TASK 1,

From the diagram,
when the thickness of the gap is 13 mm, and by changing the gas to argon from air, the U-value of glass reduces from 2.8 W/m²K to 2.65 W/m²K. The U value decreases by 6.43%

When the gas is changed to krypton the U value reduces to 2.6 W/m²K, which is a 7.14% decrease.

The U_{centre}, changes by adding an extra plane, from the diagram,
By adding an extra pane, the U value decreases from 2.8 W/m²K to 1.8 W/m²K, which is a 55.6% reduction in U-Value.

By coating the glass surfaces with a film of low emissivity, by observing the diagram, when the thickness of the air gap is 13mm and coating the glass surface with a low emissivity film of 0.1, the U value of the ~~[illegible]~~ centre of the glass decreases from 2.8 W/m²K to 1.8 W/m²K which is a 55.6% reduction in U value.

TASK 2

Answer.

$T_{cooling} = 24°C$ ⇒ cooling design temperature
$T_{heating} = 20°C$ ⇒ heating design Temperature

Therefore,

$\Delta T_{cooling} = 31.9°C - 24°C = 7.9°C$

$\Delta T_{heating} = 20°C - (-4.8°C) = 24.8°C$

from the table,

$DR = 11.9°C$

$q_{west\ window} = A \times CF_{west\ window}$

$A = 14.4\ m^2$

$CF_{west\ window} = U_{west}\ (\Delta T_{cooling} - 0.46\ DR)$
(heat Transfer)

~~Ex~~ $\therefore$ The window has a fixed heat absorbing double layer glass with a wooden frame,

$U_{window\ W} = 2.84\ W/m^2K$

i.e $CF_{west\ window} = 6.89\ \frac{W}{m^2}$

$PXI_{ww} = E_D + E_d = 559 + 188 = 747.$

$SHGC = 0.54$

No internal shading so $IAC = 1$

$FF_s = 0.56.$

$CF_{WW}(\text{Irradiation}) = PXI + SHGC + IAC + FF_s$

$q_{ww} = A \times CF_{ww} = A \times (CF_{ww}(\text{Heat transfer}) + CF_{ww}(\text{Irradiation}))$

$= 14.4 \times (6.89 + 747 \times 0.5 \times 1 \times 0.56$

$= 3352.07\ W$

Calculating the heat load of the fixed window on west,

$q_{window\ west} = A \times HF_{ww} = A \times U_{ww}\ \Delta T_{heating}$

$= 14.4 \times 2.84 \times 24.8 = 1014.22\ W$

when frame is aluminium,
$U_{ww} = 3.61$, $HSGC = 0.56$

CF'_{ww} (heat transfer) $= U'_{ww}(\Delta T_{cooling} - 0.46\, DR)$
$= 3.61 \times (7.9 - 0.46 \times 11.9)$
$= 8.76\ W/m^2$

Cooling load $q'_{ww} = A \times [CF'_{ww}$ (heat transfer) $+ CF'_{ww}$ (irradiation)$]$
$= 3499.48\ W$

Heating load $q'_{ww} = A \times HF'_{ww} = A \times U'_{ww}\, \Delta T_{heating}$
$= 14.4 \times 3.6 \times 24.8 = 1289.2\ W$

Calculating the cooling load of the fixed window on south
$q_{sw} = A \times HF_{ws} = A \times U_{sw}\, \Delta T$ heating
$= 3.6 \times 2.9 \times 24.9 = 25\cancel{3}.56\ W$

when frame is aluminium, $U_{ws} = 3.6$, $HSGC = 0.56$

CF'_{sw} (heat transfer) $= U'_{sw}(\Delta T_{cooling} - 0.46\, DR)$
$= 3.61 \times (7.9 - 0.46 \times 11.9)$
$= 8.76\ W/m^2$

Cooling load $q'_{sw} = A \times CF'_{sw}$

$= 559.3 W$

Heating load $= A \times HF'_{sw}$

$= 322.3 W$

calculating the cooling load on south window)

$q_{sw} = A \times CF_{sw}$

CF_{sw}(heat transfer part) $= 6.96 W/m^2$

$PXI_{sw} = ED + Ed = 348 + 209 = 557$

$SHGC = 0.46$.

No internal shading so, $IAC = 1$

$FF_s = 0.47$.

CF_{sw} (irradiation part) $= PXI \times SGHC + IAC + FF_s$

$= 553.98$.

$q_{sw} = 256.23$

when frame is aluminium,

$U_{sw} = 4.62 \frac{W}{m^2K}$, $HSGC = 0.55$.

CF'_{sw} (heat transfer part) $= U'_{sw}(\Delta T_{cooling} - 0.46 DR$

$= 11.21 \ \frac{W}{m^2}$

Cooling load $q'_{sw} = A \times CF'_{sw}$

$= 558.7 \ W$

Heating load $q_{sw} = A \times HF'_{sw}$

$= 412.47 \ W$