Name of the Student:_____
Max. Marks : 17 Marks **Time : 17 Minutes**

Mark Schemes

Q1.

Question Number	Acceptable answers		Additional guidance	Mark
(i)	• use of strain = extension / length	(1)	Example of calculation Change in length = $1.2 \times 10^{-21} \times 4000$ m = 4.8×10^{-18} m Fraction of proton diameter = 4.8×10^{-18} m ÷ 8.8×10^{-16} m = 0.0055	3
	• change in length = 4.8×10^{-18} (m) **Or** max strain for 0.001× proton size = 2.2×10^{-22}	(1)		
	• comparison of their change in length to 8.8×10^{-19}(m) **Or** comparison of their max strain to 1.2×10^{-21}	(1)		

Question Number	Acceptable answers		Additional guidance	Mark
(ii)	• half wavelength path difference means waves in antiphase	(1)	Do not accept 'out of phase' for MP1	4
	• so destructive interference takes place	(1)		
	• this results in zero amplitude, (so no signal detected)	(1)		
	• a change in length will result in a change in path difference, so signal detected **Or** a change in length will result in a change in phase difference, so signal detected	(1)	Accept reference to being 'not out of phase' for MP4	

Question Number	Acceptable answers		Additional guidance	Mark
(iii)	• if initially the path difference is zero there will be a maximum signal	(1)	MP2 alternative: a change from minimum amplitude would represent a much larger percentage (therefore more sensitive) MP2 Accept 'it is easier to detect the change from no light to light' MP2 Accept suitable reference to uncertainty	2
	• a change from max amplitude would represent a much smaller percentage (therefore less sensitive)	(1)		

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Q2.

Question Number	Acceptable Answers	Additional guidance	Mark
	• Use of $E = \frac{stress}{strain}$ **and** $stress = \frac{F}{A}$ (1) • 5.5×10^{-2} m^2 (1)	Example of calculation Stress $= 1.8 \times 10^{11} \times 0.005 = 9.0 \times 10^8$ N m^{-2} $A = \frac{5.0 \times 10^6 \text{kg} \times 9.81 \text{N kg}^{-1}}{9.0 \times 10^8 \text{ N m}^{-2}}$ $= 5.45 \times 10^{-2}$ m^2	**2**

Question Number	Acceptable Answers	Additional guidance	Mark
	• load needs to be accelerated upwards (1) • so greater force/stress/tension in cables (1) • a greater area decreases the stress (1)		**3**

Q3.

Question Number	Acceptable answers	Additional guidance	Mark
	An explanation that makes reference to the following points: • High viscosity oil will mean a large resistive force applied to the oscillations **(1)** • (When piston moves) a large amount of work will be done **(1)** • (Heavy damping so) energy of oscillation is quickly dissipated to the oil **(1)**	May refer to to $F = 6\pi\eta rv$ Mar refer to $\Delta W = F\Delta s$	**3**

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