OCR

RECOGNISING ACHIEVEMENT

Mark Scheme 2825/02
January 2002

1. (a) length is shorter (1)
width is greater (1)

(b) (for equilibrium) clockwise moments = anticlockwise (give this mark if lines 2 + 3 are equated to each other) (1)
(700x0.50sin60)+(200x0.75sin60) (1)
= E x 0.50 x sin10 (1)
= 5000 N (1)

(c) clockwise moment is less (1)
perpendicular distance of cog and A to J are less (1)
so less effort is required by back muscles (1)

2. (a)(i) Focus (1)
(ii) principal axis (1)

(b)(i) $p = 1 / f$ or $p = 1 / 4 \times 10^{2}$ (1)
$p = 25$ D (1)
(ii) $1 / f = 1 / v + 1 / u$ (1)
$1 / 0.040 = 1 / v + 1 / 0.060$ (1)
$v = 0.12$ m (1)

3. (a) distance moved by the object , while image remains in focus (1)

(b) image gets slightly larger / or smaller (1)
image becomes (progressively) more blurred further from u (1)

(c) ref. to the experiment object moving closer / further away while remaining acceptably in focus on the screen (1)
this distance if the "depth of field" (1)

4. (a) shape of graph (1)
minimum at 10^{-12} Wm^{-2} (1)
minimum at about 1-3kHz (1)
range about 20 – 20kHz or cut-offs (1)

(b) resonance at about 1-3 kHz (1)
due to shape / length of ear canal (1)

(c)(i) 10^{-12} Wm^{-2} (1)
(ii) $10^{2} = k / I^{2}$ (1)
$k = 10^{2}$, $P = 10^{2} / 16 = 6.25$ (1)
(iii) $IL = 10 \lg I / I_{o}$
$= 10 \lg 6.3 / 10^{-12} = 128$ (1)
= decibel or dB (1)
(iv) No + uncomfortable ecf (1)
damage may occur at intensity levels greater than 120 dB (1)

5. (a)(i) 3.0 div x 0.0030 ms div^{-1} (1)
= 0.0090 ms or 9.0 μs (1)
(ii) 2s = vt (1)
4000 x .0090 = 1.8 cm (1)
(iii) $2 d = 1500 \times 2 \times 3.0 \times 10^{-6} = 9.0 \times 10^{-3}$ (1)
d = 0.45 cm (1)

(b) If gel is not used, most reflection occurs at air / skin boundary so large first peak (1)
Reason: e.g. there is a very large difference in the acoustic impedance either side of this boundary (1)

6. (a)(i) electrons accelerated by high p.d. or power supply energy is converted into k.e. of electrons (1)
gain high k.e. (1)
sudden deceleration at target nuclei / or most of the k.e. is converted into heat at the cathode (1)
(small amount of) energy converted into X-ray of ref. to characteristic X-rays (1)
(ii) atoms of medium would obstruct electrons (1)
so k.e. at anode not large enough to produce X-rays (1)

(b)(i) different decelerations (1)
different energy photons released (1)
(ii) any two from:
more energtic X-rays / bigger E / lower λ (1)
more X-rays / greater intensity (1)
pk. Shifted towards higher E (1)
more characteristic lines (1)

(c)(i) plotting of points (2)
shape (1)
(ii) 0.085 cm (1)
(iii) $I / I_o = e^{-\mu x}$ (1)
Ln 0.50 = $-\mu x$ } use ans to cii to calculate μ (1)
$\mu = 8.15\ cm^{-1}$ ecf (ii) (1)

7. (a) Direct: damage to DNA / nucleus / or (molecules ionised) / DNA may be broken into fragments / sections removed (1)
causing cell death / impaired functions (1)
Indirect: OH^- ions formed in ionisation of water (1)
These react with DNA molecules (1)

(b)(i) $6.4 \times 10^{-6} \times 5.4 \times 10^{-18} / 1.6 \times 10^{-19}$ (1)
$= 2.16 \times 10^{-4}$ (1)
Gy (or $J\ Kg^{-1}$) (1)
(ii) H = Q x D (1)
for γ-rays $H = 2 \times 2.16 \times 10^{-4} / 2 = 2.16 \times 10^{-4}$ Sv (1)
for α-particles $H = 20 \times 2.16 \times 10^{-4}/2 = 21.6 \times 10^{-4}$ Sv (1)
$= 2.4 \times 10^{-3}$ Sv (1)

8. (a) cable has resistance (1)
hence there is a pd across cable (itself) (1)
this is not available to user (1)
(energy dissipated in cable could get ½ of last two marks)

(b) air emerging from aerogenerator is moving (1)
hence it has ke/eddies (1)
work/energy used against friction (1)
(ohmic) heating in generator (1)
any 2 2 max

(c)(i) $m = \pi R^2 l \rho$ (1)
$= \pi (0.75)^2 \times 8 \times 1.3$ (1)
(= 18.4 kg)

(ii) ke = ½ $m v^2$ (1)
= ½ x 18 x 8^2 = 576 J (Allow 588 J from ½ x 18.4 x 8^2) (1)

(iii) average power output = (40/100) x 576 = 230 W (1)
(Allow 235W from 0.4 x 588)

(d) $W = P t$ $7 \times 10^8 = 230\ t$ (1)
$t = 3.0(4) \times 10^4$ s (= 8.45 h) (allow 2.98×10^4 from $7 \times 10^6 = 235t$) (1)

(e)(i) Chemical (not potential or electrical) (1)

(ii) Energy dissipated/ wasted as heat inside battery/wires (1)

(f)(i) $E = P t$ (1)
$= 160 \times 40 \times 3600 = 2.3 \times 10^7$ J (1)

(ii) total stored energy $= 2.3 \times 10^7 \times 100 / 80$ (1)
$= 2.88 \times 10^7$ J (1)

(iii) no. of batteries $= 2.88 \times 10^7 / (7 \times 10^6)$ (1)
(=4.1) i.e 5 (1)

7. (a)	cable has resistance		1
	hence there is a pd across cable (itself)		1
	this is not available to user		1
	(energy dissipated in cable could get ½ of last two marks)		
(b)	air emerging from aerogenerator is moving		1
	hence it has ke/eddies		1
	work/energy used against friction		1
	(ohmic) heating in generator		1
	any 2		2 max
(c)(i)	$m = \pi R^2 l \rho$		1
	$= \pi (0.75)^2 \times 8 \times 1.3$		1
	(= 18.4 kg)		
(ii)	ke $= ½ m v^2$		1
	$= ½ \times 18 \times 8^2 = 576$ J (allow 588 J from $½ \times 18.4 \times 8^2$)		1
(iii)	average power output = (40 / 100) x 576 = 230 W		1
	(allow 235 W from 0.4 x 588)		
(d)	$W = P t$ $\quad 7 \times 10^6 = 230t$		1
	$t = 3.0(4) \times 10^4$ s (=8.45 h) (allow 2.98×10^4 from $7 \times 10^6 = 235\ t$)		1
(e)(i)	chemical (not potential or electrical)		1
(ii)	energy dissipated/wasted as heat inside battery/wires		1
(f)(i)	$E = P t$		1
	$= 160 \times 40 \times 3600 = 2.3 \times 10^7$ J		1
(ii)	total stored energy $= 2.3 \times 10^7 \times 100/80$		1
	$= 2.88 \times 10^7$ J		1
(iii)	no. of batteries $= 2.88 \times 10^7 / (7 \times 10^6)$		1
	(= 4.1) ie 5		1