# CL 351 Course Project


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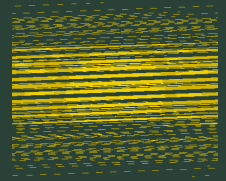
# Problem Statement



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- Most **summer clothing** materials are made to reflect the heat that falls on them but does nothing to cool the body. This is where our project comes in.

- Our project aims to make a clothing material that can be used to maintain/reduce the body temperature so that the wearer feels comfortable during summers.

# Our Solution

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- Our solution is to use a Phase Change Material (PCM) and an insulating material like cotton.
- The PCM will absorb heat from the body and change its phase, thereby cooling the area from where it absorbs the heat. The insulating material will minimize the heat reaching the body.
- Cotton is used to make the wearer feel comfortable.

# Materials Used

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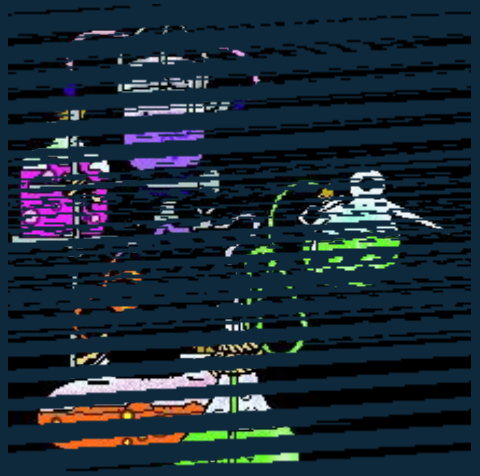
- Na2SO4.10H20 (PCM)
- Cotton (Insulating Material)
- Thermometers
- Thin airtight polythene sheet to keep the PCM



# Theory

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- During summers, the surrounding temperature (40 to 50 C) is higher than the optimum body temperature (around 35 C).
- The insulating material will prevent heat from reaching the PCM or body.
- Hence the PCM will take up heat from the surface of the body only.
- The PCM will keep absorbing heat till it reaches its melting point and will then change its phase.
- As a result of the absorbed heat, the body will feel a cooling effect.

# Theory

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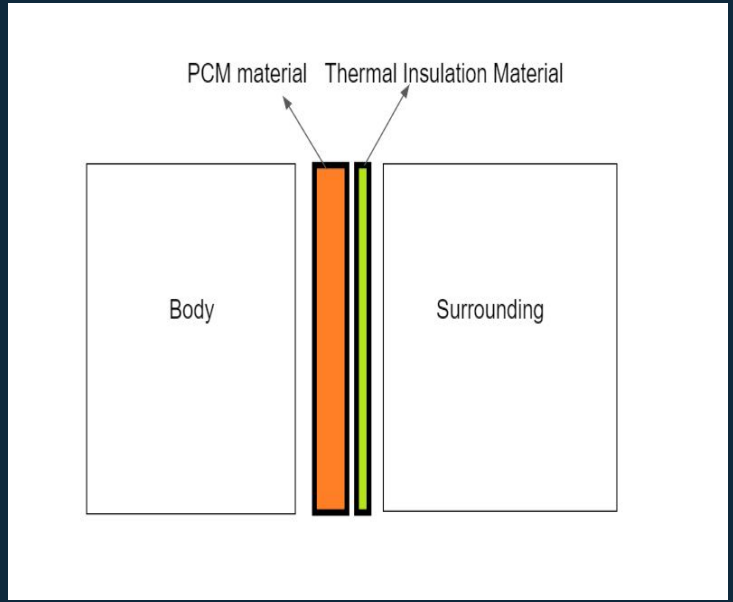
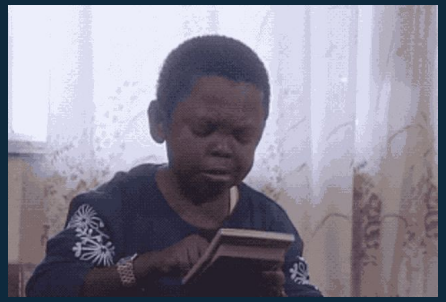
Assuming the room temperature will be less than the temperature outside.

The user will remove the jacket, and since the temperature will be less than the melting point of the PCM, it will revert to its original phase, and the jacket will be ready to use again.



# Calculations



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Latent heat of fusion (L): 245 kJ/kg,

Specific heat capacity ($C_p$): 1782 J/kg K

m = 0.050 Kg,

Melting point: 32.4 °C, Body Temperature: 33.5 °C

When the user wears the cloth with PCM outside, PCM absorbs the heat to and melts at 32.4 °C.

**Q_absorb** = mL + $m_2 C_p$□T_solid = 4089.01 + 98.01 = 4187J (approx)

When the user comes back, PCM will release the heat.

**Q_release** = mL + $m_2 C_p$□T_solid = 4089.01 + 98.01 = 4187J (approx)

# Graph

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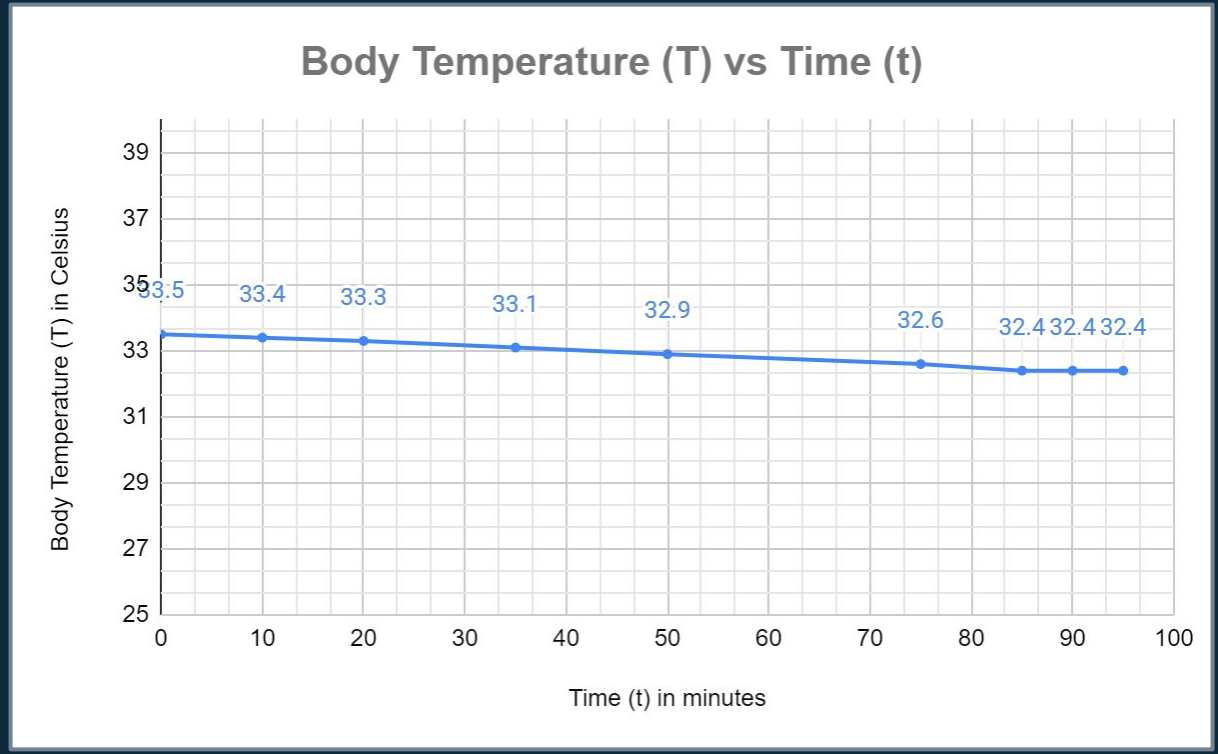
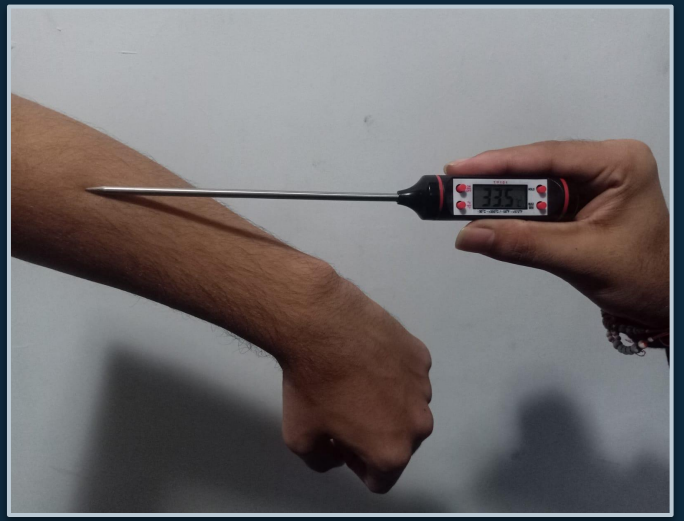

Body Temperature (T) vs Time (t)
Body Temperature (T) in Celsius
39
37
35
33
31
29
27
25
33.5
33.4
33.3
33.1
32.9
32.6
32.4
32.4
32.4
0
10
20
30
40
50
60
70
80
90
100
Time (t) in minutes

# Observations

- The melting point of the PCM was observed to be 32.4°C,
- The body temperature decreased from 33.5 °C to 32.4°C and then became constant.
- Only a fraction of the PCM changed its phase at 32.4 °C (In our calculations we assumed it to be one third of the total mass)




# ERROR

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Some possible sources of error in our calculations:

- We assumed the fraction of PCM melting to be one third of the total mass. This actual amount may vary
- We also neglected the heat absorbed by the liquid PCM since the overall temperature was nearly constant.
- Human error in taking measurements.

# Future Scope

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- The prototype can be expanded to make a full jacket.
- Using a better PCM and insulating material the amount time taken to cool the body can be reduced thereby making it a more efficient.
- Instead of restricting the jacket to only summers we can use a suitable PCM to use it all year round.

# Individual Contributions

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Prototype and  Slides.

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Prototype and Report.

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Slides and Report.

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Report.

# Thanks!

## Any questions?