Problem 1: The right way:

Note: We will use Hobbiton as our vertex, and compute 3 angles. The angle from Erebor to Dagorlad, Dagorlad to Corsairs, and Erebor to Corsairs. If the sum of the first two angles adds up to the third, the space is flat.

Import["/Net/thy2/olness/3368/1ttt.bmp"];

Show[%%];

```
rule = {
Thread[{a, b, c} -> {813, 960, 735}],
Thread[{a, b, c} -> {960, 1112, 780}],
Thread[{a, b, c} -> {813, 1112, 1498}]
}
{(a -> 813, b -> 960, c -> 735), (a -> 960, b -> 1112, c -> 780), (a -> 813, b -> 1112, c -> 1498)}

eq1 = (c^2 = a^2 + b^2 - 2 a b Cos[y])
(c^2 = a^2 - 2 b cos(y) a + b^2)

sol1 = Solve[eq1, y][[2]]
{y -> \text{cos}^{-1}\left(\frac{a^2 + b^2 - c^2}{2 \, a \, b}\right)}

result = y / Degree /. sol1 /. rule // N
{48.1057, 43.4594, 101.048}

result[[1]] + result[[2]]
91.5651
```

Problem 1: The wrong way:

```
rule = (Thread[{a, b, c} -> {813, 735, 960}], Thread[{a, b, c} -> RotateLeft[{813, 735, 960}]],
Thread[{a, b, c} -> RotateRight[{813, 735, 960}]]
{(a -> 813, b -> 735, c -> 960), (a -> 735, b -> 960, c -> 813), (a -> 960, b -> 813, c -> 735)}

eq1 = (c^2 = a^2 + b^2 - 2 a b Cos[y])
(c^2 = a^2 - 2 b cos(y) a + b^2)

sol1 = Solve[eq1, y][[2]]
{y -> \text{cos}^{-1}\left(\frac{a^2 + b^2 - c^2}{2 \, a \, b}\right)}
```
Problem 3:

```
<< Miscellaneous`PhysicalConstants`
<< Miscellaneous`Units`
?Miscellaneous`PhysicalConstants`*
?PlanckConstantReduced
PlanckConstantReduced is PlanckConstant(2 Pi), a universal constant.

PlanckConstantReduced
1.05457 \times 10^{-34} \text{ Joule Second}

ProtonMass
1.67262 \times 10^{-27} \text{ Kilogram}

proton = PlanckConstantReduced / 2 / (2 ProtonMass) // Simplify

1.57623 \times 10^{-8} \text{ Joule Second}

\frac{\text{Kilogram}}{\text{Kilogram}}

MKS[proton / SpeedOfLight^2] //. (Joule \rightarrow \text{Newton Meter}, \text{Newton} \rightarrow \text{Kilogram Meter} / \text{Second}^2)

1.75379 \times 10^{-25} \text{ Second}

% SpeedOfLight
5.25772 \times 10^{-17} \text{ Meter}

electron = PlanckConstantReduced / 2 / (2 ElectronMass) // Simplify

0.0000289419 \text{ Joule Second}

\frac{\text{Kilogram}}{\text{Kilogram}}

MKS[electron / SpeedOfLight^2] //. (Joule \rightarrow \text{Newton Meter}, \text{Newton} \rightarrow \text{Kilogram Meter} / \text{Second}^2)

3.22022 \times 10^{-22} \text{ Second}

% SpeedOfLight
9.65398 \times 10^{-14} \text{ Meter}
```
Problem 4:

\[
\text{result} = \frac{\pi}{r^2} + \pi
\]

\[
\text{result} \div (A \to 0)
\]

\[
\pi
\]

\[
\text{result} \div (A \to 4 \pi r^2)
\]

\[
5 \pi
\]

Problem 5:

\[
2^{16}
\]

65536

Problem 6

\[
\text{inside}[n_] = 2 \pi^{n/2} r^n / (n \Gamma[n/2])
\]

\[
2 \pi^{n/2} r^n / n \Gamma(n/2)
\]

\[
\text{outside}[n_] = D[\text{inside}[n], r]
\]

\[
2 \pi^{n/2} r^{n-1} / \Gamma(n/2)
\]

Table[ {n, inside[n], outside[n]}, (n, 1, 10)]

<table>
<thead>
<tr>
<th>n</th>
<th>inside[n]</th>
<th>outside[n]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2 r</td>
<td>2 r</td>
</tr>
<tr>
<td>2</td>
<td>\pi r^2</td>
<td>2 \pi r</td>
</tr>
<tr>
<td>3</td>
<td>\frac{4\pi^3}{3}</td>
<td>4 \pi r^2</td>
</tr>
<tr>
<td>4</td>
<td>\frac{8\pi^3}{3}</td>
<td>2 \pi^2 r^3</td>
</tr>
<tr>
<td>5</td>
<td>\frac{8\pi^3}{15}</td>
<td>\frac{8\pi^3}{3}</td>
</tr>
<tr>
<td>6</td>
<td>\frac{8\pi^3}{6}</td>
<td>\pi^3 r^5</td>
</tr>
<tr>
<td>7</td>
<td>\frac{16\pi^3}{105}</td>
<td>\frac{16\pi^3}{15}</td>
</tr>
<tr>
<td>8</td>
<td>\frac{16\pi^3}{24}</td>
<td>\frac{8\pi^3}{3}</td>
</tr>
<tr>
<td>9</td>
<td>\frac{32\pi^3}{945}</td>
<td>\frac{32\pi^3}{105}</td>
</tr>
<tr>
<td>10</td>
<td>\frac{32\pi^3}{120}</td>
<td>\frac{32\pi^3}{12}</td>
</tr>
</tbody>
</table>

Integrate[1, (r, -r, r)]

2 r
Integrate[r, {r, 0, r}, {φ, 0, 2π}]
π r^2

Integrate[r^2 Sin[θ], {r, 0, r}, {φ, 0, 2π}, {θ, 0, π}]
4 π r^3

Integrate[r^3 Sin[θ]^2 Sin[ρ], {r, 0, r}, {φ, 0, 2π}, {θ, 0, π}, {ρ, 0, π}]
π^3 r^4

Integrate[r^4 Sin[θ]^3 Sin[ρ]^2 Sin[ω], {r, 0, r}, {φ, 0, 2π}, {θ, 0, π}, {ρ, 0, π}, {ω, 0, π}]
8 π^2 r^5

D[%, r]
8 π^2 r^4

D[%, r]
4 π r^3

D[%, r]
2 π r

D[%, r]

D[%, r]