Complete solutions to Intro(h)

1. An object with a velocity of $31m/s$ means it travels $31m$ in one second. First we convert $31m$ into km, how?
Divide by 1000:

$$31 \div 1000 = 0.031$$

So $31m = 0.031km$. Therefore the object covers $0.031km$ in one second. What distance does it cover in one hour?
Since $3600s = 1$ hour, the object covers $0.031 \times 3600 = 111.6km$ in one hour. Hence

$$31m/s = 111.6km/h$$

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2. Since acceleration is $32.174\,feet/\sec^2$ we only need to express $32.174feet$ into metres. Since $1foot = 0.305m$ so

$$32.174 \times 0.305 = 9.813$$

$32.174feet = 9.813m$. Thus

$$32.174\,feet/\sec^2 = 9.81\,\mathrm{m/s^2} \text{ (3 s.f.)}$$

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3. What does a sound velocity of $342m/s$ mean?
Sound travels a distance of $342m$ in one second. How many miles does it travel in 1 second?
Because $342m = 0.342km$ and $1km = 0.621$ miles, so the number of miles in one second is:

$$0.621 \times 0.342 = 0.2124$$

Sound travels a distance of 0.2124 miles in one second. How far does it travel in 1 hour?
Since there are 3600 seconds in 1 hour so $0.2124 \times 3600 = 764.64$
Therefore sound velocity is 765 miles per hour.

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4. The density $1206\,kg/m^3$ means $1m^3$ of air has a mass of $1.206kg$. What is the mass in grams?
There are $1000g$ in $1kg$ so we multiply by 1000:

$$1.206kg = 1.206 \times 1000g = 1206g$$

Air has a mass of $1206g$ for $1m^3$. Next we write $1cm^3$ in terms of m^3:

$$1cm^3 = 1cm \times 1cm \times 1cm = 0.01m \times 0.01m \times 0.01m$$
$$= 1 \times 10^{-6} m^3$$

$1206\,g/m^3$ in g/cm^3 is:

$$1206 \times 1 \times 10^{-6} = 1206 \times 10^{-6}$$
$$= 1.206 \times 10^3 \times 10^{-6}$$
$$= \frac{1.206 \times 10^3}{10^6}$$
$$= \frac{1.206}{10^3}$$
$$= 1.206 \times 10^{-3}$$

Thus

$$1.206\,kg/m^3 = 1.206 \times 10^{-3}\,g/cm^3 \text{ (4 s.f.)}$$

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5. First we express $1cm^4$ in terms of m^4:

$$1cm^4 = 1cm \times 1cm \times 1cm \times 1cm$$
$$= 0.01m \times 0.01m \times 0.01m \times 0.01m$$
$$= 1 \times 10^{-8} m^4$$
$$0.63cm^4 = 0.63 \times 1 \times 10^{-8} m^4$$
$$= 6.3 \times 10^{-1} \times 10^{-8} m^4$$
$$= 6.3 \times 10^{-9} m^4$$
$$0.63cm^4 = 6.3nm^4 \quad (n = \text{nano} = 10^{-9})$$

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6. We first write $1 foot^2$ into m^2, how?
Since $1 foot = 0.305m$ we have
$$1 foot^2 = 1 foot \times 1 foot = 0.305m \times 0.305m$$
$$= 0.093025m^2$$
$$5 feet^2 = 5 \times 0.093025m^2$$
$$= 0.465m^2 \ (3 \text{ s.f.})$$

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7. (a) First we write 30 miles in terms of metres(m), how?
Since 1 mile $= 1.609$ km we have
$$30 \text{ miles} = 30 \times 1.609 \text{ km} = 48.27 \text{ km} = 48270 \text{ m}$$
Therefore 30 miles per hour = 48270 metres per hour. Since we want m/s we have to divide by $3600s$ (=1 hour):
$$\frac{48270}{3600} = 13.4$$
30 miles per hour = 13.4 m/s (3 s.f.)

(b) $80 km/h = \dfrac{80 \times 1000}{3600} m/s = 22.22 m/s$ (2 d.p.)

(c) 186000 miles per second $= 186000 \times 1.609$ km/s
$$= 299\,274 \text{ km/s}$$
$$= 299\,274 \times 1000 \text{ m/s}$$
$$= 299\,274\,000 \text{ m/s}$$
$$= 2.99 \times 10^8 \text{ m/s} \quad (3 \text{ s.f.})$$

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8. Elasticity is $0.2 \times 10^{11} N$ over an area of $1m^2$. How do we convert $1m^2$ into cm^2?
Using $1m = 100cm$ we have
$$1m^2 = 1m \times 1m = 100cm \times 100cm$$
$$= 1 \times 10^4 cm^2$$
Thus
$$0.2 \times 10^{11} \text{ N/m}^2 = (0.2 \times 10^{11} / 1 \times 10^4) \text{ N/cm}^2$$
$$= (0.2 \times 10^{11} / 10^4) \text{ N/cm}^2$$
$$= 2 \times 10^6 \text{ N/cm}^2$$
