Principle of the conservation of mechanical energy

KE + GPE is constant if no external forces other than gravity do work on a particle.

The work energy principle

The change in the total energy of a particle is equal to the work done on the particle

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Work done = Force × distance

$= Fs$ J

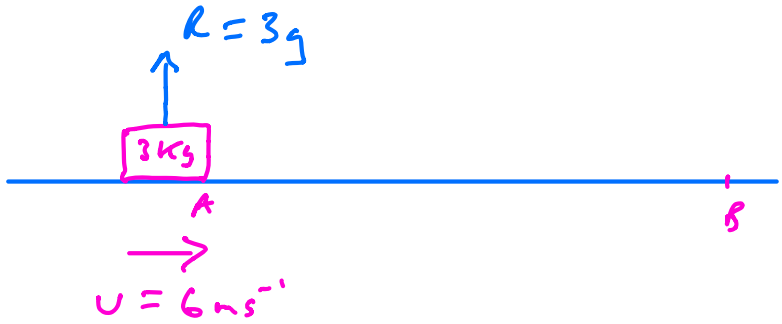
Power (Rate of doing work)

Power $= F\frac{ds}{dt} = Fv$ Js^{-1} = Watts

if F constant

Exercise 2C

Q5



$\mu = 0.4$

a) Loss in KE $\frac{1}{2}mu^2 - \frac{1}{2}mv^2$

$= \frac{1}{2} \times 3 \times 6^2 - 0$

$= 54\,J$

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b) Work-energy principle

work done against friction

= loss in KE $= 54\,J$

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c) Friction force $= \mu R$

Work done against friction $= 0.4 \times 3g \times s$

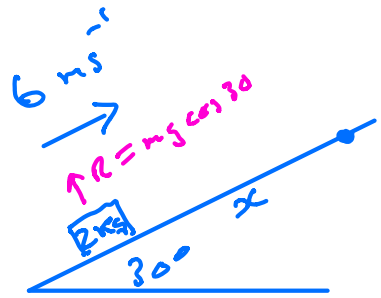
$54 = 0.4 \times 3 \times 9.8s$

$\frac{54}{(0.4 \times 3 \times 9.8)} = s$

$4.59 = s$

$AB = 4.59\,m$

Q15



$\mu = \frac{1}{3}$

Loss in KE = Gain in GPE + Work against Friction

$$\frac{1}{2}mu^2 = mgh + \mu R x$$

$$\frac{1}{2} \times 2 \times 6^2 = 2 \times 9.8 \times x \sin 30^\circ + \frac{1}{3} \times 2 \times 9.8 \cos 30 \times x$$

$$36 = 9.8x + \frac{\sqrt{3}}{3} \times 9.8x$$

$$\frac{36}{\left(9.8 + \frac{\sqrt{3}}{3} \times 9.8\right)} = x$$

$$x = 2.33 \text{ m}$$

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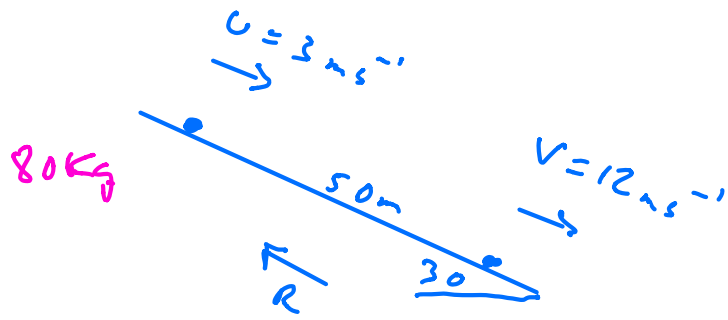
17)



Loss in GPE = Increase in KE + Work against Resistance

$$mgh = \left(\frac{1}{2}mv^2 - \frac{1}{2}mu^2\right) + 50R$$

$$80 \times 9.8 \times 50 \sin 30 = \frac{1}{2} \times 80\left(12^2 - 3^2\right) + 50R$$

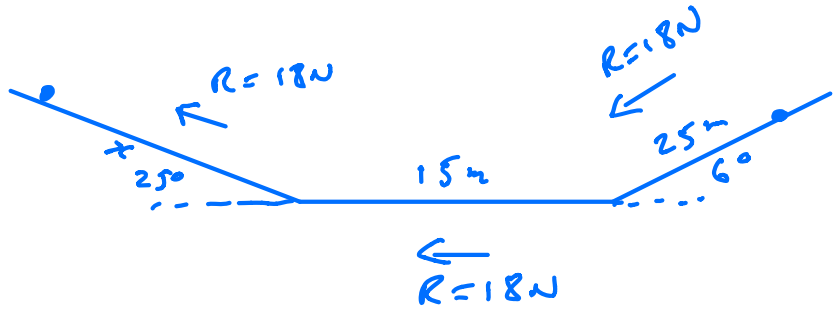
$$\frac{19600 - 5400}{50} = R$$

$$R = 284\ N$$

b) Let resistance be proportional to speed

Q12

40kg



Loss in GPE = Work done Against Resistance

$$mg \times x \sin 25^\circ - mg \times 25 \sin 6^\circ = 18 \times (x + 15 + 25)$$

$$40g \sin 25^\circ \times x - 40g \times 25 \sin 6^\circ = 18x + 18 \times 40$$

$$x(40g \sin 25^\circ - 18) = 18 \times 40 + 40g \times 25 \sin 6^\circ$$

$$x = \frac{18 \times 40 + 40g \times 25 \sin 6^\circ}{(40g \sin 25 - 18)}$$

$$x = 16.8\ m$$