثر درجة حرارة السطح حتى يصل إلى إشعاع هذا النوع.

Emissivity : قدرة الجسم على الإشعاع بالمقارنة مع الجسم الأسود

$E = \varepsilon \sigma T^4$ (by radiation)

Black painted
$\delta = 0$
all ~~reflective~~



absorber

$\alpha + \tau + \delta = 1$

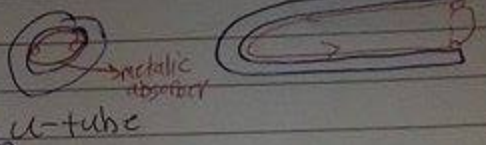
$\alpha + \delta = 1$

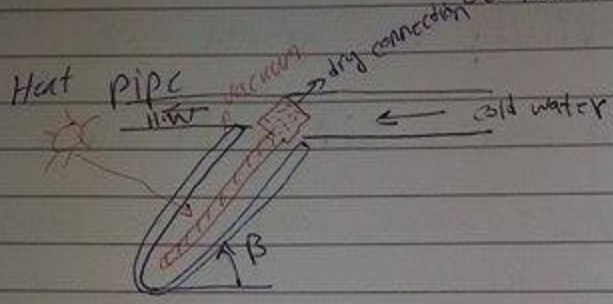
$\varepsilon_\lambda = \alpha_\lambda$ (absorbtivity)

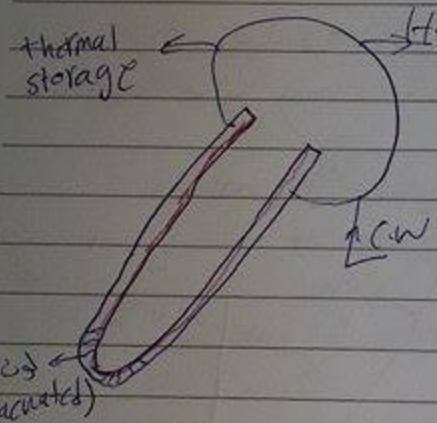
عند طول موجي معين

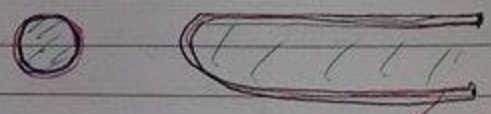
Five Apple

flow through









Heat pipe should be on a minimum slope of 25°