

QUESTION ONE

a.i. u

v

a -9.8

s -30 (down)

t 5

$$s = ut + \frac{1}{2}at^2$$

$$-30 = 5u + \frac{1}{2}(-9.8)(5)^2$$

$$5u = (4.9)(25) - 30$$

$$u = 18.5 \text{ ms}^{-1}$$

ii. u 18.5

v

a -9.8

s -30

t 5

$$v = u + at$$

$$v = 18.5 + (-9.8)(5)$$

$$v = -30.5 \text{ ms}^{-1}$$

b.i. 0-t

u u

v

a a

s p

t t

0-2t

u u

v

a a

s p+q

t 2t

0-3t

u u

v

a a

s p+q+r

t 3t

using $s = ut + \frac{1}{2}at^2$

$$p = ut + \frac{1}{2}at^2$$

$$p+q = 2ut + 2at^2$$

$$p+q+r = 3ut + \frac{9}{2}at^2$$

$$\Rightarrow q = 2ut + 2at^2 - ut - \frac{1}{2}at^2$$

$$\Rightarrow r = 3ut + \frac{9}{2}at^2 - ut - \frac{1}{2}at^2 - ut - \frac{3}{2}at^2$$

$$q = ut + \frac{3}{2}at^2$$

$$r = ut + \frac{5}{2}at^2$$

to prove $2q = p+r$

$$2q = 2\left(ut + \frac{3}{2}at^2\right)$$

$$p+r = ut + \frac{1}{2}at^2 + ut + \frac{5}{2}at^2$$

$$2q = 2ut + 3at^2$$

$$p+r = 2ut + 3at^2$$

$$\Rightarrow \boxed{2q = p+r}$$

Q.E.D.

ii. 0-3t

u u

v

a a

s p+q+r+x

t 4t

$$p+q+r+x = 4ut + 8at^2$$

$$\Rightarrow x = 4ut + 8at^2 - 2ut - 3at^2 - ut - \frac{3}{2}at^2$$

$$x = ut + \frac{7}{2}at^2$$

$$2r - q = 2\left(ut + \frac{5}{2}at^2\right) - \left(ut + \frac{3}{2}at^2\right)$$

$$= 2ut + 5at^2 - ut - \frac{3}{2}at^2$$

$$= ut + \frac{7}{2}at^2$$

$$\Rightarrow \boxed{x = 2r - q \text{ Q.E.D.}}$$