Question Number	Answer	Mark
17(a)	• Use of Young modulus = gradient (of either initial linear region of graph) (1) (MP1 accept ratios of co-ordinates up to strains of (E_{28})0.0015 or (E_2) 0.0014) • See 3.2 to 3.3 × 10^{10} (Pa) **Or** 4.2 to 4.4 × 10^{10} (Pa) (1) • Comparison of the two values obtained i.e. use of E_{28}/E_2 **Or** $(E_{28} - E_2)/E_2$ (1) • E_{28}/E_2 = 1.30 to 1.40 **Or** $(E_{28} - E_2)/E_2$ = 0.30 to 0.40 (1) (MP4 is conditional on candidates using the linear sections for both graphs in MP1) <u>Example of calculation</u> $E_{28} = \frac{140 \times 10^6 \text{ Pa}}{0.0032} = 4.38 \times 10^{10}$ Pa $E_2 = \frac{104 \times 10^6 \text{ Pa}}{0.0032} = 3.25 \times 10^{10}$ Pa $E_{28}/E_2 = \frac{4.38 \times 10^{10} \text{ Pa}}{3.25 \times 10^{10} \text{ Pa}} = 1.35$	**4**
17(b)	• Use of counting squares or approximation of the area to a series of shapes from the 28-day graph (1) • $\frac{0.35 \times 10^6 - \text{area under 28-day graph}}{0.35 \times 10^6}$ (1) • Percentage reduction = 12.0 % to 15.0 % (1) <u>Example of calculation</u> ΔE_{28} = (½×80 × 10^6 Pa×0.0019) + [½(80 + 128) Pa × 10^6 × (0.0038 – 0.0019)] + (64 ×0.0001 × 4 × 10^6 Pa) = 299 200 J m^{-3} Percentage reduction = $\frac{350\,000 \text{ J m}^{-3} - 299\,200 \text{ J m}^{-3}}{350\,000 \text{ J m}^{-3}} \times 100 = 14.5$ %	**3**

17(c)	• The breaking stress/force is greater (1) • The concrete is less flexible **Or** the concrete is stiffer (Do not accept a greater Young modulus) (1) • There is a smaller plastic region **Or** the elastic region is greater **Or** there's little change in the toughness **Or** a change in the properties of the concrete after you've used it could cause problems (1)	**3**
	Total for question 17	**10**