Elastic strings and springs 3C

1 Work done $= \dfrac{\lambda x^2}{2l} = \dfrac{8\times 0.4^2}{2\times 0.6}$

$= 1.07\text{ J (3 s.f.)}$

2 Work done $= \dfrac{\lambda x^2}{2l} = \dfrac{4\times 0.2^2}{2\times 0.8}$

$= 0.1\text{ J}$

3 Work done $= \dfrac{10\times 0.6^2}{2\times 1.2} - \dfrac{10\times 0.3^2}{2\times 1.2}$

$= \dfrac{10}{2.4}(0.6^2 - 0.3^2)$

$= \dfrac{10}{2.4}\times 0.9\times 0.3$

$= 1.125\text{ J}$

4 a $\dfrac{20}{2\times 0.7}(0.2^2 - 0^2) = 0.571\text{ J (3 s.f.)}$

b $\dfrac{20}{2\times 0.7}(0.3^2 - 0.1^2)$

$= \dfrac{20}{1.4}\times 0.4\times 0.2 = 1.14\text{ J (3 s.f.)}$

c $\dfrac{20}{2\times 0.7}(0.7^2 - 0.5^2)$

$= \dfrac{20}{1.4}\times 1.2\times 0.2 = 3.43\text{ J (3 s.f.)}$

5 $(\uparrow)\ T = 2g$

$\dfrac{10x}{1.2} = 2g$

$x = \dfrac{2.4g}{10} = 0.24g$

Energy stored $= \dfrac{10\times(0.24g)^2}{2\times 1.2}$

$= 23.04\ldots$

Energy stored in the spring is 23 J (2 s.f.)

6 $(\uparrow)\ T = 2mg$

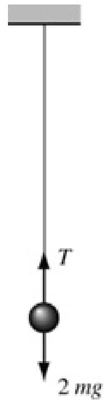
$\dfrac{\lambda\times 2a}{a} = 2mg$

$\Rightarrow \lambda = mg$

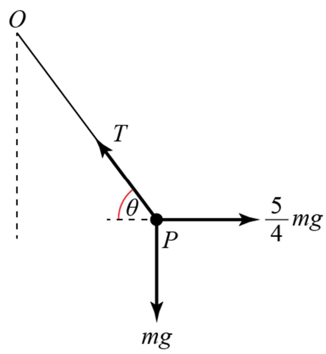
Energy stored $= \dfrac{\lambda x^2}{2l}$

$= \dfrac{mg(2a)^2}{2a}$

$= 2mga$



7 a

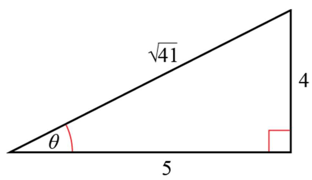


$(\rightarrow)\ T\cos\theta = \dfrac{5mg}{4}$

$(\uparrow)\ T\sin\theta = mg$

So, $\dfrac{T\sin\theta}{T\cos\theta} = \tan\theta = \dfrac{mg}{5mg/4} = \dfrac{4}{5}$

So, from the right-angled triangle:



$\sin\theta = \dfrac{4}{\sqrt{41}}$ and $\cos\theta = \dfrac{5}{\sqrt{41}}$

So, $T = \dfrac{mg}{\sin\theta} = \dfrac{mg}{4/\sqrt{41}} = \dfrac{\sqrt{41}mg}{4}$

The tension in the string is $\dfrac{\sqrt{41}mg}{4}$ N

7 b Using Hooke's law, $T = \frac{2mgx}{a}$

So $\frac{\sqrt{41}mg}{4} = \frac{2mgx}{a}$

and $x = \frac{\sqrt{41}}{8}a$

$$\text{Elastic energy stored } = \frac{\lambda x^2}{2l}$$
$$= \frac{2mg}{2a}\left(\frac{41a^2}{64}\right)$$
$$= \frac{41mga}{64}$$

The elastic energy stored is $\frac{41mga}{64}$ J