1. Find

$$\int\left(\frac{2}{3}x^3 - 6\sqrt{x} + 1\right)dx$$

giving your answer in its simplest form.

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As with differentiation, best to write each terms in index form ie. $\sqrt{x} = x^{1/2}$. Then easy to apply integral rule.

$$\int\left(\frac{2}{3}x^3 - 6x^{1/2} + 1\right)dx$$

Note: $1 = 1 \times x^0$

$\int x^0 dx = x$

$$= \frac{2}{3} \times \frac{x^4}{4} - \frac{6x^{3/2}}{(3/2)} + x + c$$

c = constant of integration

$$= \frac{x^4}{6} - 4x^{3/2} + x + c$$

A note on constant of integration. In a real instance there will be some initial or boundary conditions that give a meaning or value for c. But just integrating we do not know what those are, so we just put "c". For example consider constant acceleration.

$$\text{Acc} = \frac{dv}{dt} = a$$

where a is the constant acceleration

$$\text{So } v = \int a\, dt$$

$$v = at + c$$

What does c mean here? When $t = 0$ $v = c$ so c represents the initial velocity usually called u

$$v = u + at.$$

What about s = distance. $v = \frac{ds}{dt} = u + at$

$$\text{gives } s = \int v\, dt = \int (u + at)\, dt$$

$= ut + \frac{1}{2}at^2 + c$. We NORMALLY take $s = 0$ when $t = 0$. This gives $c = 0$ or $s = ut + \frac{1}{2}at^2$. But it might not be so. c represents the value of s when $t = 0$.