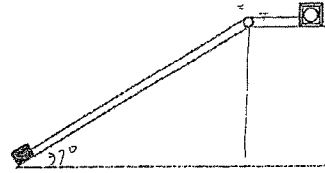


- ( ) 16. 如圖所示，一拖拉馬達放置於高 16 米的平台上，斜面光滑仰角 37 度，馬達拉繩最大加速度為  $2 \text{ m/s}^2$ ，輸出最大功率為 960 瓦特，今欲將一 20 公斤物體沿斜面拉至平台高度，請問最短時間為？(A) 3.3 (B) 4.4 (C) 5.5 (D) 6.5 (E) 7.5 秒



Sol: 5.45827 秒

- 限制
- (i)  $a \leq 2 \text{ m/s}^2$
  - (ii)  $P \leq 960 \text{ W}$

(1)  $0 \leq t \leq 3 \Rightarrow a = 2$

(2)  $t > 3 \Rightarrow P = 960 \Rightarrow F_{\text{拉}} \cdot v = 960$

$$F = ma \Rightarrow \left( \frac{960}{v} - mg \sin 37^\circ \right) = ma \Rightarrow \frac{960}{v} - 120 = 20 \frac{dv}{dt}$$

$$\Rightarrow \frac{dv}{dt} + \frac{48}{v} + 6 = 0 \quad (\text{這是微分方程})$$

}  $t = 3, v = 6$

```
Remove["Global`*"];
```

```
(* Find v(t): t=2sec v=?, t=4sec v=? *)
```

```
eq1 = v'[t] - 48/v[t] + 6;
```

```
sol = NDSolve[{eq1 == 0, v[3] == 6}, v, {t, 3, 10}];
```

```
v = v /. sol[[1]];
```

```
vel[t_] := 2*t /; t <= 3 (* a_max = 2 m/s^2 const *)
```

```
vel[t_] := v[t] /; t > 3 (* Power_max = 960W const *)
```

```
vel[2]
```

4

```
vel[4]
```

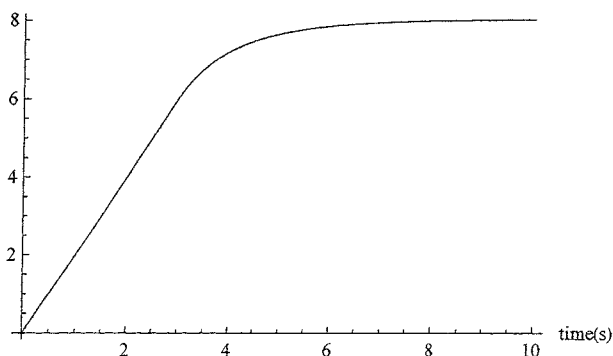
7.18537

```
vel[6]
```

7.83235

```
Plot[vel[t], {t, 0, 10}, AxesLabel -> {"time (s)", "velocity (m/s)"}]
```

velocity(m/s)



(\* Find dis(t): t=2sec d=?, t= 4sec d=? \*)

dis[t\_] := NIntegrate[vel[t0], {t0, 0, t}];

dis[2]

4.

dis[3]

9.

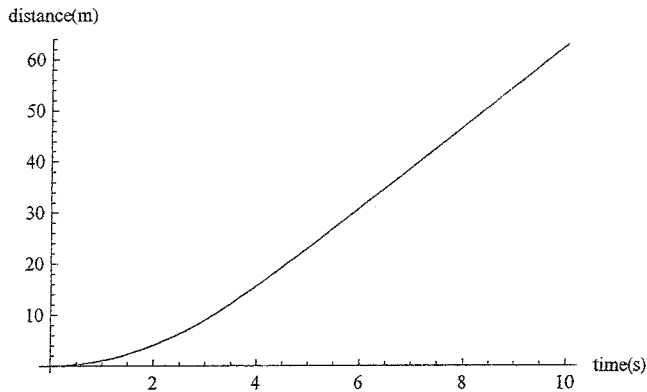
dis[4]

15.6975

dis[5]

23.1406

Plot[dis[t], {t, 0, 10}, AxesLabel -> {"time (s)", "distance (m)"}]



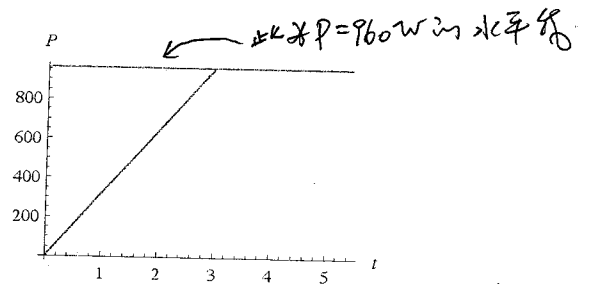
(\* Find time\*)

```
dend = 80. / 3;
timefind = FindRoot[dis[t] = dend, {t, 5}];
tend = t /. timefind;
Print["find T=", tend, "sec"];
Print["find v=", vel[tend], "m/sec"];
Print["find d=", dis[tend], "m"]
```

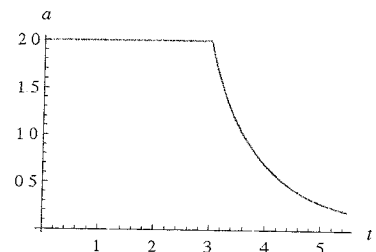
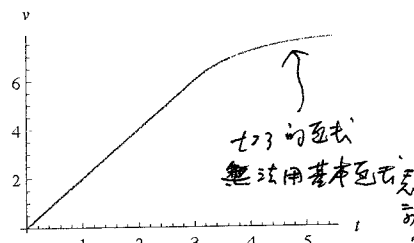
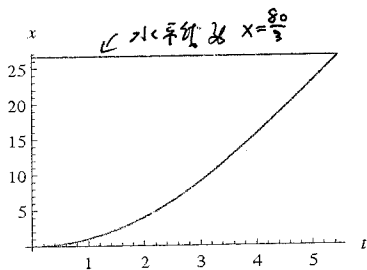
find T=5.45827sec

find v=7.74558m/sec

find d=26.6667m



此图, 由  $P = m(\frac{2}{5}g + a) \cdot v$  画出,  
目的: check t=3 的 P 是否为 960W.  
果然是



是一个内插函数

total time = 5.45827

x[ 5.45827 ] = 26.6667

80/3 = 26.6667