Ex 3C

① PE lost $= 0.6 \times 9.8 \times 5 = 29.4$ J

Now KE gain = PE loss $\therefore \frac{1}{2} \times 0.6 \times v^2 = 29.4$

$v = 9.90 \text{ ms}^{-1}$

② (a) KE gained $= \frac{1}{2} \times 1 (20^2 - 0^2) = 200$ J

(b) PE lost = KE gained $= 200$ J

(c) $200 = 1 \times 9.8 \times h \quad \therefore h = 20.4$ M

③ (a) KE gained $= \frac{1}{2} \times 8 (5^2 - 3^2) = 64$ J

(b) Wd by force = KE gain $= 64$ J

(c) Wd $= F \times s \quad 64 = 16 \times s \quad s = 4$ M

④ (a) KE loss $= \frac{1}{2} \times 6 (0^2 - 5^2) = 75$ J

(b) Wd against fric = KE loss $= 75$ J

(c) $F = \mu R_n \quad R_n = mg = 6g \quad \therefore F = \frac{1}{3} \times 6g = 19.6$ N

Now wd against fric $= F \times s = 19.6 s = 75$

$\therefore s = 3.83$ M

⑤ (a) KE loss $= \frac{1}{2} \times 0.2 (5^2 - 10^2) = 7.5$ J.

(b) wd v's fric = KE loss $= 7.5$ J.

(c) wd v's fric $= F \times s$

$7.5 = F \times 9$

$F = 0.833$ N

Now $\mu = \frac{F}{R_n} = \frac{0.833}{0.2g} = 0.425$

⑥ PE lost $= 0.5 \times 9.8 \times 7 = 34.3$ J.

Now KE gained = PE lost

$\frac{1}{2} \times 0.5 \times v^2 = 34.3$

$v = 11.7 \text{ ms}^{-1}$

(7) gain in KE $= \frac{1}{2} \times 0.2(40^2 - 0^2) = 160$ J

Now loss in PE = gain in KE $0.2 \times 9.8 \times h = 160$ $\therefore h = 81.6$ M

(8) loss in KE $= \frac{1}{2} \times 0.01(0^2 - 400^2) = 800$ J

wd by Frictn $= F \times 5 = 0.04F$

Now wd by resist = loss in KE

$0.04F = 800$

$F = 20000$ N

(9) loss in KE $= \frac{1}{2} \times 0.02(0^2 - 500^2) = 2500$ J

wd by's Resist $= 36000 \times s$

Now wd by's res = loss in KE

$36000s = 2500$ $s = 69.4$ MM

(10) (a) PE lost $= 3 \times 9.8 \times 25 \sin 40 = 37.8$ J

(b) KE gained = PE lost $= 37.8$ J

(c) $\frac{1}{2} \times 3 \times V^2 = 37.8$ $V = 5.02$ ms^{-1}

(11) PE lost $= 5 \times 9.8 \times x \sin 30 = 24.5x$

& KE gained $= \frac{1}{2} \times 5 \times (4^2 - 0^2) = 40$ J

Now KE gained = PE lost $40 = 24.5x$

$\therefore x = 1.63$ M

(12) PE gained $= 0.4 \times 9.8 \times \frac{x \sin 35}{1} = 3.92x \sin 35$

KE lost $= \frac{1}{2} \times 0.4(0^2 - 12^2) = 28.8$

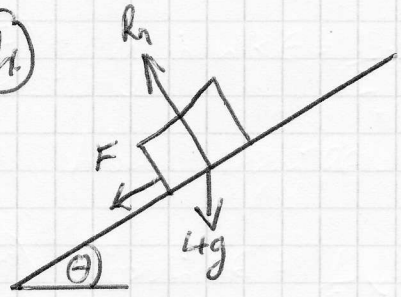
Now KE lost = PE gained $3.92 \sin 35\, x = 28.8$ $x = 12.8$ M

(13) PE gained $= 0.5 \times 9.8 \times 10 \sin\theta = 29.4$

KE lost $= \frac{1}{2} \times 0.5(0^2 - u^2) = 0.25u^2$

Now KE lost = PE gained $\therefore$ $0.25u^2 = 29.4$ $u = 10.8$ ms^{-1}

(14)

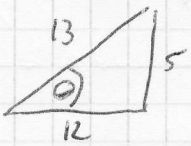


Gain in PE $= 4 \times 9.8 \times x \sin\theta = 15.1x$ J.

Loss in KE $= \frac{1}{2} \times 4 \times (0^2 - 8^2) = 128$ J

Wd by frict $= F \times x$

Now $F = \mu R_n = \frac{1}{4} \times 4g\cos\theta = \frac{12g}{13}$



$\therefore$ Wd by frict $= \frac{12g}{13} \times x$

Now particle comes to rest b'cos of wd by frict

$\therefore$ Wd by frict = energy loss = KE lost − PE gained

$$\frac{12g}{13}x = 128 - 15.1x$$

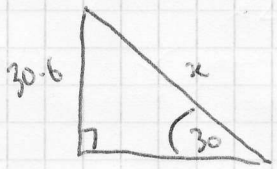
$$\frac{12g}{13}x + 15.1x = 128$$

$$x\left[\frac{12g}{13} + 15.1\right] = 128$$

$$x = 5.3 \text{ m}$$

(15) PE lost = KE gained $= \frac{1}{2} \times 90 \times (25^2 - 5^2) = 27\,000$ J.

Now $27\,000 = 90 \times 9.8 \times h$ $\therefore h = 30.6$ m



$x = \frac{30.6}{\sin 30} = 61.2$ m

(16) Cyclist's final level is zero P.E.

loss in KE = 0

loss in PE $= 80 \times 9.8 \times 80\sin\theta = 3136$ J

$\therefore$ loss in energy $= 3136 + 0 = 3136$ J

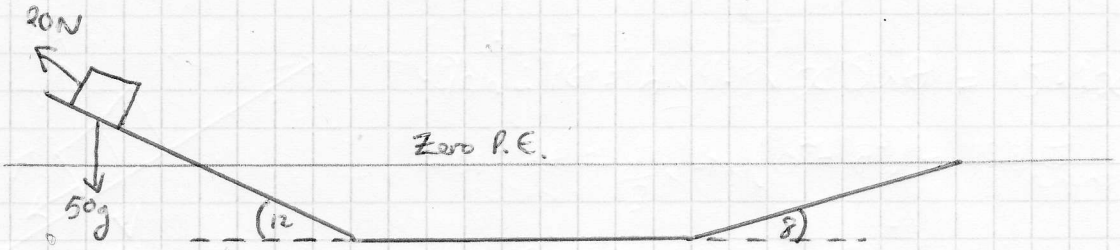
Now energy loss caused by wd v's resistance $= F \times 5 = F \times 160$

+ wd v's res = loss in energy

$\therefore$ $160F = 3136$

$$F = 19.6 \text{ N}$$

(17)



let dist down slope = x m

loss in PE = $50 \times 9.8 (x \sin 12 - 30 \sin 8)$

loss in KE = $\frac{1}{2} \times 50 (0^2 - 0^2) = 0$

∴ Total loss of energy = $490(x \sin 12 - 30 \sin 8)$

Wd v's resistances = $F \times S = 20 \times (x + 10 + 30) = 20(x + 40)$

Now Wd v's res = loss of energy

$\therefore \quad 20(x+40) = 490(x \sin 12 - 30 \sin 8)$

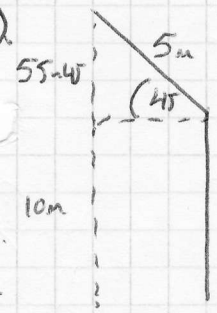
$x + 40 = x\,24.55 \sin 12 - 30 \times 24.55 \sin 8$

$x - x\,24.55 \sin 12 = -40 - 735 \sin 8$

$x[1 - 24.55 \sin 12] = -142.3$

$x = 34.8$ M

(18)



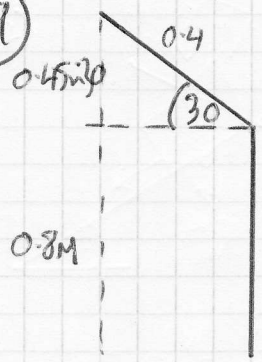
loss in PE = $M \times 9.8 \times (10 + 5 \sin 45)$

gain in KE = $\frac{1}{2} \times M \times (V^2 - 0)$

Now gain in KE = loss in PE $\quad \frac{1}{2} M (V^2) = M \times 9.8 (10 + 5 \sin 45)$

$V = 16.3 \text{ ms}^{-1}$

(19)



loss in P.E. $= M \times 9.8 \times (0.8 + 0.2) = 9.8M$ Joules

gain in KE $= \frac{1}{2}M(V^2 - 0^2) = \frac{MV^2}{2}$

wd v's frict $= F \times s = \mu Mg \cos 30 \times 0.4 = 0.49\sqrt{3}M$

Now Total energy lost = loss in PE − gain in KE = wd v's frict

$\therefore \quad 9.8M - \frac{MV^2}{2} = 0.49\sqrt{3}M$

$\frac{V^2}{2} = 9.8 - 0.49\sqrt{3}$

$V = 4.23 \text{ ms}^{-1}$

(a) gain in KE $= \frac{1}{2} \times 40(12^2 - 0^2) = 2880$ J

loss in P.E. $= 40 \times 9.8 \times 15 \sin\theta = 3528$ J

wd v's frict $= F \times s = F \times 15$

$F = \mu R_N = \mu 40g \cos\theta = 313.6\mu$

$\therefore$ wd v's frict $= 4704\mu$

Now total energy lost = wd v's frict

$3528 - 2880 = 4704\mu$

$\mu = 0.138$