Revision Sheet

A-Level Physics · Unit 6 Deformation of solids

6 vocabulary items · 25 marks of exam questions (8 questions)

Part 1 · Vocabulary review answer key. Section A wants the exact English spelling.

Question	Answer	Marks
1	tensile	1
2	extension	1
3	limit of proportionality	1
4	elastic	1
5	strain	1
6	Young modulus	1

Question 7 (Answer: **C**)

- Read the force at an extension of 4.0 cm from the graph: 30 kN.
- The energy stored is the area under the line, $\frac{1}{2}Fx$.
- $\frac{1}{2}(30 \times 10^3)(0.040) = 600$ J; D omits the factor of one half.

Question 8 (Answer: **B**)

- The area under the loading line is the work done stretching the rubber.
- The area under the unloading line is the work the rubber gives back.
- The area between them is the difference – energy dissipated as heat in the rubber.

Question 9 (Answer: **D**)

- The graph plots *length*, not extension, so subtract the natural length first.
- At $F = 0$ the length is 0.20 m and at $F = 2.4$ N it is 0.60 m, so the extension is 0.40 m.
- $k = F/x = 2.4/0.40 = 6.0$ N m^{-1}; C comes from dividing by the length 0.60 m instead.

Question 10 (Answer: **C**)

- Both curves start and finish at the origin: when the force returns to zero, so does the extension.
- That means the wire recovers completely, so the deformation at Q is still elastic.
- The loading line is curved, so Hooke's law fails along PQ; note the axes are swapped, so the work done to P is the area under the curve, not force × extension.

Question 11 (Answer: **A**)

- Stress is F/A, and both the load and the cross-section are the same, so the stresses are equal.
- The extensions differ and the lengths are equal, so the strains differ.
- Young modulus is a property of the material, so copper and steel differ there too.

Question 12 (Answer: **D**)

- The limit of proportionality is set by the *stress*, so the force at which it occurs is unchanged.
- A wire of twice the length stretches twice as far for the same force, since $x = FL/AE$.
- So the new point sits at the same height on the force axis but at double the extension.

13(a)	ratio of stress to strain
13(b)(i)	$R_0 = \rho L / A$
13(b)(ii)	$k = F / x$
	$E = FL / Ax = ((F / x) \times (L / A)) = kL / A$ leading to $k_0 = EA / L$
13(c)(i)	straight line with positive gradient starting at (0, R_0)
13(c)(ii)	straight horizontal line starting at (0, k_0)
13(d)(i)	$L = [0.034 \times \pi \times (0.80 \times 10^{-3})^2] / 1.8 \times 10^{-8} = 3.8$ (m)
13(d)(ii)	$k = [1.3 \times 10^{11} \times \pi \times (0.80 \times 10^{-3})^2] / 3.8$ **or** $k = EA / [RA / \rho] = E\rho / R$ $= [1.3 \times 10^{11} \times 1.8 \times 10^{-8}] / 0.034$
	$k = 6.9 \times 10^4$ N m^{-1}

14(a)(i)	$\sigma = F / xy$
14(a)(ii)	$\varepsilon = (z - w) / w$
14(a)(iii)	$E = \sigma / \varepsilon$
	$= Fw / xy(z - w)$
14(b)(i)	extension = 2.2 mm (*allow* 2.0–2.4 mm)
14(b)(ii)	strain energy = area under graph/line **or** $\frac{1}{2}Fx$ **or** $\frac{1}{2}kx^2$
	$= \frac{1}{2} \times 120 \times 1.4 \times 10^{-3}$ **or** $\frac{1}{2} \times 8.6 \times 10^4 \times (1.4 \times 10^{-3})^2$
	= 0.084 J
14(b)(iii)	(some of the) deformation of the wire is plastic/permanent/not elastic **or** wire goes past the elastic limit/enters plastic region
	energy (that cannot be recovered) is dissipated as thermal energy/becomes internal energy