OCR

RECOGNISING ACHIEVEMENT

A2 HEALTH PHYSICS

Mark Scheme 2825/02
June 2004

1 (a)(i) ligament keeps bones in place / joins bone to bone (1)
(ii) tendon attaches muscle to bone (1)

(b)(i) clockwise moment = anticlockwise moment (at equilibrium) (1)
substitution: 80 x 0.050 = F x 0.020 (1)
answer: F = 200 N (1)

(ii) MA = load / effort (1)
substitution: 80 / 200
answer: 0.40 (1)

[total 7]

2(a) nothing heard until 100 Hz +/- 20Hz or becomes audible at 100 Hz (1)

louder until about 2 kHz (allow 1-3 kHz) /or quieter after 2 kHz / or loudest at about 2 kHz (1)

inaudible above about 10 kHz +/- 2 kHz (1)

(b) Factor (1), comment (1) to max. (2) each factor e.g.
background noise / higher threshold intensity (2)
age / hearing deterioration with increasing age (2) etc.
tinnitus, threshold intensity is higher (above ringing) (2)
allow loud noise, damages ear (2)
wax, less sensitive / ear drum stiffer (2)
altitude, ref. to pressure in middle ear (2)
frequency,, ref. to resonance in ear canal (2)

[total 7]

3

(a) *u* : distance of object from lens
v: distance of image from lens (1)

(b)(i) 1/f = 1/0.75 + 1/1.5 (1) or 1/75 + 1/150
f = 0.50 m or 50 cm (1)

(ii) p = 1/f or p = 1/ 0.50 (1) or 1/50
p = 2.0 D (1) allow 2 D

(c) p = 1 / 0.50 + 1/0.019 (1)
p = 54.6 D (1) allow 55 D

(d)(i) 54.6 + 2.0 = 56.6 D ans (c) + ans(b)(ii) (1)
ecf **(b)(ii)** allow 57 D

(ii) 56.6 = 1/u + 1/0.019 (1) ecf d(i)
u = 0.25 m (1)

(iii) normal near point at about 25 cm +/- 5 cm, (so lens appropriate) (1)
ecf **(d)(ii)**

[total 11]

4 (a) any relevant point (1) each to a max. of (2)
conventional X-rays e.g.

bone absorbs X-ray/photon /or X-rays penetrate further in soft tissue / or lower attenuation in soft tissue / or more X-rays get through soft tissue (1)

shadow of bone formed on film,/ ref. to image on film sensitive to

X-rays, fluorescent screen / image intensifier (1)

max. (2)

any relevant point (1) each to a max. of (3) e.g.

X-ray tube moves around body / multiple tubes, (1)

detector moves around body (opposite to tube) / or line of detectors (1)

intensity of beam measured at each point, or computer uses data to build up image of the brain, or computer to process data (1)

to max. (3)

(b) any relevant point (1) each to a max of (5) e.g.

conventional X-ray: absorption of X-rays depends on Z^3 / atomic /proton number, (1)

so with conventional X-rays, most are absorbed by skull, (1)

so poorer contrast within soft tissue of brain,/ or **better** contrast CT (1)

scanning produces 3-D image, (1)

any one from: (1)
any angle/ section / plane can be viewed
bone has high Z (so high absorption),
tissue has low Z (so low absorption),
CT: image is not generated from a shadow,

to max. (5) [total 10]

5(a)(i) (total linear) attenuation coefficient (1)

(ii) energy of the X-ray (photon)/ or frequency / or wavelength (1)
(density / atomic number of) material through which beam passes (1)

(b) $0.42 = e^{-0.025\mu}$ (1) or $I / I_0 = 0.42$
$\ln(0.42) = -0.025\mu$ (1)
$\mu = 34.7$ (1) (or 0.347)
m^{-1} (1) (or cm^{-1})

[total 7]

6(a)(i) direct effect: e.g. radiation ionises / damages DNA (1)

which can lead to mutation / cancer / sterilisation of cell (1)

(ii) indirect effect: e.g. photons interact with water in cell s/ or H and OH

/ or free radicals produced / H_2O_2 formed (1)

which damages DNA or affects the permeability of cell membrane (1)

(b)(i) radiation has greatest effect on cells that are dividing (1)

malignant cells divide more rapidly than healthy cells (1)

(ii) sensible method (1), detail (2) e.g.

X-ray tube rotated about patient / or multiple beams (1)
tumour at the centre of rotation of tube (1)
tumour gets large dose compared with surrounding cells (1)

or
lead placed around area (1)
X-rays target tumour (1)
X-rays cannot penetrate lead (1)

or
small dose / fraction repeated at intervals (1)
healthy tissue has time to recover / or recovers more quickly than cancerous cells (1)
more chance of catching cancerous cells dividing (1)

or

radioactive substance put near tumour (1)
e.g. alpha source or short ½ life (1)
low range or disappears quickly from body (1)

[total 9]

7(a) I.L. = 10 lg I / I_0 (0)

62 = 10 lg $I / 10^{-12}$ (1)

$I = 1.5849 \times 10^{-6}$ Wm^{-2} (1) or $I = 10^{6.2} \times 10^{-12}$ or $I = 10^{-5.8}$

allow reverse argument $I = 10 \lg 1.6 \times 10^{-6} / 10^{-12}$ (1)
I = 62.04 dB (1)

(b)(i) complete table correct (1) 0.0625 0.160 0.250 0.346 0.694

x-axis labelled correctly **and**
y-axis labelled correctly (1)

both scales suitable / uniform / (1)

all points plotted correctly (1)

line of best fit drawn (1) no point greater than 2 squares from line / at least one point on either side of the line

(ii)ecf from graph e.g. comment about <u>straight</u> line (1)

passes through / close to origin (1)

(c) intensity at 0.60 m = 4 x intensity at 1.2 m / or gradient,*k*,= 2.68×10^{-5} /
or $I_1 / I_2 = d_2^2 / d_1^2$ / or $\Delta y / \Delta x = k$ (1)

$= 7.2 \times 10^{-5}$ W m^{-2} (1) + / - 0.8

discomfort felt at about 1 W m^{-2} / or 120 dB (1)

7.4×10^{-5} W m^{-2} is smaller than 1 Wm^{-2} / or 78 dB is smaller than 120 dB hence correct conclusion e.c.f. (1)

(d) e.g. the ear has a logarithmic response to sound intensity or loudness is subjective etc. (1)

[total 14]

8 Any sensible comments 1 each up to a total **maximum** of **5** marks
macroscopic: e.g. laser heats / burns / cauterises tissue (1)

blood vessels shrink / seal (1)

cellular: e.g. water content of cells vaporises (1)

cell dies (1)

advantages: e.g. sterile surgery (1)

accurate cut / fine cut (1)

less blood / clean surgery etc.(1)

[total 5]

9 (a) (i)	Mass	= 0.15 × 5 × 60	1
		= 45 kg	1
(ii)	Energy required	= 45 × 4200 × (38 – 8) Must have temperature difference	1
		= 5.67×10^6 J	1
(b) (i)	Work done	= Force × distance turned (Allow F.d)	1
		= 80 × 2 π × 0.2	1
		= 100 J	
(ii)	Power produced	= Energy per rev. × Number of rev. per second	
		= 100 × 1.3	
		= 130 W	1
(iii)	Total number of revolutions	= 5.67×10^6 / 100	
		= 56700	1
(iv)	Time for pedalling	= 56700 / 1.3	1
		= 43615 secs	
		= 12.1 hours	1
c (i)	Total resistance in heater circuit	= *EMF* / current Must see some evidence of equation used and physics of problem other than V = IR eg $R_{total} = R_1 + R_2$	1
		= 24 / 5	
		= 4.8 Ω	1
	Resistance of element	= 4.8 – 1.2	1
		= 3.6 Ω	
(ii)	Length or wire	= RA / ρ	1
		= 3.6 × 0.32 × 10^{-6} / 1.5 × 10^{-7}	1
		= 7.68 m	1
d	Discussion on energy losses	Work done against friction in bearings etc	1
		Power loss from resistance of generator and connecting wires	1
		Heat radiated from tank	1

In one second student outputs 130 J of which only 120 J to generator
and only 90J to tank
Thus pedalling time will be longer by factor 130 / 90 giving a new time of 17.5 hours. 2

(Any explained energy loss plus extra time calculations scores up to 2 marks)
(Any correct calculation of extra time scores 1 mark)

Maximum 4 marks for question

Up to 3 marks for intelligent discussion (but ignore sound)
Up to 2 marks for calculation **Max 4**