The conversion formula:-

Degree Fahrenhite:

(1.8 x Degree celsius) + 32

$F^\circ = (1.8 \times C^\circ) + 32$

Degree celsius :

(Degree fahrenhite − 32) x 5/9

$C^\circ = (F^\circ - 32) \times \frac{5}{9}$

Degree Kelvin :-

Degree celsius + 273

$K^\circ = C^\circ + 273$

Dgree Rankin :-

Degree fahrenhite + 460

$F^\circ + 460$

General Gas Law :

Temperature and pressure must be in absolute

$$\frac{P(V_1)}{T_1 \rightarrow {}^\circ K , R} = \frac{P(V_2)}{T_2}$$

psi a → psi g

− 14.7

psi g → psi a

+ 14.7

ideal gas Law :-

$PV = n \cdot R \cdot T$

Expansion formula:-

Expansion =

(cofficient) x (length) x (rise in temp)

Rankin Scale :-

Rankin = $F^\circ + 460$

▯ more than zero > 0

so we gonna add (+)

Rankin = $460 - F^\circ$

less than zero < 0

so we gonna subtract (-)

Thermal efficiency :

indicator horsepower (IHP)

$$\frac{\text{IHP} \times 33000}{\text{weight of fuel burned / min} \times \text{heat value} \times 778}$$

Brake horsepower (BHP)

$$\frac{\text{BHP} \times 33\,000}{\text{weight of fuel burned / min} \times \text{heat value} \times 778}$$

$$\begin{tikzcd} R \arrow[r, shift left, "-460"] & F \arrow[l, shift left, "+460"] \arrow[r, shift left, "\frac{F^\circ - 32}{1.8}"] & C \arrow[l, shift left, "1.8 \times C + 32"] \arrow[r, shift left, "+273"] & K \arrow[l, shift left, "-273"] \end{tikzcd}$$

Boyle's Law :

Temperature = constant

pressure needs to be in absolute

$V_1 P_1 = V_2 P_2$

charles' Law :-

pressure = constant

$V_1 \cdot \text{absolute } T_2 = V_2 \cdot \text{absolute } T_1$

also

Volume = constent

$P_1 T_2 = P_2 T_1$

pressure and temperature must be in absolute

$$\begin{tikzcd} C^\circ \arrow[d, bend right, "+273"'] \\ K^\circ \arrow[u, bend right, "-273"'] \end{tikzcd}$$

$$\begin{tikzcd} {}^\circ F \arrow[d, bend right, "+460"'] \\ {}^\circ R \arrow[u, bend right, "-460"'] \end{tikzcd}$$

first law of thermodyncamics :

change in internal of system = heat added to the system − the work done

second law of thermodynumics :

heat energy move from hot object to cold object

or

from high energy to law energy

Example of conversion :-

Fahrenheit readings above zero, 460° is added.

°F = 72 °R = ??

R° = °F + 460

= 72 + 460

= 530 °R

Fahrenheit reading is below zero, it is subtracted

°F = -40 °R = ??

°R = 460 - °F

= 460 - 40

= 420 °R

Example of Charles' Law :-

Example: A 15 ft³ cylinder of oxygen is at a temperature of 21°C and a pressure of 750 psig. The cylinder is placed in the sun and the temperature of the oxygen increases to 60°C. What would be the new pressure in psig?

$$P1T2 = P2T1$$

$V_1 = 15 ft^3$

$T_1 = 21°C$

$P_1 = 750 psig$

$T_2 = 60°C$

$P_2 = ?? psig$

$\boxed{1}$ 21°C → °R

F° = (1.8 x °C) + 32

= (1.8 x 21) + 32

F° = 69.8

°R = 69.8 + 460 T_1

= 529.8 ≈ 530 °R

60°C → °R

F° = (1.8 x °C) + 32

= (1.8 x 60) + 32

F° = 140

°R = 140 + 460 T_2

= 600 °R

$\boxed{2}$ 750 psig → psia

750 + 14.7 =

P_1 ← 764.7 psia

$\boxed{3}$ $P_1T_2 = P_2T_1$

764.7 (600) = P_2 (530)

$\frac{458820\cancel{0}}{53\cancel{0}} = \frac{P_2 (53\cancel{0})}{53\cancel{0}}$

P_2 = 865.7 psia → psig

= 865.7 - 14.7

= 851 psig

3 2 4
764.7
600
0000
00000
458820 00
4588 20 00

53 ⟌ 45882.0

865.7
- 14.7
851.0

Example of Expansion :-

If a steel rod measures exactly 9 ft at 21 °C, what is its length at 55 °C? The coefficient of expansion for steel is 11 × 10–6.

Expansion = (11 × 10 – 6) × (9 feet) × 34°

Expansion = (coefficient) (length) (rise in temperature)

$11 \times 10^{-6} \cdot 9 \cdot 34$

$\underbrace{11 \cdot 9} \cdot 34 \cdot 10^{-6}$

$\underbrace{99 \cdot 34} \cdot 10^{-6}$

$= 3366 \cdot 10^{-6}$

= 0.003366

2
399
34
1396
2970
3366

Example of Boyle's Law:

Example: 10 ft³ of nitrogen is under a pressure of 500 psia. If the volume is reduced to 7 ft³, what will the new pressure be?

V1P1 = V2P2 ←

$V_1 = 10 ft^3$

$P_1 = 500 psia$

$V_2 = 7 ft^3$

$P_2 = ??$

10 (500) = 7 P_2

$\frac{5000}{7} = \frac{\cancel{7} P_2}{\cancel{7}}$

P_2 = 714.29 psia

500
10
000
5000
5000

$\boxed{714.285}$
7 ⟌ 5000.0
49
10
7
30
28
20
14
60
56
40
35
5

Example of General gas law:

Example: 20 ft³ of the gas argon is compressed to 15 ft³. The gas starts out at a temperature of 15.5°C and a pressure of 1 000 psig. After being compressed, its temperature is32°C. What would its new pressure be in psig?

$$\frac{\text{Pressure (Volume 1)}}{\text{Temperature 1}} = \frac{\text{Pressure (Volume 2)}}{\text{Temperature 2}}$$

When using the general gas law formula, temperature and pressure must be in the absolute.

$V_1 = 20 ft^3$

$V_2 = 15 ft^3$

$t_1 = 15.5°C$

$P_1 = 1000 psig$

$t_2 = 32°C$

$P_2 = ?? psig$

$\boxed{1}$ T_1 ⇒ 15.5°C → °R

F° = (1.8 x 15.5) + 32

= 27.72 + 32

F° = 59.72

°R = 59.72 + 460

$= 519.72 \approx 520\,°R$

$\boxed{2}$ $T_2 \Rightarrow 32°C \rightarrow °R$

$°f = (1.8 \times 32) + 32$

$= 57.6 + 32$

$°f = 89.6$

$°R = 89.6 + 460$

$= 549.6 \approx 550\,°R$

$\boxed{3}$ $P_1 = 1000$ psig $\rightarrow$ psia

$1000 + 14.7 = 1014.7$ psia

$\boxed{4}$ $\frac{P(V_1)}{T_1} = \frac{P(V_2)}{T_2}$

$\frac{1014.7(20)}{520} = \frac{P_2(15)}{550}$

$1014.7(20) \cdot 550 = P_2(15) \cdot 520$

$\frac{1161700.\cancel{0}}{52\cancel{0}} = P_2(15) \cdot \frac{\cancel{520}}{\cancel{520}}$

$\frac{22340.4}{15} = \frac{P_2(\cancel{15})}{\cancel{15}}$

$P_2 = 1489.36$ psia

a $\rightarrow$ g

$= 1489.36 - 14.7 =$

$P_2 = 1474.66$ psig

1474.7 psig

```
      1
  10147
x    20
-------
  00000
 202940
-------
 20294.0
```

```
   142
   142
 202940
    550
-------
 000000
1014700 00
10147000 00
-----------
11161700.0
```