OCR

RECOGNISING ACHIEVEMENT

Mark Scheme 2825/02
June 2002

1. (a)(i) one mark for direction of each labelled arrow, to go through / touch the point of contact of foot with ground (3)

(ii) reduces forward momentum / velocity /allow *slows it down / stops it* in Fig 1.1 (1)
no effect in Fig.1.2 (1)
increases forward momentum / velocity/ allow *accelerates foot / pushes the body forward* in Fig.1.3 (1)

(b)(i) e.g. take moments about a point through which P passes or (when in equilibrium, the sum of) the clockwise moments = (sum of) anticlockwise moments (1)
$T \times 0.050 + 40 \times 0.040 = 300 \times 0.16$ (1)
$T = 928$ N (1)

(ii) e.g. moments about a point through which T passes (or equivalent)
or $P \times 0.050 + 40 \times 0.090 = 300 \times 0.21$ (1)
$P = 1190$N (1)
Allow reasoning that resolves forces vertically
$P + 40 = 300 + 928$
$P = 1190$ N

2. (a)(i) near point = 25cm +/-5cm (1)
far point = ∞ / infinity (1)
(ii) long sight / hypermetropia (1)
short sight / myopia (1)
old sight orrestricted range of accommodation gains one mark
allow presbyopia for two marks

(b)(i) $p = 1 / v + 1 / u$ (1)
$p = 1 / 0.35 + 1 / 0.017$ (1)
$p = 61.7$ D (allow 62 D) (1)
if calculation performed in cm leading to answer p = 0.617D allow two marks out of 3 (penalising the unit mark)

(ii) $p = 1 / 0.25 + 1 / 0.017$ (1)
$p = 62.8$ D (allow 63 D) (1)
$62.8 - 61.7 = +1.14$ D (allow 1.1 D or 1 D) (1)
allow alternative routes

(iii) $1 / f = 1 / 0.017 = p = 58.8$ D (1)
$p = 1 / 0.017 + 1 / 0.80 = 60.1$ D (1)
$58.8 - 60.1 = (-) 1.27$ D (1)
allow alternative routes

(iv) bifocals / varifocals (allow lens with two different powers or both concave and convex) (1)

3. (a)(i) diagram showing:
area of oval window is smaller than the area of the ear drum (1)
lever system of bones / ossicles or schematic lever system (1)
lever system of bones increases the force (so p increases) (1)
(as $p = f/a$,) if a decreases, p increases (for the same force) or
if f increases so p increases (1)

(ii) to allow vibrations to pass into the fluid / inner ear (1)
bigger pressure required to move the denser medium or
reference to acoustic impedance matching (1)

(b)(i) $IL = 10 \lg I / I_o$ or
$IL = 10 \lg 8.0 \times 10^{-12} / 1.0 \times 10^{-12}$ (1)
= 9.03 (dB) (1)

(ii) ear responds logarithmically (to sound intensity) (1)
a change of 6.0dB is greater than a change of 3.0dB so the first change is
perceived as being a greater increase in loudness (1)
ecf (i) ref. to bigger jump in intensity level

4. (a) when p.d. applied across crystal, it changes shape (1)
with alternating p.d. it oscillates (at resonant frequency) (to produce u.s) (1)
when u.s. incident on crystal or crystal deformed, it produces (a.c.) p.d. (1)
ref. to resonance e.g. applied a.c. must be at resonant frequency of crystal (1)

(b) speed of sound (in the medium) (1)
density (of the medium) (1)
allow *temperature*

(c)(i) 1 $f = (1.63 \times 10^6 - 4.29 \times 10^2)^2 / (1.63 \times 10^6 + 4.29 \times 10^2)^2$ (1)
$f = 0.999$ (allow 1.0 if working shown) (1)

1 $f = (1.63 \times 10^6 - 1.42 \times 10^6)^2 / (1.63 \times 10^6 + 1.42 \times 10^6)^2$ (1)
$f = 4.74 \times 10^{-3}$ (allow 4.7×10^{-3}) (1)

(ii) any 2, one mark each to a maximum of 2 (2)
without it most of the u.s. is reflected / or with it most is
transmitted
removes air
small reflection when difference in acoustic impedance is small
closer impedance matching

5. (a) rotation (or wobble) of the axis of spin (1)
about the direction of the external magnetic field (1)

(b) hydrogen (1)
any two from:
abundant in the body (1)
odd number of protons (allow odd number of nucleons) (1)
possess the property of spin (1)
possess magnetic moment (act like tiny magnets) (1)

(c) the frequency of precession (of the targeted nuclei) (1)
found in the radio frequency part of the e/m spectrum (1)

(d) different types of tissue have different relaxation times (1)

(e) sensible comparison (1 each) e.g.
X-rays are damaging / ionising **and** MRI has so far no known side effects (1)
or
MRI is sensitive to variation in soft tissue (and can distinguish between blood and brain cells) **and** X-rays cannot image these (but would image skull) (1)

6. (a) e.g. skin burn (damage to lens of eye, bone marrow effects, blood count depression, impairment of fertility, effects on foetus, central nervous system, sickness) (1)
do not allow cancer / leukaemia / mutation

(b) any four for one mark each to a **maximum of 4** e.g.
non-stochastic effect occurs above a threshold dose (1)
a stochastic effect is one in which there is no threshold dose (1)
the probability of the effect being induced is proportional to the dose received (1)
severity of effect is not affected by an increased dose unlike in the case of a non-stochastic effect (1)
non-stochastic effects occur at higher doses (1)
non-stochastic effects usually include cell death or sterility (1)
stochastic effects usually include cell mutation (1)
max (4)

7. (a) the energy absorbed per kg (of irradiated material) (1)

(b)(i) $4.2 \times 10^{-7} \times 70$ (1)
$= 2.94 \times 10^{-5}$ J (1)

(ii) $4.2 \times 10^{-7} / 5.44 \times 10^{-18}$ (1)
$= 7.7 \times 10^{10}$ (1)
$\times 1.6 \times 10^{-19} = 1.23 \times 10^{-8}$ (1)
If 5.4×10^{12} ion-pairs (per body) give one mark out of three
If 2.94×10^{-5} J is used instead of 4.2×10^{-5} J give two marks out of three
Ckg^{-1} (1)

(iii) Do **not** accept *the whole body does not absorb energy uniformly*
Some discussion must be made about why e.g. (1)
different uptake / absorption by different organs
not all of the mass of the body will have absorbed energy due to shielding etc
absorbed dose depends on the absorbing medium which in this case is slightly different to air i.e. factor not considered.

8. (a) sensible feature **and** reason one mark for each up to a maximum of 4, e.g.**(4)**
- Graph has low value over the first 6 h **and** ref. to low demand as most people are sleeping
- Demand peaks at mid-day **and** ref. to (electricity consumed for) cooking
- Demand peaks at 1800 / 1900 h **and** ref. to (consumption for) cooking
- Peaks greater in January at tea time / 1700 h **and** ref. to heating and cooking at the end of work
- Demand does not fall below a min. value **and** ref. to reason such as street lights / storage heaters
- Similar shapes of graphs for January and August **and** suggestion that the pattern of the day is similar
- Graph for January is higher than for August **and** ref. to more energy needed for heating
- Graph has a steep slope in morning **and** ref. to industry switching on appliances (allow 'graph goes up in the morning as people go to work)

(b) look for reference to **time** in both marking points one mark for each up to a maximum of 2, e.g.**(2)**
- it takes time for (added) coal to burn or / it takes time for coal to give out heat at the required rate
- coal fires do not go out straight away or / it takes time to cool down
allow alternative response here if a sensible comment is made about the problems / costs associated with allowing a power station to cool i.e. it is uneconomical to get going again

(c)(i) 66 +/- 2 GW Allow single unlabelled line on graph if it lies in the range (1)
(ii) 74 – graph value e.g. 66 = 8 GW allow 73.5 to 74 GW for peak value (1)
A bald answer of 8 GW with no graph value gets 1 mark

(d)(i) Δ gpe = mgΔh or words or numbers **clearly** arranged to show the change in gpe
e.g. Δgpe = m x 9.8 x 100 (1)
power = energy converted / time taken or numbers **clearly** arranged to show power
e.g. power = 1.0×10^9 = m x 9.8 x 100 / **1** (1)
volume = mass / density or equivalent (1)
calculation e.g. volume (s^{-1}) = 1.02×10^6 / 1.0×10^3 = 1.02×10^3 m^3 (s^{-1}) (1)

(ii) 1.0×10^3 = 35 x area of reservoir **(1)** **or** Vol / s x time = total volume
total volume = $1.0 \times 10^3 \times 4 \times 60 \times 60$ (1)
area = 28.6 m^2 (in one second) **(1)** **or** total volume = 1.44×10^7 m^3 (1)
area for 4 h = 28.6 x 4 x 60 x 60 **or** $1.44 \times 10^7 = 35 \times l^2$ (1)
= 4.11×10^5 m^2 **(1)**
$(4.11 \times 10^5)^{0.5}$ = 641 m (648m) **(1)** **or** $(4.11 \times 10^5)^{0.5}$ = 641 m (648m) (1)

(iii) Two comments relevant to the feasibility **ecf (ii)** one mark for each to a maximum of 2 e.g. **(2)**
- ref. to physical dimensions / very large area needed
- drop of 100 m may be a problem with regard to geographical siting
- 7 more lakes needed to meet the demand **ecf (c)**
- argument for this type of pumped storage facility may gain credit if *rapid* response to change in demand is mentioned
- use of peak power at night to store energy as gpe
- sensible comment on a *stated* effect on the environment e.g. destroys habitat / affects ecology **do not allow any reference to costs or noise**

(iv) look for energy conversions for both marks one mark each to max. 2 e.g. **(2)**

- turbine is inefficient as some of the ke of water is converted into heat
- conversion to heat energy is due to friction in turbine / friction in generator / friction in pipes
- some ke retained by water after passing through turbine / not all ke given to turbine