MI JAN II

1) $\max$ height $=40 \mathrm{~m}$
a)

$$
\begin{aligned}
& a \uparrow=-9.8 \\
& S=40 \mathrm{~m} \\
& V \uparrow=0 \text { (at max heart) }
\end{aligned}
$$

$$
v^{2}=u^{2}+2 a s \Rightarrow 0=u^{2}-19.6 \times 40 \Rightarrow u^{2}=784
$$

$$
\Rightarrow u=28 \mathrm{~ms}^{-1}
$$

b)

$$
\begin{array}{ll}
u \uparrow=28 & s=u t+\frac{1}{2} a t^{2} \\
a \uparrow=-9.8 \quad 33.6=28 t-4.9 t^{2} \\
s \uparrow=33.6 \quad \Rightarrow 4.9 t^{2}-28 t+33.6=0 \\
t=\frac{28 \pm \sqrt{28^{2}-4(4.9)(33.6)}}{9.8} \quad t_{1}=4 \quad t_{2}=\frac{12}{7}
\end{array}
$$

$$
\text { (Total time above } \left.=4-\frac{12}{7}=\frac{16}{7} \mathrm{sec}\right)
$$

2) 



$$
\begin{aligned}
\text { CLM } & \Rightarrow 3(3)+2(-2)=3\left(V_{p}\right)+2\left(V_{p}+1\right) \\
& \Rightarrow 5=5 V_{p}+2 \\
& \Rightarrow \quad 5 V_{p}=3 \Rightarrow V_{p}=\frac{3}{5} \Rightarrow V_{q}=\frac{8}{5}
\end{aligned}
$$

Speed of $P=\frac{3}{5} m s^{-1} \quad$ Speed of $Q$ is $\frac{8}{5} m s^{-1}$
b)

$$
\begin{aligned}
& \text { Mom } P \text { before }=3(3)=9 \mathrm{Ns} \\
& \text { Mom } P \text { after }=3\left(\frac{3}{s}\right)=\frac{9}{\mathrm{~s}} \mathrm{Ns} \\
& \text { Impulse }=\text { change in Mom }=9-\frac{9}{s}=\frac{36}{\mathrm{~s}} \mathrm{Ns}
\end{aligned}
$$

3) 


$\mu=\frac{1}{2}$
point of shying down

$$
\not \subset \Rightarrow \text { fimax } K
$$

$$
\begin{align*}
& R F \uparrow=0 \Rightarrow N R=\frac{4}{5} w+\frac{12}{5} \quad \text { fax }=\mu N R=\frac{2}{5} w+\frac{6}{5} \\
& \begin{aligned}
& R+\uparrow=0 \Rightarrow f_{\text {max }}=\frac{3}{5} w-\frac{16}{5} \Rightarrow \frac{3}{5} w-\frac{16}{5}=\frac{2}{5} w+\frac{6}{5} \\
& \Rightarrow \frac{1}{5} w=\frac{22}{5} \Rightarrow W=22 N
\end{aligned} \\
& N R=\frac{4}{5}(22)+\frac{12}{5}=\frac{100}{5}=20 N \tag{ii}
\end{align*}
$$

4) 


b)


$$
\begin{gathered}
S=\frac{1}{2}(S)(60+64) \\
S=310 \mathrm{~m}
\end{gathered}
$$

c)


$$
\begin{gathered}
\frac{1}{2}(20)(s+v)=90 \\
\Rightarrow 5+v=9 \\
\Rightarrow V=4 M s^{-1}
\end{gathered}
$$

d)


$$
a c c=\frac{-1}{20} \Rightarrow \text { deceleration }=\frac{1}{20} \mathrm{~ms}^{-2}
$$

5) 



$$
\begin{aligned}
& R 2 N R \times 2+N R \times 8=20 g \times 4+40 g \times 6 \\
& \Rightarrow 10 N R=320 g \\
& \Rightarrow N R=32 g N
\end{aligned}
$$

$$
R f \uparrow=0 \Rightarrow 2 N R=60_{\mathrm{S}}+M g \Rightarrow 64 g=60_{\mathrm{g}}+M g \Rightarrow M=4 \mathrm{~kg}
$$

6) $\tan \alpha=\frac{3}{4}$

a) (P) $R f \uparrow=0 \Rightarrow N R=\frac{6}{259} \quad f_{\text {max }}=\mu N R=\frac{3}{259}$
b) (P)

$$
\begin{aligned}
R F^{\top}=m a & \Rightarrow T-\frac{9}{50} 9-\frac{3}{25} 9=0.3 \times 1.4 \\
& \Rightarrow T=\frac{21}{50}+\frac{15}{50} 9 \Rightarrow T=3.36 \mathrm{~N}
\end{aligned}
$$

c) $u^{\wedge}=0 \quad a^{\hat{A}}=1.4 \quad t=0.5 \quad v=u+a t \Rightarrow v=0.7 \mathrm{~ms}^{-1}$


$$
\begin{aligned}
-\frac{9}{509}-\frac{6}{50} 9=0.3 a \Rightarrow-0.39 & =0.3 a \\
\Rightarrow a & =-9 \mathrm{~ms}^{-2}
\end{aligned}
$$

$$
\begin{aligned}
& U N=0.7 \quad a^{\lambda}=-9.8 \quad v N=0 \\
& v=u+a t \Rightarrow 0=0.7-9.8 t \Rightarrow t=\frac{1}{14} \mathrm{sec}
\end{aligned}
$$

(Q)

$$
\begin{aligned}
R f \downarrow=m a \Rightarrow m g-3.36=m \times 1.4 & \Rightarrow 8.4 m=3.36 \\
& \Rightarrow m=0.4 \mathrm{ks}
\end{aligned}
$$

c) $u \hat{Q}=0 \quad a \hat{A}=1.4 \quad t=0.5 \quad v=u+a t \Rightarrow \quad v=0.7 \mathrm{~ms}^{-1}$


$$
\begin{aligned}
-\frac{9}{509}-\frac{6}{50} g=0.3 a \Rightarrow-0.3 g & =0.3 a \\
\Rightarrow a & =-9 \mathrm{~m}^{-2}
\end{aligned}
$$

$$
\begin{aligned}
& u N=0.7 \quad a^{\lambda}=-9.8 \quad v i=0 \\
& v=u+a t \Rightarrow 0=0.7-9.8 t \Rightarrow t=\frac{1}{14} \mathrm{sec}
\end{aligned}
$$

7) $\overbrace{3}^{\frac{\theta}{\theta} \underbrace{}_{4}}$

$$
\begin{aligned}
\theta=\tan ^{-1}\left(\frac{3}{4}\right) & =36.9^{\circ} \\
\Rightarrow \text { bearing } & =037^{\circ}
\end{aligned}
$$

b) position = original position + velocity $x$ time
(i) position $=(i+j)+(2 i-3 j) t \Rightarrow p=(1+2 t) i+(1-3 t) ;$
(ii) position $=(-2 j)+(3 i+4 j) t \Rightarrow q=3 t+(-2+4 t)$;
(iii) $\overrightarrow{P Q}=q-P=(3 t-1-2 t) i+(-2+4 t-1+3 t) j$

$$
=(t-1) i+(7 t-3) j
$$

c) Qis due North of $P$ when $i=0 \Rightarrow t=1 \Rightarrow 3$ pm
d) Ais due North-West op $P$ when $-i=j$

$$
\Rightarrow-(t-1)=7 t-3 \Rightarrow 8 t=4 \Rightarrow t=\frac{1}{2} \quad(2: 30 p m)
$$

