Pyrometer:

1) RADIATION PYROMETER:

Principle of operation:

All bodies above absolute zero temperature radiate the heat. The amount of energy radiated by the body depends on the temperature of the body. This is called Stefan - Boltzman's law. This law can be used to measure the temperature of the body. Stefan - Boltzman's law is when applied to non-black body takes the form.

$$W = \sigma \epsilon T^4$$

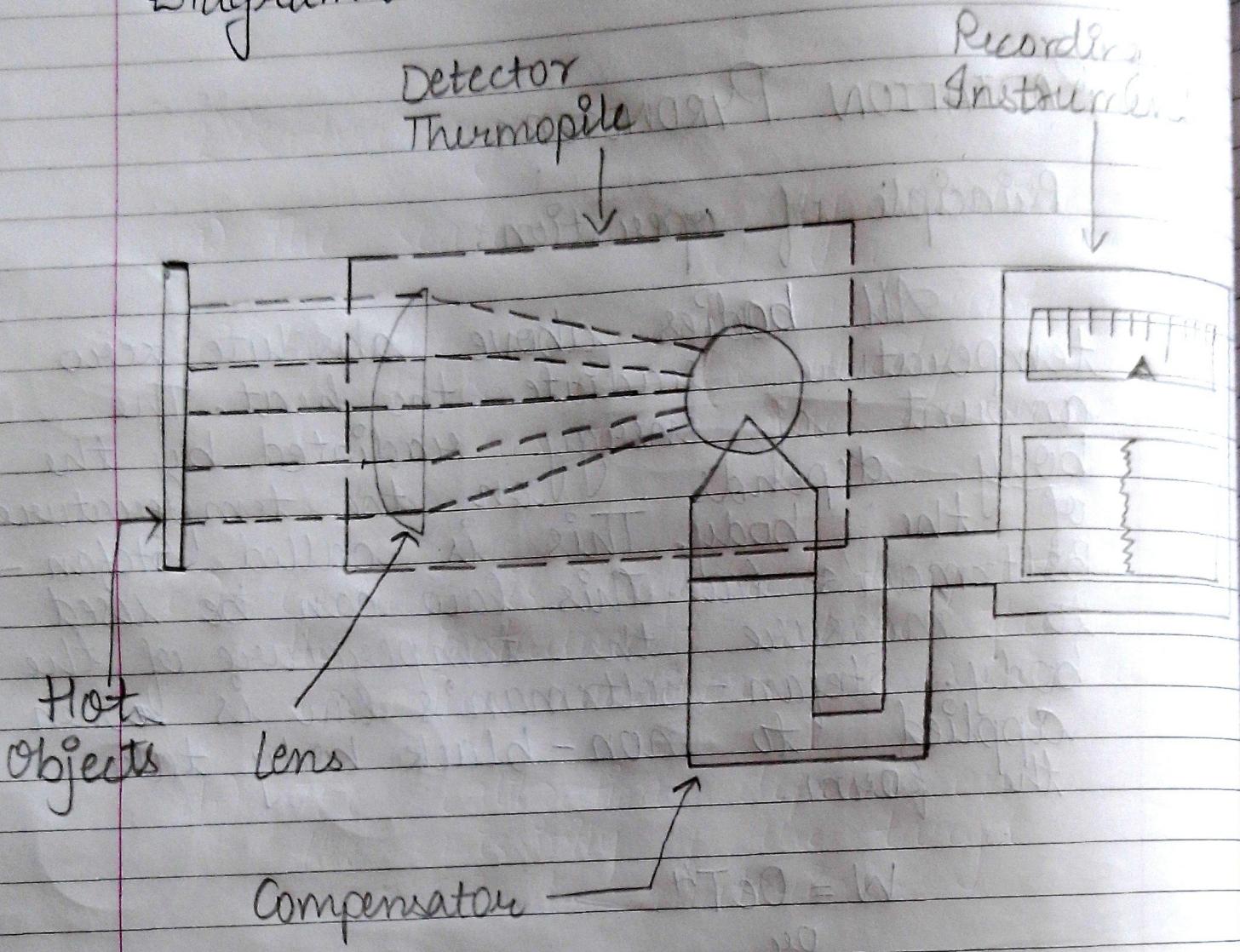
or

$$W = KT^4$$

where W = radiant energy
σ = Stefan constant
ϵ = Emissivity
T = temperature of body (absolute)
K = constant

Stefan - Boltzman's law states that "the amount of radiant energy emitted by the body is proportional to the forth power of the absolute temperatur

Diagram:



Construction and Working:

The radiation pyrometer is designed to collect the radiation from the radiating object and focus it by means of mirrors or lens on to a detector. The detector usually a thermocouple or thermopile produces emf proportional to the temperature and it is given to the suitable millivoltmeter. As the millivoltmeter is calibrated for temperature, it shows the temperature of the body.

The recorder attached with the thermopile also provides the graph of the temperature variations.

Thermopile and the lens are fitted in the blackened tube.

Applications:

i) For high temperature measurement above the limits of the thermocouple.

ii) For measurement of temperature in the contaminated atmosphere.

iii) For measurement of temperature where direct contact of the sensor is not possible.

iv) Capable to measure temperature of the moving or stationary objects.

v) For the temperature measurement of large object or surface.

Advantages:

a.) Can measure very high temperature.

b.) No direct contact with the object is required.

c.) High speed of response.

d.) Reasonable price.

Disadvantages:

a.) The scale is highly nonlinear.

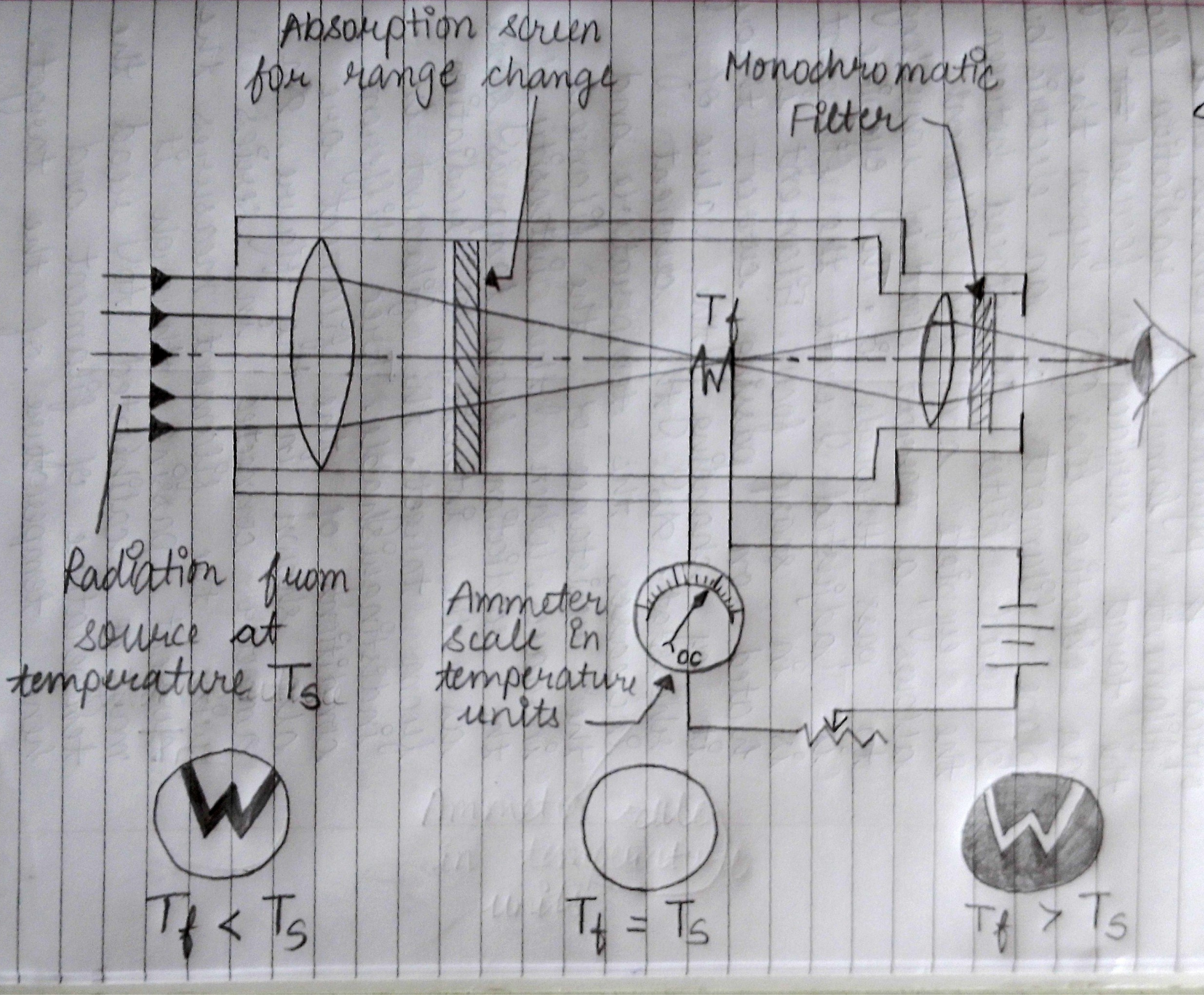
b.) Presence of smoke and dust particles in the vincity may result in the measurement error.

c.) Cooling is required to protect the instrument where the operating conditions are very hot.

d.) The calibration depends on the emissivity of the target ~~maintained~~ material.

2) OPTICAL PYROMETER:

Diagram:



Principle of Operation:

As shown in the figure, the optical pyrometer consists of a filament lamp. The radiation from the target surface is focused by an objective lens (L) upon the plane filament of an electric bulb. A red filter is placed between the eyepiece and the filament allows a narrow band of wavelength to pass through it. The eyepiece is adjusted until the filament is in sharp focus. Filament is heated on passing current through it by changing the value of rheostat. As the current increases the temperature and the resistance of the filament increases. When the intensity of the radiation from lamp is same as the intensity of radiation from target, the filament is indistinguishable. Three different conditions of the filament are also shown in the figure. An ammeter connected in series with the filament measures the current passing through it may be calibrated to read the temperature of filament and hence temperature of the target.

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Advantages:

i) Portable and simple in operation.

ii) No direct contact with the object is required.

iii) Capable to measure temperature of the moving or stationary object.

iv) Can measure very high temperature.

v) Excellent accuracy.

Disadvantages:

i) Cannot measure the temperature of the pure gas flame because the flame of the pure gas is colourless.

ii) Expensive.

iii) Probability of human error is high because operator has to adjust the current manually.

iv) Because of manual adjustment continuous measurement and automatic control of temperature is not possible.

v) Not suitable for temperature below 700°C because the eye is insensitive

to wavelength characteristics below this temperature.

Applications:

a.) Can measure very high temperature.

b.) To check temperature of the moving or stationary objects in steel and metal industries.

c.) To check and calibrate the radiation pyrometer.

d.) For measurement of temperature where direct contact of the sensor is not possible.

e.) In steel and metal industries for measurement of high temperature in the refining and alloying process.