# Gasoline Blending Sample Problem

What are the API gravity, RVP, & average octane number for a 33/67 blend of Light Straight Run Gasoline & Mid-Cut Reformate?

| | Light Straight Run Naptha | Mid Cut Reformate | Volume Average Octane Blending | Non-Linear Octane Blending |
|---|---|---|---|---|
| Blend vol% | 33% | 67% | 100% | |
| Gravity, °API | 81.8 | 32.8 | | |
| Specific Gravity | 0.6634 | 0.8612 | | |
| Aromatics, vol% | 2.2 | 94.2 | | |
| Olefins, vol% | 0.9 | 0.6 | | |
| RVP, psi | 10.8 | 1.0 | | |
| RON | 63.7 | 109.3 | | |
| MON | 61.2 | 100.4 | | |
| (R+M)/2 | 62.5 | 104.9 | | |
| J = R-M | 2.5 | 8.9 | | |

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# Gasoline Blending Sample Problem

What are the API gravity, RVP, & average octane number for a 33/67 blend of Light Straight Run Gasoline & Mid-Cut Reformate?

Since these values are volume% they can be directly calculated as volume averages.

$$\bar{A} = (0.33)(2.2) + (0.67)(94.2) = 63.8$$

$$\bar{O} = (0.33)(0.9) + (0.67)(0.6) = 0.7$$

| | ight ht Run ptha | Mid Cut Reformate | Volume Average Octane Blending | Non-Linear Octane Blending |
|---|---|---|---|---|
| | 3% | 67% | 100% | |
| | 1.8 | 32.8 | | |
| | 6634 | 0.8612 | | |
| | 2.2 | 94.2 | 63.8 | |
| | 0.9 | 0.6 | 0.7 | |
| | 0.8 | 1.0 | | |
| RON | 83.7 | 109.3 | | |
| MON | 61.2 | 100.4 | | |
| (R+M)/2 | 62.5 | 104.9 | | |
| J = R-M | 2.5 | 8.9 | | |




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# Gasoline Blending Sample Problem

What are the API gravity, RVP, & average octane number for a 33/67 blend of Light Straight Run Gasoline & Mid-Cut Reformate?

API gravity <u>cannot</u> be directly calculated as a volume average, but specific gravity can.

$$\gamma_o = (0.33)(0.6634) + (0.67)(0.8612)$$
$$= 0.7958$$

$$G = \frac{141.5}{0.7958} - 131.5$$
$$= 46.3$$

| | | Mid Cut Reformate | Volume Average Octane Blending | Non-Linear Octane Blending |
|---|---|---|---|---|
| | | 67% | 100% | |
| | | 32.8 | 46.3 | |
| | | 0.8612 | 0.7959 | |
| | | 94.2 | 63.8 | |
| | | 0.6 | 0.7 | |
| | | 1.0 | | |
| | | 109.3 | | |
| MON | 61.2 | 100.4 | | |
| (R+M)/2 | 62.5 | 104.9 | | |
| J = R-M | 2.5 | 8.9 | | |




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| | Light Straight Run Naptha | Mid Cut Reformate | Volume Average Octane Blending | Non-Linear Octane Blending |
|---|---|---|---|---|
| | | 67% | 100% | |
| | | 32.8 | 46.3 | |
| | | 8612 | 0.7959 | |
| | | 94.2 | 63.8 | |
| | | 0.6 | 0.7 | |
| | | 1.0 | 4.8 | |
| | | 09.3 | | |
| | | 00.4 | | |
| (R+M)/2 | 62.5 | 104.9 | | |
| J = R-M | 2.5 | 8.9 | | |

RVP cannot be directly calculated as a volume average. Volume average the $RVP^{1.25}$ terms

$$(RVP)^{1.25} = (0.33)(10.8)^{1.25} + (0.67)(1.0)^{1.25}$$
$$= 7.13$$
$$(RVP) = (7.13)^{1/1.25} = 4.81$$




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# Gasoline Blending Sample Problem

What are the API gravity, RVP, & average octane number for a 33/67 blend of Light Straight Run Gasoline & Mid-Cut Reformate?

The simple volume average indicates a gasoline that could meet Regular gasoline octane specs.

$$\bar{R} = (0.33)(63.7) + (0.67)(109.7) = 94.3$$

$$\bar{M} = (0.33)(61.2) + (0.67)(100.4) = 87.5$$

| | ight ht Run ptha | Mid Cut Reformate | Volume Average Octane Blending | Non-Linear Octane Blending |
|---|---|---|---|---|
| | 3% | 67% | 100% | |
| | 1.8 | 32.8 | 46.3 | |
| | 6634 | 0.8612 | 0.7959 | |
| | 2.2 | 94.2 | 63.8 | |
| | 0.9 | 0.6 | 0.7 | |
| | 0.8 | 1.0 | 4.8 | |
| | 3.7 | 109.3 | 94.3 | |
| | 1.2 | 100.4 | 87.5 | |
| (R+M)/2 | 62.5 | 104.9 | 90.9 | |
| J = R-M | 2.5 | 8.9 | | |




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# Gasoline Blending Sample Problem

What are the API gravity, RVP, & average octane number for a 33/67 blend of Light Straight Run Gasoline & Mid-Cut Reformate?

The Ethyl model takes into account the aromatics & olefin contents of the blend stocks.

$$\overline{(A^2)} = (0.33)(2.2)^2 + (0.67)(94.2)^2$$
$$= 5{,}947$$
$$\overline{(A^2)} - \bar{A}^2 = 5{,}947 - (63.8)^2$$
$$= 1871$$

| | | Mid Cut Reformate | Volume Average Octane Blending | Non-Linear Octane Blending |
|---|---|---|---|---|
| | | 67% | 100% | |
| | | 32.8 | 46.3 | |
| | | 0.8612 | 0.7959 | |
| | | 94.2 | 63.8 | |
| | | 0.6 | 0.7 | |
| | | 1.0 | 4.8 | |
| RON | 63.7 | 109.3 | 94.3 | |
| MON | 61.2 | 100.4 | 87.5 | |
| (R+M)/2 | 62.5 | 104.9 | 90.9 | |
| J = R-M | 2.5 | 8.9 | | |




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# Gasoline Blending Sample Problem

What are the API gravity, RVP, & average octane number for a 33/67 blend of Light Straight Run Gasoline & Mid-Cut Reformate?

The Ethyl model takes into account the aromatics & olefin contents of the blend stocks.

$$\overline{(O^2)} = (0.33)(0.9)^2 + (0.67)(0.6)^2$$
$$= 0.509$$
$$\overline{(O^2)} - \bar{O}^2 = 0.509 - (0.7)^2$$
$$= 0.020$$

| | | Mid Cut Reformate | Volume Average Octane Blending | Non-Linear Octane Blending |
|---|---|---|---|---|
| | | 67% | 100% | |
| | | 32.8 | 46.3 | |
| | | 0.8612 | 0.7959 | |
| | | 94.2 | 63.8 | |
| | | 0.6 | 0.7 | |
| | | 1.0 | 4.8 | |
| RON | 63.7 | 109.3 | 94.3 | |
| MON | 61.2 | 100.4 | 87.5 | |
| (R+M)/2 | 62.5 | 104.9 | 90.9 | |
| J = R-M | 2.5 | 8.9 | | |




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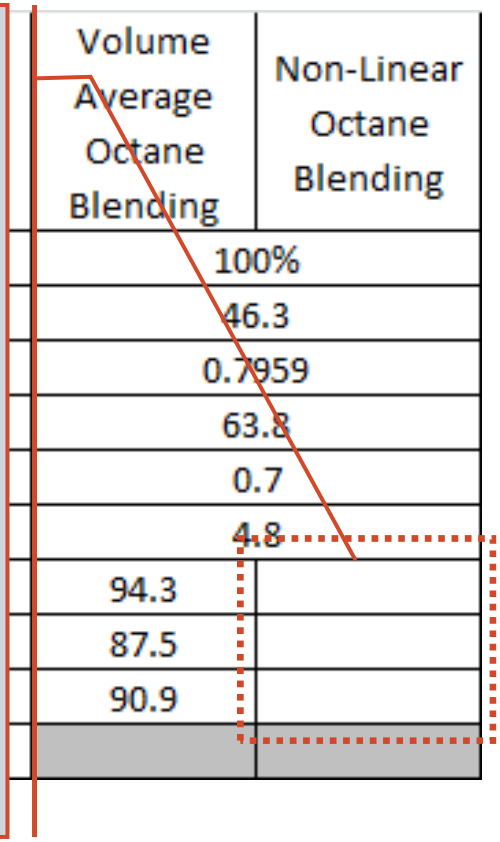
# Gasoline Blending Sample Problem

What are the API gravity, RVP, & average octane number for a 33/67 blend of Light Straight Run Gasoline & Mid-Cut Reformate?

The Ethyl model takes into account the spread between the Research & Motor octane numbers.

$$\overline{J} = (0.33)(2.5) + (0.67)(8.9)$$
$$= 6.79$$
$$\overline{RJ} = (0.33)(63.7)(2.5) + (0.67)(109.3)(8.9)$$
$$= 704.3$$
$$\overline{RJ} - \overline{R} \cdot \overline{J} = 704.3 - (94.3)(6.79) = 64.5$$
$$\overline{MJ} = (0.33)(61.2)(2.5) + (0.67)(100.4)(8.9)$$
$$= 649.2$$
$$\overline{MJ} - \overline{M} \cdot \overline{J} = 649.2 - (87.5)(6.79) = 55.5$$

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# Gasoline Blending Sample Problem

What are the API gravity, RVP, & average octane number for a 33/67 blend of Light Straight Run Gasoline & Mid-Cut Reformate?

Using the Ethyl model based on 135 blends…

$$R = 94.25 + (0.03324)(64.5) + (0.00085)(0.020) = 96.4$$

$$M = 87.5 + (0.04285)(55.5) + (0.00066)(0.020) - (0.00632)\left(\frac{1871}{100}\right)^2 = 87.6$$

| | | | Volume Average Octane Blending | Non-Linear Octane Blending |
|---|---|---|---|---|
| | | | 100% | |
| | | | 46.3 | |
| | | | 0.7959 | |
| | | | 63.8 | |
| | | | 0.7 | |
| | | | 4.8 | |
| | | | 94.3 | 96.4 |
| | | | 87.5 | 87.6 |
| | | | 90.9 | 92.0 |
| J = R-M | 2.5 | 8.9 | | |

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# Gasoline Blending Sample Problem

What are the API gravity, RVP, & average octane number for a 33/67 blend of Light Straight Run Gasoline & Mid-Cut Reformate?

This model shows that it is likely that the gasoline will meet Premium octane specs.

| | ght ht Run ptha | Mid Cut Reformate | Volume Average Octane Blending | Non-Linear Octane Blending |
|---|---|---|---|---|
| | 3% | 67% | 100% | |
| Gravity, °API | 81.8 | 32.8 | 46.3 | |
| Specific Gravity | 0.6634 | 0.8612 | 0.7959 | |
| Aromatics, vol% | 2.2 | 94.2 | 63.8 | |
| Olefins, vol% | 0.9 | 0.6 | 0.7 | |
| RVP, psi | 10.8 | 1.0 | 4.8 | |
| RON | 63.7 | 109.3 | 94.3 | 96.4 |
| MON | 61.2 | 100.4 | 87.5 | 87.6 |
| (R+M)/2 | 62.5 | 104.9 | 90.9 | 92.0 |
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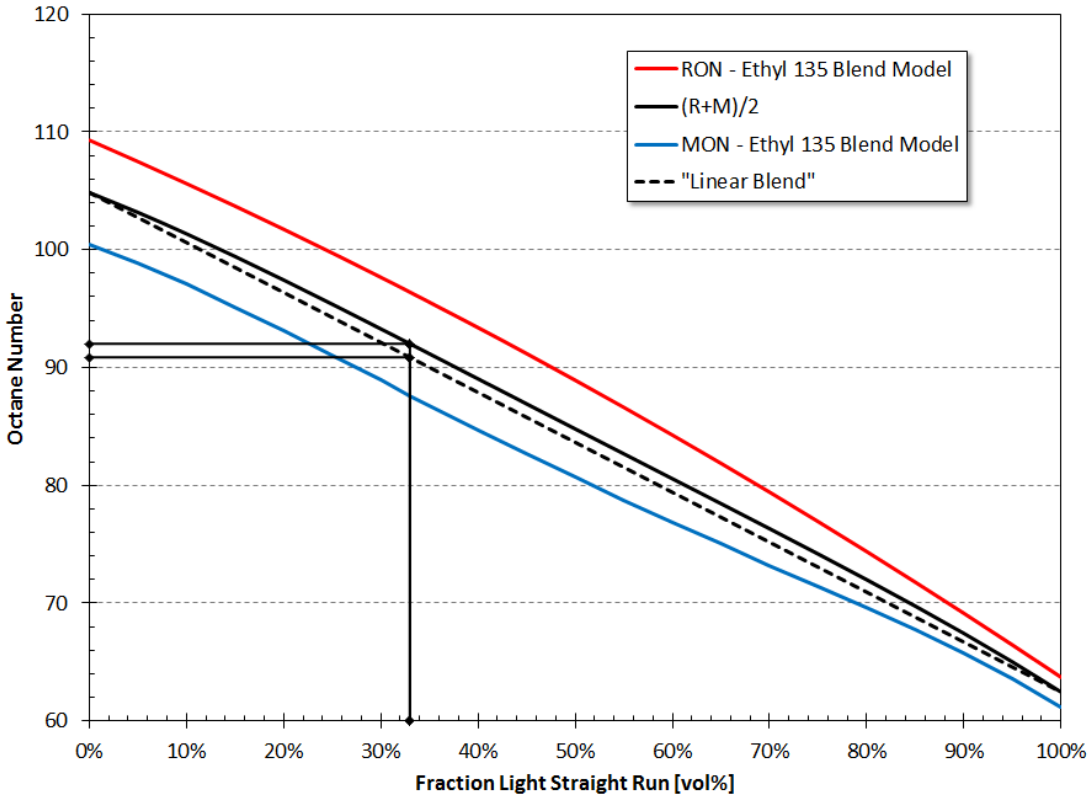


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