10th March 2017 - Revision Session
Worked Solutions.

Q1)a) $v_f = 27.8 ms^{-1}$ $\quad m_{vehicle} = 360kg$

$t = 4.6s$ $\quad m_{rider} = 82kg$

$m_{tot} = 442kg.$

i) $a = \frac{\Delta v}{t} = \frac{27.8}{4.6}$

$= 6.0 ms^{-2}$

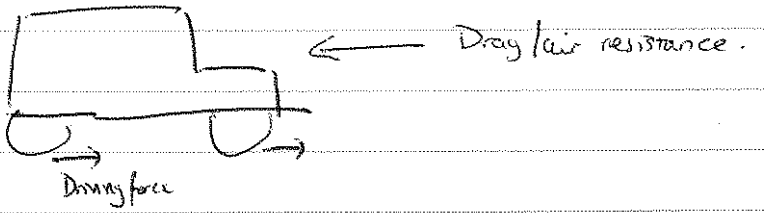
ii) $F = ma$

$= 442 \times 6.0$

$= 2700N$

b) As the velocity increases, the air resistance will increase. Therefore for the resultant force to stay the same the forward force would also have to increase.

c)



d) $F = \frac{P}{v}$

Speed constant so $F_{resist} = F_{drive}$

$F = \frac{22 \times 10^3}{55} = 400N$

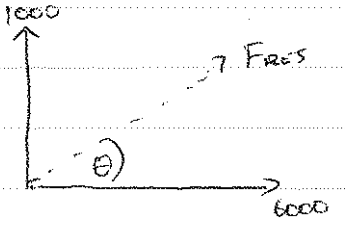
2)a) i) Vertical resultant force $F_{VER} = 1000N$ ↑ +ve

Horizontal resultant force $F_{HOR} = 6000N$ → +ve

$$|F_{res}| = \sqrt{1000^2 + 6000^2}$$

$$= 6083N \quad (6100N \text{ to } 2 \text{ s.f.})$$

ii)



$$\tan\theta = \frac{1000}{6000}$$

$$\theta = \tan^{-1}\left(\frac{1000}{6000}\right)$$

$$\theta = 9.5^\circ$$

iii) $m = W/g = 6500/9.81$

$= 660\,kg$

$a = F/m$ (from Newton's 2nd law

$a = 6100/660$

$a = 9.2\,ms^{-2}$

b) i) $E_p = mg\Delta h = W\Delta h$

$= 6500 \times 600$

$= 3.9 \times 10^6\,J$

ii) $E = Pt = 320 \times 10^3 \times 55$

$= 1.8 \times 10^7\,J$

Efficiency $= \frac{3.9 \times 10^6}{1.8 \times 10^7} = 0.22$

$= 22\%$

3)a) $m = 1300\ kg$ $F_{braking} = 6.2\ kN$

$F = ma$ (N2L)

$a = F/m = 6.2 \times 10^3 / 1300$

$= 4.8\ ms^{-2}$

b) $u = 27\ ms^{-1}$ $v = 0$

$a = -4.8\ ms^{-2}$ $s = ?$

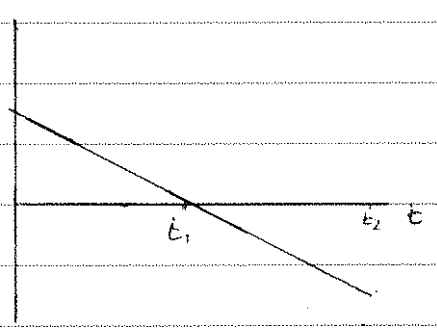
$v^2 = u^2 + 2as$

$s = \frac{v^2 - u^2}{2a} = \frac{0 - 27^2}{2 \times -4.8}$

$= 76\ m$

4a) i) Gradient.

ii)



b) i) As the ball exerts a force on the ground, the ball exerts an equal and opposite force on the ball.

ii) The downward force is due to the weight of the ball. The reaction force on the ball from the ground is greater than this downward force, causing a resultant upwards force.