Chapter 11 Past Paper Questions - Answers

1. (a) density = $\frac{\text{mass}}{\text{volume}}$ **(1)** 1

(b) (i) volume of copper = $\frac{70}{100} \times 0.8 \times 10^{-3}$ (= 0.56×10^{-3} m^3)

(volume of zinc = 0.24×10^{-3} m^3)

mc (= $\rho_C V_C$) = $8.9 \times 10^3 \times 0.56 \times 10^{-3}$ = 5.0 kg **(1)** (4.98 kg)

$m_Z = \frac{30}{100} \times 0.8 \times 10^{-3} \times 7.1 \times 10^3$ = 1.7 (kg) **(1)**

(allow C.E. for incorrect volumes)

(ii) m_b (= 5.0 +1.7) = 6.7 (kg) **(1)**

(allow C.E. for values of m_C and m_Z)

$\rho_b = \frac{6.7}{0.8 \times 10^{-3}}$ = 8.4×10^3 kg m^{-3} **(1)**

(allow C.E. for value of m_b)

[or ρ_b = (0.7 × 8900) + (0.3 × 7100) **(1)** = 8.4×10^3 kg m^{-3} **(1)**] max 4

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2. (a) the force (needed to stretch a spring is directly) is proportional to the extension (of the spring from its natural length) or equation with all terms defined **(1)**

up to the limit of proportionally **(1)** 2

(b) (i)

QWC	**descriptor**	**mark range**
good-excellent	The candidate provides a comprehensive and coherent description which includes all the necessary measurements in a logical order. The description should show awareness of the need to use a range of standard masses. In addition, the use of the measurements is explained clearly, including an outline of a graphical method to find the mass of the rock sample, or calculation using two or more standard masses and averaging. For 6 marks there must be a description of how to make accurate measurements.	**5-6**
modest-adequate	The candidate's description includes the necessary measurements using one standard mass as well as the rock sample. The description may not be presented in a logical order and they show little consideration in relation to making the measurements accurately. A clear explanation is provided of how to find the mass of the rock sample from their measurements, including correct use of Hooke's law through calculations or inadequate graphical method.	**3-4**
poor-limited	The candidate knows the necessary measurements to be made using a standard mass and the rock sample. The explanation of how to find the mass of the rock sample may be sketchy.	**1-2**

The explanations expected in a competent answer should include a coherent account of the following measurements and their use

measurements

(use a metre rule to) measure the length of the spring **(1)**

when it supports a standard mass (or known) mass (*m*) and when it supports the rock sample

repeat for different (standard) masses

accuracy – use a set square or other suitable method to measure the position of the lower end of the spring against the (vertical) mm rule or method to reduce parallax

use of measurements

either

plot graph of mass against length (or extension) **(1)**

read off mass corresponding to length (or extension) due to the sample **(1)**

or

the extension of the spring = length – unstretched length **(1)**

mass of rock sample = $\frac{\text{extension of spring supporting rock sample}}{\text{extension of spring supporting known mass}} \times M$ **(1)**

(ii) use a (G) clamp (or suitable heavy weight) to fix/clamp the base of the stand to the table **(1)**

clamp (or weight) provides an anticlockwise moment (about the edge of the stand greater than the moment of the object on the spring)/ counterbalances (the load) **(1)**

or adjust the stand so the spring is nearer to it **(1)**

so the moment of the load is reduced (and is less likely to overcome the anticlockwise moment of the base of the stand about the edge of the stand) **(1)**

or turn the base of the stand/rotate the boss by 180° **(1)**

so the weight of the load acts through the base **(1)** 2

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3. (a) Hooke's law: the extension is proportional to the force applied **(1)** up to the limit of proportionality or elastic limit [or for small extensions] **(1)** 2

(b) (i) (use of $E = \frac{F}{A}\frac{l}{e}$ gives) $e_s = \frac{80 \times 0.8}{2.0 \times 10^{11} \times 2.4 \times 10^{-6}}$ **(1)**

$= 1.3 \times 10^{-4}$ (m) **(1)** (1.33×10^{-4} (m))

$e_b = \frac{80 \times 1.4}{1.0 \times 10^{11} \times 2.4 \times 10^{-6}} = 4.7 \times 10^{-4}$ (m) **(1)** (4.66×10^{-4} (m))

total extension = 6.0×10^{-4} m **(1)**

(ii) $m = \rho \times V$ **(1)**

$m_s = 7.9 \times 10^3 \times 2.4 \times 10^{-6} \times 0.8 = 15.2 \times 10^{-3}$ (kg) **(1)**

$m_b = 8.5 \times 10^3 \times 2.4 \times 10^{-6} \times 1.4 = 28.6 \times 10^{-3}$ (kg) **(1)**

(to give total mass of 44 or 43.8×10^{-3} kg) 7

(c) (use of $m = \rho A l$ gives) $l = \frac{44 \times 10^{-3}}{8.5 \times 10^3 \times 2.4 \times 10^{-6}}$ **(1)**

= 2.2 m **(1)** (2.16 m)

(use of mass = 43.8×10^{-3} kg gives 2.14 m) 2

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