Young's Modulus Mark Scheme

Q1.

Question Number	Acceptable answers	Additional guidance	Mark
	C		1

Q2.

Question Number	Acceptable Answers	Additional Guidance	Mark
	B		1

Q3.

Question Number	Acceptable Answers	Additional guidance	Mark
i	For the 30-year-old • greater stress for a given strain **Or** greater Young Modulus **Or** stiffer **Or** max deformation of the 23-year-old lens is greater **Or** breaking stress of 30-year-old lens is greater (1)	Accept answers for the 23-year-old	1
ii	• Reference to the graph consistent with their answer to (i) (1)		1

Q4.

Question Number	Acceptable answers		Additional guidance	Mark
(b)	An explanation that makes reference to the following points: • Weight of blanket decreases as it dries	(1)	Allow mass for weight	
	• Tension in line decreases	(1)		
	• So stress decreases and Young modulus is constant so strain decreases	(1)		
	• extension decreases **Or** line gets shorter	(1) (1)	MP4 dependent on MP3 MP5 dependent on MP4	5
	• height of the blanket from the ground increases			

Q5.

Question Number	Acceptable Answers		Additional guidance	Mark
	• Young modulus of steel > young modulus of wood **Or** steel is stiffer **Or** greater stress for a given strain **Or** less strain under the same stress	(1)	Answers must a comparison between steel and wood	5
	• So there are less changes in dimensions under a given force for steel	(1)	Accept deformation for changes in dimension	
	• Breaking stress of steel > breaking stress of wood **Or** steel is stronger **Or** steel withstands greater forces without breaking	(1)	MP3 accept UTS steel > UTS wood	
	• steel can withstand a larger force/weight than wood of the same (cross-sectional) area **Or** Under the same force/weight steel can have a smaller (cross-sectional) area than wood	(1)		
	• Steel coasters can be built that withstand the larger forces from faster cars **Or** (taller tracks can be built because) steel tracks can have smaller dimensions	(1)		

Q6.

Question Number	Acceptable answers	Additional guidance	Mark
	• X is brittle at greater stresses/forces (1) • Y will deform plastically at greater stresses/forces (1) • The Young modulus for X is greater than Y (1) • A screen made from material Y would be more suitable as it is more flexible (1)	Accept converse for MP3 and MP4 MP4: accept less stiff for flexible.	4

Q7.

Question Number	Acceptable Answers	Additional guidance	Mark
	• Steel had a lower fracture toughness due to the low temperature (1) • at low temperatures less energy is absorbed before fracture (1) • the (absorbed) energy was sufficient to cause fracture (1)		3

Q8.

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

Q9.

Question Number	Acceptable answers	Additional guidance	Mark
(b)	An answer that makes reference to the following: • Shrilk has less strain for same stress (1) **Or** Shrilk is stiffer • Shrilk breaks at a higher stress (compared to polythene) (1) **Or** Shrilk can withstand a greater stress/force/load/weight **Or** Shrilk is stronger • Shrilk doesn't stretch as much (for a given force) (1)	It should be clear from the student's answer that shrilk is the better material Ignore references to Young modulus, renewable, biodegradable, cost Accept converse arguments for polythene	3

Q10.

Question Number	Acceptable Answer	Additional Guidance	Mark
(a)	• As graphene is only 1 atom thick so the CSA/thickness is far smaller than for a sample of steel **Or** most applications need a thickness greater than one atom **Or** if more than one layer of graphene is used it will be weaker or the bonds between the layers will not be strong **Or** Graphene is difficult to manufacture because it has only one atomic layer (1) • Although graphene has a greater breaking stress it will break at a lower force (1)	MP1: accept graphene can only be 1 atom thick but steel can be any thickness (MP1, treat references to cost/energy as neutral)	2

Q11.

Question Number	Answer	Additional Guidance	Mark
	Max three Elderly bone: • lower gradient showing the bone is under more strain for a given stress (1) • graph ends at a lower stress showing it has a lower breaking stress (1) • Area under graph is smaller as less energy is absorbed before fracture (1) • Graph is shorter showing less plasticity (1)	Accept answer with respect to healthy bone Accept more brittle	3

Q12.

Question Number	Acceptable answers	Additional guidance	Mark
	• The tension in each of the remaining cables would increase **Or** Total force remains the same, but the total cable area decreases (1) • (The area of each cable doesn't change) so the stress in each cable would increase (1) • With an increased stress, the strain of each cable would increase so the extension would be greater. (1)		3

Q13.

(ii)	**MAX THREE** • Stress and strain are no longer proportional **Or** Fibre no longer obeys Hooke's law (1) • Fibres are stretched irreversibly (1) • Smaller change in stress to strain **Or** Larger change in strain to stress **Or** Collagen fibres becomes less stiff (1) • Collagen fibres break when stress = 8.0 N m^{-2} **Or** Collagen fibres break when strain = 0.08 (1)		3