Deformation of Solids

Mark Scheme 4

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Deformation of Solids
Sub Topic	
Paper Type	Theory
Booklet	Mark Scheme 4

Time Allowed: **57 minutes**

Score: **/47**

Percentage: **/100**

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 **(a) (i)** F / A B1 [1

(ii) $\Delta L / L$ B1 [1

(iii) allow $FL / A\Delta L$ B1 [1]

(iv) allow $\rho L / A$ or $\rho(L + \Delta L) / A$ B1 [1]

(b) (i) $\Delta L = FL / EA$
$= (30 \times 2.6) / (7.0 \times 10^{10} \times 3.8 \times 10^{-7})$ M1
$= 2.93 \times 10^{-3}$ m = 2.93 mm A0 [1]

(ii) $\Delta R = \rho \Delta L / A$ C1
$= (2.6 \times 10^{-8} \times 2.93 \times 10^{-3}) / (3.8 \times 10^{-7})$
$= 2.0 \times 10^{-4}\ \Omega$ A1 [2]

(c) change in resistance is (very) small M1
so method is not appropriate A1 [2]

2 **(a)** energy = average force × extension B1
$= ½ \times F \times x$ B1
(Hooke's law) extension proportional to (applied) force B1
hence $F = kx$ B1
so $E = ½kx^2$ A0 [4]

(b) (i) correct area shaded B1 [1]

(ii) 1.0 cm^2 represents 1.0 mJ or correct units used in calculation C1
$E_S = 6.4 \pm 0.2$ mJ A2 [3]
(for answer > ±0.2 mJ but ≤ ±0.4 mJ, then allow 2/3 marks)

(iii) arrangement of atoms / molecules is changed B1 [1]

3

crystalline:	atoms / ions / particles in a regular arrangement / lattice			
	long range order / orderly pattern		B1	
	(lattice) repeats itself	(1)		
polymer:	long chain molecules / chains of monomers		B1	
	some cross-linking between chains / tangled chains	(1)		
amorphous:	disordered arrangement of molecules / atoms / particles		B1	
	any ordering is short-range	(1)		
	(*three 'B' marks plus any other 2 marks*)		B2	[5]

4 **(a) (i)** Fig. 5.2 B1 [1]

(ii) Fig. 5.3 B1 [1]

(b) kinetic energy increases from zero then decreases to zero B1 [1]

(c) (i) $\Delta E_P = mg\Delta h$ / mgh C1

$= 94 \times 10^{-3} \times 9.8 \times 2.6 \times 10^{-2}$ using $g = 10$ then –1

$= 0.024\,J$ A [2]

(ii) *either* $0.024 = ½\,k \times (2.6 \times 10^{-2})^2$ *or* $½\,kd^2 = ½k \times (2.6 \times 10^{-2})^2 - ½kd^2$ C1

$0.012 = ½k \times d^2$ $kd^2 = ½k \times (2.6 \times 10^{-2})^2$ C1

$d = 0.018\,m$ $d = 0.018\,m$

$= 1.8\,cm$ $= 1.8\,cm$ A1 [3]

5 **(a** *either* energy (stored)/work done represented by area under graph
or energy = <u>average</u> force × extension …… B1
energy = ½ × 180 × 4.0 × 10^{-2} …… C1
= 3.6 J …… A1 [3]

(b) (i) *either* momentum before release is zero …… M1
so sum of <u>momenta</u> (of trolleys) after release is zero …… A1
or force = rate of change of momentum (M1)
force on trolleys equal and opposite (A1)
or impulse = change in momentum (M1)
impulse on each equal and opposite (A1) [2]

(ii) 1 $M_1V_1 = M_2V_2$ …… [1]

2 $\underline{E} = ½ M_1V_1^2 + ½ M_2V_2^2$ …… B1 [1]

(iii) $E_K = ½mv^2$ and $p = mv$ combined to give ……
$E_K = p^2 / 2m$ …… A0 [1]

2 m smaller, E_K is larger because p is the same/constant …… M1
so trolley B …… A0 [1]

6 **(a) (i)** Young modulus = stress/strain …… C1
data chosen using point in linear region of graph …… M1
Young modulus = $(2.1 \times 10^8)/(1.9 \times 10^{-3})$
= 1.1×10^{11} Pa …… A1 [3]

(ii) This mark was removed from the assessment, owing to a power-of-ten inconsistency in the printed question paper.

(b) area between lines represents energy/area under curve represents energy .. M1
when rubber is stretched and then released/two areas are different …… A1
this energy seen as thermal energy/heating/difference represents energy released as heat …… A1 [3]