**Q2**   **(a)**    v comp decreases going up          **B1**
as gravitational force / acceleration is against motion or downwards
or -9.8 ms$^{-2}$ or is constant          **B1**
vertical comp is zero at P          **B1**

h comp no change          **B1**
as no resistive force/gravitational force has no effect          **B1**

v comp increases on way down          **B1**
as gravitational force / acceleration is in same direction as motion or
downwards or + 9.8 ms$^{-2}$ or is constant          **B1**

vertical comp more than horizontal at start but gets smaller than
horizontal as it goes up          **B1**

Penalise confusion of horizontal and vertical twice and then apply ecf

         **MAX 5**

**2**   **(b)**    k.e. decreases on way up / k.e. increases on the way down    **B1**
k.e. not zero at top of flight / k.e. min at P (top)          **B1**
p.e. increases on way up / p.e. max at P / decreases on way down **B1**
loss of ke =gain in pe at any point on flight / k.e. converted to p.e.   **B1**
k.e. = p.e halfway up / pe. + k.e. = constant          **B1**
k.e. the same as starting value at G          **B1**
p.e. zero at G / p.e. same as starting value at G          **B1**

         **MAX 4**

   **(c)**    air resistance/drag slows down the ball or reduces vertical or
horizontal component or reduces k.e.          **B1**
height reached is less          **B1**
range is less          **B1**
acceleration is no longer constant          **B1**
acceleration greater than g when going up or greater than − 9.8
going up or less than 9.8 coming down          **B1**
h comp reduces when going up and coming down          **B1**
k.e. at G less than k.e. at T / k.e. transfers to thermal          **B1**
terminal velocity (may be) reached on the way down          **B1**

         **MAX 3**

**QWC:**
Technical language: uses terms correctly such as vert. and horizontal components,
kinetic and potential energies, velocity force acceleration          **B1**
SPAG: written work has less than four errors in spelling, punctuation and sentence
formation, at least two sentences in each section          **B1**

         **Total: [14]**

**3**    **(a)**    (pulley wheel) at rest / in equilibrium / acceleration is zero      **B1**

     **(b)(i)**    500 N force down and general shape correct      **B1**
                angles correct (one angle labelled correctly)      **B1**
                $T_1$ and $T_2$ directions labelled correctly      **B1**
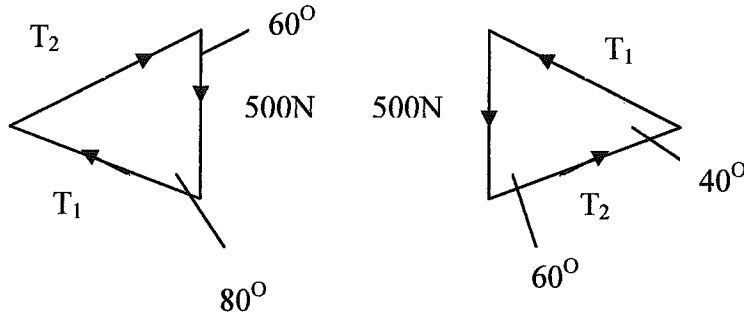


     **(ii)**    Formulae correct (resolving or sin rule) / scale diagram drawn correctly with scale
               given      **B1**
               $T_1 = 674$ (N) allow 650 to 700 for scale diagram      **A1**
               $T_2 = 766$ (N) allow 740 to 790 for scale diagram      **A1**

                                              **Total: [7]**

**Q4**    **(a)**    $P = F / A$      **C1**

            $F = 1.0 \times 10^5 \times 0.25 = 25000$ (N)      **A1**

     **(b)**    $\rho = m / V$      **C1**

            $m = 800 \times 0.25 \times 0.75 = 150$      **C1**

            $W = 1470$ (N)      **A1**

     **(c)**    26470 (N)      **B1**
                                 **Total: [6]**

**Q5**    **(a)(i)**    carries on going / carries on with the same velocity / slides forwards
                                             **B1**
               as there is no force to slow it down / (not enough) friction or resistance or restraining
               force      **B1**

         **(ii)**    arrow to the left      **B1**

     **(b)**    the seat belt produces the force (restraining force) / holds passenger in seat
                                               **B1**
            in the opposite direction to the motion of the car      **B1**
            stops the passenger continuing to move forward / hitting the front
            seats / windscreen in front / the driver is not hit from behind      **B1**
            seat belts stretch to increase the time/distance      **M1**
            hence force is reduced      **A1**

|  |  |
|---|---|
| seat belts have wide area | M1 |
| hence pressure reduced | A1 |

                                    **MAX 3**

                                    **Total: [6]**

**Q6**    **(a)(i)**    $F = kx$ / k is the gradient of the graph          **C1**

                    $k = 2.0 / 250 \times 10^{-3}$    $= 8.0$            **A1**

                    Correct unit for value given in (a)(i)
                    i.e. 0.008 or $8 \times 10^{-3}$ requires $N\ mm^{-1}$.
                    Allow $N\ m^{-1}$ / $kg\ s^{-2}$    if no working in (a)(i).
                    Do not allow unit mark if incorrect physics in part (a)(i)    **B1**

       **(ii)**      $W = \frac{1}{2}$ (F x extension) / area under the graph      **C1**
                        $= \frac{1}{2} \times 2.0 \times 0.250$
                           $= 0.25$ (J)                **A1**

   **(b)(i)**    $F = 8 \times 0.15 = 1.2$ (N)                **A1**

       **(ii)**      Hooke's law continues to be obeyed / graph continues as a straight
                   line  / k is constant / elastic limit has not been reached    **B1**

   **(c)(i)**    1. correct time marked on the graph with a V (t = 0.75 s or 1.75 s)   **B1**

                    2. tangent in the correct place for downward velocity or implied by values
                                                             **B1**
                    value between 0.95 to 1.1($m\ s^{-1}$)                 **A1**

       **(ii)**      1. X marked in a correct place (maximum or minimum on graph)    **M1**

                    2. relates the extension / compression to $F = kx$ to explain why the force is a
                    maximum or maximum extension gives max force or maximum extension gives max
                    acceleration                                        **A1**

                                       **Total: [12]**