1   (a   (i)   Straight line through origin   B1

            (ii)   Strain (energy) OR elastic (energy)   B1

      (b)   Use of $1/2mv^2$ C1
            $0.5 \times 2.5 \times v^2 = 0.48$ C1
            $v^2 = 0.48/(0.5 \times 2.5)$ OR $v^2 = 0.384$ C1
            $v = 0.62\,\text{m/s}$ A1

                                                                                                         [Total: 6]

2   (a   (i)   straight line between A and B   B1

            (ii)   limit of proportionality   B1

      (b)   (WD =) $\frac{1}{2}\,F \times d$ OR $F_{ave} \times d$ OR 6.0×0.030 OR 18 (J)   C1
            $0.18\,\text{J}$ A1

      (c)   (i)   ($x =$) 2.0 (cm) OR 6.0 – 4.0 OR $F = kx$ OR 4.0 (N/cm)   C1
                   $12.0 \times 2.0/3.0$ OR 4.0×2.0 OR 8.0 (N)   C1
                   $0.80\,\text{kg}$ OR 800 g   A

            (ii)   ($e =$) 1.0 (cm)   OR   ($\Delta e = -$)1.0 (cm)   C1
                   4.0 N   OR   4.0 N   A1

                                                                                                         [Total: 9]

3 **(a** strain / elastic (potential) (energy)   B1

  (b) **(i)** (KE =) $\frac{1}{2}mv^2$ in any form   C1

       1200 J   A1

  (ii) (G)PE (gained) = KE (lost) in any form   C1

       (G)PE = mgh OR h = PE ÷ mg in any form   C1

       1.8 m   e.c.f. from **(b)(i)**   A1

  (iii) friction with air OR air resistance OR thermal energy / heat produced/lost   B1

  (c) **(i)** limit of proportionality   B1

  (ii) Hooke's law   B1

4 **(a (i)** Hooke's Law   B1   [1]

     (ii) straight line (graph) / constant gradient   B1
         through origin/(0,0)   B1   [2]
         ignore through zero
         ignore extension proportional to load

  (b) curved extension to graph with increasing gradient, condone decreasing
      NOT if any part of curve is vertical/horizontal or has negative gradient   B1   [1]

[Total: 4]

5 **(a** extension (of spring) proportional to load / force (applied)
      OR load / force (applied) proportional to extension
      OR force = constant × extension
      OR extension = constant × force
      OR $F = kx$ in any form with symbols explained   B1

  (b) (graph is through the origin AND is a straight line / has a constant gradient   B1

     (ii) $F = kx$ in any form OR $(k =)$ F/x C1
         use of a point anywhere on graph e.g. 50 / 20
         2.5 N / mm OR 2500 N / m   A

     (iii) from 50 mm extension, graph curves with no negative gradient   B1

     (iv) straight line through origin with smaller gradient than graph shown finishing
          at more than 50 mm

[Total: 7]

6 **(a** (*W* =) *mg* **or** 0.25 × 10 **or** 250 × 10 **or** 2500   C1
   2.5 N   A1   [

   (b) (i) limit of proportionality **or** (the point where) proportionality between force and
              extension stops **or** Hooke's Law no longer obeyed (condone elastic limit)   B1   [1]

        (ii) gradient **or** numbers from graph divided e.g. 4.5 ÷ 10   C1
              0.45 N / cm **or** 45 N / m   A   [2]

   (c)   0 (N) **or** zero **or** no net force etc. (ignore absent unit; wrong unit loses mark)   B1   [1]

        (ii) 1.   0.9 N (accept 0.8 N < value < 1.0 N)   [1]
              2.   (a =) *F/m* **or** 0.90/0.12 (e.c.f. from **2(c)(i)**)   C
                    7.5 m / s^2 (e.c.f. from **2(c)(i)**)   A   [2]

                                                                                                                   [Total: 9]