

- 1     **(a) (i)** Straight line through origin B1
- (ii)** Strain (energy) OR elastic (energy) B1
- (b)** Use of  $\frac{1}{2}mv^2$  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)** 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  $h = PE \div mg$  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

- 3 (a) (i) straight line between A and B B1
- (ii) limit of proportionality B1
- (b) (WD =)  $\frac{1}{2} F \times d$  OR  $F_{\text{ave}} \times d$  OR  $6.0 \times 0.030$  OR 18 (J) C1  
 0.18 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  $4.0 \times 2.0$  OR 8.0 (N) C1  
 0.80 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]**

- 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 B1 [1]  
 NOT if any part of curve is vertical/horizontal or has negative gradient

**[Total: 4]**

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

- (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  
 2.5N/mm OR 2500N/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  $0.25 \times 10$  or  $250 \times 10$  or 2500  
2.5 N C1  
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.  $4.5 \div 10$   
0.45 N/cm or 45 N/m C1  
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  $0.8 \text{ N} < \text{value} < 1.0 \text{ N}$ ) [1]  
2.  $(a =) F/m$  or 0.90/0.12 (e.c.f. from 2(c)(i)) C  
7.5 m/s<sup>2</sup> (e.c.f. from 2(c)(i)) A [2]

**[Total: 9]**