CHAPTER 8 TEST REVIEW -- MARKSCHEME

1.	A	**4.**	D	**7.**	A	**10.**	A and C	**13.**	C
2.	A	**5.**	C	**8.**	D	**11.**	D	**14.**	C
3.	D	**6.**	D	**9.**	B	**12.**	D	**15.**	B

16. (a) (i) fuel enrichment means that the amount of uranium-235 present in the fuel is increased / *OWTTE*;
this means that more U-235 available for fission;
therefore the reaction can be sustained; 3

(ii) enriched fuel can be used in the manufacture of nuclear weapons;
so possibly threatening World peace; 2

(b) (i) (energy released) = $2.1895 \times 10^5 - (1.3408 + 0.83749 + 0.0093956) \times 10^5$;
= 181.44 ≈ 180 MeV 1

(ii) kinetic; 1

(c) (i) number of atoms in 1 kg of carbon = $\frac{N_A \times 1000}{12}$ and number in 1 kg of U-235 = $\frac{N_A \times 1000}{235}$;
energy per kg carbon = $\frac{4N_A}{12}$ keV and per kg U-235 = $\frac{1.8\times10^8 N_A}{235}$ keV;
therefore, ratio = 2.3×10^6; 3

(ii) a much higher energy density implies that uranium will produce more energy per kg / smaller quantity of uranium needed to produce same amount of energy / *OWTTE*; 1

(d) (i) no of atoms = $\left(\frac{6.0\times10^{26}}{90}\right) = 6.7\times10^{24}$;
$\lambda = \frac{0.69}{9.1\times10^8} = 7.6\times10^{-10}\ (\mathrm{s}^{-1})$;
activity = $7.6 \times 10^{-10} \times 6.7 \times 10^{24}$;
= 5.1×10^{15} Bq 3

(ii) $\lambda = 0.024\ \mathrm{yr}^{-1}$;
activity = $5.1 \times 10^{15} \times e^{-0.024 \times 70}$;
= 9.6×10^{14} Bq; 3

(e) initial activity is very high;
it is still highly radioactive after 70 years;
thereby posing a severe health risk / causing problems of disposal / *OWTTE*; 3

17. (a) the force acting/accelerating (on the body) is directed towards equilibrium (position);

and is proportional to its/the bodies displacement from equilibrium; 2

(b) (i) 1.5×10^{-10} m; 1

(ii) $T = 1.1 \times 10^{-12}$ s;

$f = \left(\frac{1}{1.1 \times 10^{-12}}\right)$;

$= 9.1 \times 10^{13}$ Hz 2

(iii) $\omega = (2\pi f) = 5.7 \times 10^{14}$ (rad s^{-1});

$E_{max} = \left(\frac{1}{2} m\omega^2 x_0^{\ 2}\right) = \frac{1}{2} \times 1.7 \times 10^{-27} \times (1.5)^2 \times 10^{-20} \times (5.7)^2 \times 10^{28}$;

$= 6.2 \times 10^{-18}$ J 2

(c) (i) $k = (4\pi^2 f^2 m_p) = 40 \times 83 \times 10^{26} \times 1.7 \times 10^{-27}$;

≈ 560 N m^{-1} 1

(ii) use of $F = kx$ and $F = ma$;

to give $a = \frac{560 \times 1.5 \times 10^{-10}}{1.7 \times 10^{-27}} = 5.0 \times 10^{19}$ m s^{-2} ; 2

(d) (i) infra red radiation radiated <u>from Earth</u> will be absorbed by greenhouse gases;

and so increase the temperature of the atmosphere/Earth; 2

(ii) the natural frequency of oscillation (of a methane molecule) is equal to 9.1×10^{13} Hz;

because of resonance the molecule will readily absorb radiation of this frequency; 2

18. (a) (i) mass = $50 \times 5.0 \times 10^4 \times 10^3$;

loss in gpe = $50 \times 5.0 \times 10^4 \times 10^3 \times 310 \times 9.81$;

Accept use of 335 m (including centre of mass of tank water) accept g = 10.

7.6×10^{12} (J);

$\approx 8 \times 10^{12}$ (J) 3

Do not penalize if the first marking point is incorporated into the second marking point.

(ii) flows for 6250 s;

1.2×10^9 W ***or*** 1.3×10^9 W;

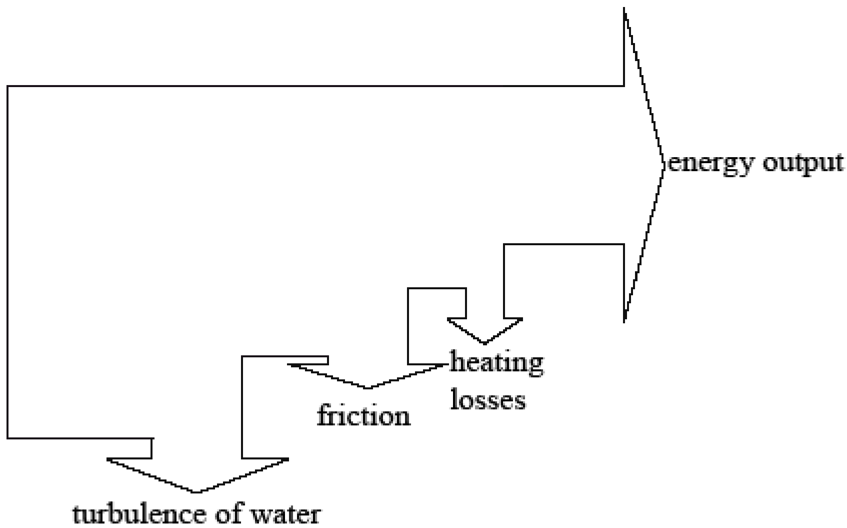
Accept solution from (a)(i) or from flow rate.

(b) (i) 53%; 1

(ii) losses in correct order and approximately correct ratio of size;

arrows correctly labelled with source of loss; 2

Labelling of width in % is acceptable for correct ratio only.



(*diagram not to scale*)

(c) (i) emf is proportional to rate of change of flux (linkage);
position 2 XY is moving perpendicular to field lines/
position 1 is moving parallel to field lines;
rate of change is flux is greatest in position 2 / rate of change is less in position 1 than position 2; **3**
Accept argument in terms of force on electrons.

(ii) $\varepsilon = 0.015 \times 1.5 \times 160$;
3.6 V; **2**

(iii) recognizes that coil has two sides;
11 kV; **2**
*Award **[1 max]** for 5.4 kV (only one side considered).*

(d) (i) transmit at high/increased potential difference/voltage;
use (step-up) transformer to (increase potential difference/ voltage and) reduce current;
lower current means I^2R/resistive losses reduced;
large cable cross-section/good conductor used for cables so resistive losses reduced; **3 max**
Do not accept discussion of reduction of station distance from consumer.

(ii) *advantage*: pumped storage on demand;
disadvantage: but needs to be re-stored before re-use; **2**
Answer must focus on comparison between tidal and pumped storage.
Do not accept arguments based on unreliability of tide or installation costs

(e) (i) total volume of ice = $14 \times 10^{12} \times 1.5 \times 10^{3}$ m^3;
mass = $2.1 \times 10^{16} \times 920 = 1.9 \times 10^{19}$ kg; **2**

(ii) new volume 1.9×10^{16} m^3;
level change = $\dfrac{\text{new volume}}{\text{area of ocean}}$;
51 m; **3**

19. (a) (i) infrared; 1

(ii) nitrogen dioxide in the atmosphere will readily absorb infrared radiation radiated from the surface of Earth / *OWTTE*;
and re-radiate the energy in <u>random directions</u> (so preventing the energy radiated from Earth escaping into space); 2

(b) *emissivity*:
the ratio of energy/power emitted (per unit area) of a body;
to the energy/power emitted (per unit area) of a black body
of the same dimensions at the same temperature;

or

ratio of power emitted by a body;
to the power emitted if it were a black body;

albedo:
the fraction of energy/power incident in a surface that is reflected / *OWTTE*; 3
Allow answers that define in terms of the albedo of Earth.

(c) (i) power per unit area = $e\sigma T^4$;
$= 0.720 \times 5.67 \times 10^{-8} \times 242^4$;
$= 140 \text{ W m}^{-2}$ 2

(ii) $= 0.720 \times 344$;
$= 248 \text{ W m}^{-2}$ 1

(d) (i) new power radiated by atmosphere =$[0.720 \times 5.67 \times 10^{-8} \times 248^4]$
$= 154 \text{ W m}^{-2}$; 1

(ii) new power absorbed by Earth = $(154 + 248) = 402 \text{ W m}^{-2}$; 1

(e) $402 = 5.67 \times 10^{-8} \times T^4$;
$T = 290\text{K}$;
to give $\Delta T = 2\text{K}$; 3

20. (a) energy emitted per unit time / power per unit area;
proportional to [absolute temperature/temperature in K]^4; 2
Must define symbols if used.

(b) (i) power $= 5.67 \times 10^{-8} \times 4\pi \times [7.0 \times 10^8]^2 \times 5800^4$;
$= 4.0 \times 10^{26}$ W 1

(ii) $\frac{\text{incident energy}}{\text{area}} = \frac{3.97 \times 10^{26}}{4\pi[1.5 \times 10^{11}]^2}$;
$= 1400 \text{ W m}^{-2}$; 2

(iii) max 2 of:
(albedo of Earth means) some radiation is reflected;
Earth's surface is not always normal to incident radiation;
some energy lost as radiation travels to Earth; 2 max

(iv) power absorbed = power radiated;
uses $5.67 \times 10^{-8} \times 255^4$ = to yield answer close to
240 / evaluates $\sqrt[4]{\frac{240}{\sigma}}$; 2

(c) radiation from the Sun is re-emitted at longer wavelengths;
(longer radiation) wavelengths are absorbed by greenhouse gases;
some radiation re-emitted back to Earth; 3

(d) more CO_2/named greenhouse gas released into atmosphere;
<u>enhanced</u> greenhouse effect;
because more re-radiation of energy towards surface; 3