1. (a) (i) a quantity that has magnitude only
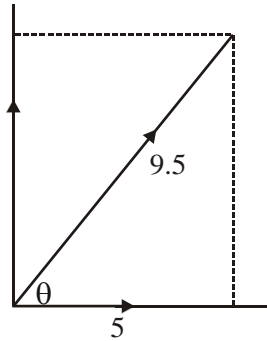[or has no direction]   **(1)**

(ii) any two: e.g. energy   **(1)**
temperature   **(1)**   3

(b) (i)

scale   **(1)**
5 N and 9.5 N   **(1)**
correct answer (8.1 N ± 0.2 N)   **(1)**

[or $9.5^2 = 5.0^2 + F^2$ **(1)**
$F^2 = 90.3 - 25$ **(1)**
$F = 8.1$ N   **(1)**   (8.07 N)]

(ii) $\cos\theta = \dfrac{5.0}{9.5}$
gives $\theta = 58°$ **(1)**   (± 2° if taken from scale diagram)   4

[7]

2. (a) (i)   right hand support
$W_p = 88$(N) and $W_x = 29$(N) **(1)**

$F = 44 + 29 = 73$ N **(1)**

left hand support

$F = 44$N **(1)**

(ii) right hand support, moments about left hand support

$88 \times 0.75 + 29 \times 0.5 = F \times 1.5$ gives $F = 54$ N **(1)**

left hand support

$F_L + F_R = 118$ (N) **(1)** so $F_L = 64$N **(1)**   6

[6]

3. (a) (i) horizontal component of the tension in the cable **(1)**

   (ii) vertical component of the tension in the cable **(1)**   2

   (b) (i) $T_{vert} = 250 \times 9.81 = 2500$ N **(1)**   (2452 N)

   (ii) $T_{horiz} = 1200$ N

   (iii) $T^2 = (1200)^2 + (2500)^2$ **(1)**
   $T = (1.44 \times 10^6 + 6.25 \times 10^6)^{1/2} = 2800$ N **(1)**   (2773 N)
   (if use of $T_{vert} = 2450$ N then $T = 2730$ N)

            (allow C.E. for values from (b) (i) and (b)(ii))

   (iv) $\tan \theta = \dfrac{1200}{2500}$ **(1)**
   $\theta = 26°$ **(1)**
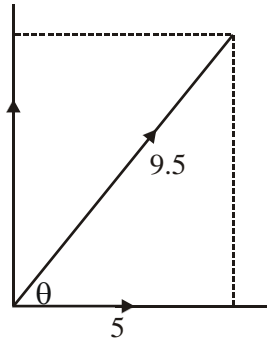   (allow C.E. for values from (b) (i) and (b)(ii))   6

   [8]

4. (a) component (parallel to ramp) $= 7.2 \times 10^3 \times \sin 30$ **(1)** $(= 3.6 \times 10^3$ N)   1

   (b) mass $= \dfrac{7.2 \times 10^3}{9.81} = 734$ (kg) **(1)**

   $a = \dfrac{3600}{734} = 4.9(1)$ m s^{-2} **(1)**   2

   (c) (use of $v^2 = u^2 + 2as$ gives) $0 = 18^2 - (2 \times 4.9 \times s)$ **(1)**
   $s = 33(.1)$ m **(1)**
   (allow C.E. for value of a from (b))   2

   (d) frictional forces are acting **(1)**
   increasing resultant force [or opposing motion] **(1)**
   hence higher deceleration [or car stops quicker] **(1)**
   energy is lost as thermal energy/heat **(1)** ☐   Max 2

   [7]

1. (a) (i) a quantity that has magnitude only
[or has no direction]   **(1)**

(ii) any two: e.g. energy   **(1)**
     temperature   **(1)**   3

(b) (i)

scale   **(1)**
5 N and 9.5 N   **(1)**
correct answer $(8.1 \text{ N} \pm 0.2 \text{ N})$ **(1)**

[or $9.5^2 = 5.0^2 + F^2$ **(1)**
$F^2 = 90.3 - 25$ **(1)**
$F = 8.1 \text{ N}$ **(1)**   (8.07 N)]

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left hand support

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$F_L + F_R = 118$ *(N)* **(1)** so $F_L = 64\text{N}$ **(1)**   6

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(iii) $T^2 = (1200)^2 + (2500)^2$ **(1)**
$T = (1.44 \times 10^6 + 6.25 \times 10^6)^{1/2} = 2800$ N **(1)**   (2773 N)
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(iv) $\tan \theta = \dfrac{1200}{2500}$ **(1)**
$\theta = 26°$ **(1)**
         (allow C.E. for values from (b) (i) and (b)(ii))   6

                                                                    [8]

4. (a) component (parallel to ramp) = $7.2 \times 10^3 \times \sin 30$ **(1)** (= 3.6×10^3 N)   1

(b) mass = $\dfrac{7.2 \times 10^3}{9.81}$ = 734 (kg) **(1)**

$a = \dfrac{3600}{734} = 4.9(1)$ m s^{-2} **(1)**   2

(c) (use of $v^2 = u^2 + 2as$ gives) $0 = 18^2 - (2 \times 4.9 \times s)$ **(1)**
$s = 33(.1)$ m **(1)**
(allow C.E. for value of a from (b))   2

(d) frictional forces are acting **(1)**
increasing resultant force [or opposing motion] **(1)**
hence higher deceleration [or car stops quicker] **(1)**
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                                                                    [7]