

**GCE**

**Physics A**

Advanced GCE **2825/02**

Health Physics

**Mark Scheme for June 2010**

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<b>Abbreviations, annotations and conventions used in the Mark Scheme</b>	/ = alternative and acceptable answers for the same marking point ; = separates marking points NOT = answers which are not worthy of credit ( ) = words which are not essential to gain credit _____ = (underlining) key words which <b>must</b> be used to gain credit ecf = error carried forward AW = alternative wording ora = or reverse argument			
<b>Question</b>	<b>Expected Answers</b>			<b>Marks</b>
<b>1(a)</b>	The <u>nearest</u> point that an eye can <u>focus</u> on comfortably Or the closest distance of distinct vision / awtte			<b>1</b>
<b>(b) (i)</b>	$p = 1 / f$ $59.0 = 1 / f$			<b>1</b> <b>1</b>
<b>(ii)</b>	$f = 1.69 \times 10^{-2} \text{ m}$ (allow $1.7 \times 10^{-2} \text{ m}$ )			<b>1</b>
<b>(iii)</b>	$1 / u + 1 / v = 1 / f$ $1 / 1.69 \times 10^{-2} + 1 / 0.45 = 1 / 0.0169$ 61.2 D (allow 61.2 if $1/u = 59$ )			<b>1</b> <b>1</b> <b>1</b>
<b>(c)</b>	$p = 1 / u + 1 / v$ $p = 1 / 0.0169 + 1 / 0.25$ $p = 63.17 \text{ D}$ (allow 63)			<b>0</b> <b>0</b> <b>1</b>
<b>(d)(i)</b>	$p = 59.0 + 1 / 0.45$ $p = 61.22 \text{ D}$ $63.17 \text{ D} - 61.22 \text{ D}$ $= 1.95 \text{ D}$ (allow 1.8 D)			<b>0</b> <b>1</b> <b>0</b> <b>1</b>
<b>(ii)</b>	convex			<b>1</b>
<b>(iii)</b>	long sight			<b>1</b>
				<b>Total: 12</b>

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<b>Question</b>	<b>Expected Answers</b>			<b>Marks</b>
<b>2</b>	any for 1 each to a max. 7 e.g. <b>reason for defect / cause:</b> uneven curvature of the cornea / cornea not spherical causing different focal lengths in different planes  <b>description of vision / allow description of test:</b> identical (black) lines in different orientations should appear equally black and / or clear an astigmatic eye will see some lines darker and more sharply in focus than others  <b>correction:</b> defect may be corrected with a cylindrical lens e.g. diagram such that light in one plane is undeviated while light in the other plane is refracted diagram of rays in one plane converging differently to rays in another plane			1 1  1 1  1  1 1 1  <b>Total: 7</b>

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<b>Question</b>	<b>Expected Answers</b>			<b>Marks</b>
<b>3</b>	<p><b>Formation of image to a max 4</b> e.g.  X-rays are detected by a film / scintillation counter etc.,  High 'Z' means high attenuation / low transmission  <i>[Allow atomic mass / nucleon number]</i>  shadow on the film / reference to exposure after attenuation  Reference to photoelectric effect / energy range around 1-100keV / allow lower E  absorption <math>\propto Z^3</math></p> <p><b>Explanation of the use of a contrast medium to a max.3</b> e.g.</p> <p>X-rays do not differentiate / show up soft tissues well ...  ... as similar absorption / 'Z' is similar / 'Z' is low for these tissues. allow ref to hard and soft tissue  Contrast medium has high 'Z' / absorbs X-rays strongly /  It is usually taken orally / can be injected.</p> <p><b>Example of type of structure that can be imaged to a max.1</b> e.g.</p> <p>digestive tract / throat / stomach.</p> <p><b>to a max. 8</b></p>			1  1 1  1 1    1 1       1  <b>Total:8</b>

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<b>Question</b>	<b>Expected Answers</b>	<b>Marks</b>		
4(a)(i)	clockwise moment : $F \times 22 \sin 14$	1		
	anticlockwise moment : $450 \times 38 \cos 30$	1		
	clockwise moments = anticlockwise moments (at equilibrium)	1		
	answer : $F = 2782 \text{ N}$	1		
(ii)	answer : $F = 1606 \text{ N}$	1		
(b)	<b>e.g. (to max of 4)</b>			
	the smaller the angle made with the horizontal, the greater the force F needed to maintain stance in equilibrium	1		
	smaller angle means bigger moment	1		
	so as muscles cannot move from pivot, (to exert a larger moment),			
	the force F must be increased	1		
	keep back as vertical as possible	1		
	use leg muscles to do some of the lifting	1		
	consequence e.g. tendon 'goes' etc.,	1		
	spine is strong compressively / weak in shear	1		
	load close to pivot /	1 to max. 4		
	etc.,			
		<b>Total: 9</b>		

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<b>Question</b>	<b>Expected Answers</b>			<b>Marks</b>
<b>5(a)(i)</b>	$I = P / A$ $= 5.2 / \pi (0.12 \times 10^{-3})^2$ $= 1.15 \times 10^8$ unit: $W m^{-2}$			<b>1</b> <b>1</b> <b>1</b> <b>1</b>
<b>(ii)</b>	reference to eye <u>lens / cornea</u> so additional focusing / extra refraction			<b>1</b>
<b>(b)(i)</b>	$E = h c / \lambda$ $= 6.6 \times 10^{-34} \times 3.0 \times 10^8 / 515 \times 10^{-9} \quad (1)$ $= 3.86 \times 10^{-19} J \quad (1)$			<b>1</b> <b>1</b> <b>1</b>
<b>(ii)</b>	$p = n h f$ ecf (i) $2.6 / 3.8 \times 10^{-19}$ $= 6.8 \times 10^{18}$			<b>1</b> <b>1</b>
<b>(iii)</b>	birth marks are red / red light is reflected at red s so less red light absorbed or alternative argument with green light			<b>1</b> <b>1</b>
<b>(c)</b>	any 2 advantages and 2 related reasons e.g. laser light boils water content of cell so surgery is sterile focusing is very fine / much finer than a scalpel so less damage than with scalpel seals blood vessels as it cuts so less blood / vision is easier during incision <b>any relevant ans. to a max. of 4</b>			<b>1</b> <b>1</b> <b>1</b> <b>1</b>  <b>Total: 16</b>

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<b>Question</b>	<b>Expected Answers</b>			<b>Marks</b>
<b>6(a)</b>	shape with min. at about 2 kHz frequency range from 0.020 kHz to 20 kHz min. intensity at $10^{-12} \text{ W m}^{-2}$ max. intensity at $10^{-3} - 1 \text{ W m}^{-2}$			<b>1</b> <b>1</b> <b>1</b> <b>1</b>
<b>(b)(i)</b>	I.L. = $10 \ln I / I_0$ $25 = 10 \ln I / 10^{-12}$ $I_1 = 3.16 \times 10^{-10} \text{ W m}^{-2}$ $I_2 = 3.16 \times 10^{-5} \text{ W m}^{-2}$ $10^{-5} / 10^{-10} = 10^5$ ( larger by a factor of .....)			<b>1</b> <b>1</b> <b>1</b> <b>1</b>
<b>(ii)</b>	Intensity is the power of sound (normal) per unit area / $I = P/A$ loudness is a <i>subjective</i> response to intensity or response varies from individual to individual  a comment that is relevant to a max. of 2 e.g.  The only conclusion that can be made is that the intensity is greater by a factor of $10^5$ . A doubling in intensity level does not correspond to a doubling in loudness you can't tell as loudness is subjective e.g. my calculation shows it's $10^5$			<b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b>
				<b>Total: 12</b>



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<b>7(a)</b>	the total charge of one sign produced (by ionisation) per unit mass of air	<b>1</b>		
<b>(b)(i)</b>	$D = f \times \text{Exposure}$ $D = 85 \times 2.8 \times 10^{-5}$ $D = 2.4 \times 10^{-3} \text{ Gy or J kg}^{-1}$	<b>1</b>		
<b>(ii)</b>	ref. to type of radiation / energy distributed by the radiation $\text{m}^{-1}$ penetrated	<b>1</b>		
<b>(iii)</b>	$H = Q \times D$ $H = 1.2 \times 2.4 \times 10^{-3} = 2.9 \times 10^{-3} \text{ Sv}$ ecf (i)	<b>1</b>		
		<b>Total: 6</b>		

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- (a)  $mg \Delta h$  / gravitational potential energy / of upper carriage decreases / is converted into.....B1  
     gravitational energy of lower carriage.....B1  
     and  $E_k$  of carriage(s).....B1  
     allow for the third mark ref. to heat in brakes / work done against friction
- (b)  $T_1 = mg \sin \theta$   
 $T_1 = 10000 \times 9.81 \times 150 / 260$  or  $10000 \times 9.81 \times \sin 35$ .....B1  
 $T_1 = 5.7 \times 10^4 \text{ N}$  or 5.66, 5.63,  $5.62 \times 10^4 \text{ N}$  .....B1
- (c)(i)  $m = F/a$ ,  $8.7 \times 10^3 / 1.5$  .....C1  
      $= 5.8 \times 10^3 \text{ kg}$ .....C1  
 $m = 10000 - 5800 = 4200 \text{ kg}$  .....C1  
 $V = m / \rho$   
 $V = 4.2 \times 10^3 / 1000 = 4.2 \text{ m}^3$  .....A1
- (ii)  $t = (v-u) / a$   
 $t = 6.6 / 1.5$  .....C1  
 $t = 4.4 \text{ s}$  .....A1
- (iii)  $s = ut + 0.5 \times a \times t^2$   
 $= 0 + 0.5 \times 1.5 \times 4.4^2$  .....C1  
 $= 14.5 \text{ m}$  or  $15 \text{ m}$ .....A1
- (d) (i)  $3800 \times 9.81 \times 150 = \text{change in gpe}$ .....B1  
 $= 5.6$  or  $5.59 \text{ MJ}$  .....B1
- (ii)  $E = m c \Delta T$ .....C1  
 $5.5 \times 10^6 = 6 \times 25 \times 470 \times \Delta T$  .....C1  
 $\Delta T = 78 \text{ K}$  allow  $79 \text{ K}$  if  $5.6 \text{ MJ}$  used .....A1
- (iii) some thermal energy is lost to the surroundings / brakes lose heat.....B1  
     sensible explanation, .....B1  
     e.g. mechanism e.g. radiation, by which energy is transferred or  
     to where the thermal energy might also be transferred e.g. cable or pulley

Total 20

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