

- 1 (a) mgh in any form, numbers, words, symbols C1
5.4 J OR 5.297 J OR 5.292 J OR 5.3 J OR 5.29 J A1
- (b) $\frac{1}{2}mv^2$ in any form, numbers, words, symbols C1
14.7 (J) C1
- (energy given by player =) 9.3 J OR his (b) – (a) correctly evaluated A1
- (c) friction with floor / inside ball OR energy to deform ball OR sound OR idea of hysteresis of rubber
ignore heat / air resistance B1
- (ii) 78% OR ratio of PEs
accept ($14.7 \times 0.78 =$) 11.47 (J) OR ($0.78 \times 0.9 =$) 0.702 (m) C1
- 3.12 m to at least 2 sig figs A1
- (iii) idea of (some of) energy lost / becomes / converted / transferred to heat in ball
ignore friction B1 [9]
- 2 (a) (i) (speed =) distance/time in any form, words, letters, numbers C1
0.15 m/s or 15 cm/s A1
(if answer only, 1 mark for either if no units)
- (ii) (PE =) mgh OR mgh OR Wh symbols, words or numbers C1
100 J OR 98.1 J OR 98 J A1
- (iii) his (ii)/40 OR his (ii)/4
2.5 W OR 2.45 W e.c.f. from (ii) A1
- (b) (input) greater/output less NOT a numerical factor B1

[Total: 7]

- 3 (a) mgh OR $0.15 \times 10 \times 0.3$ C1
0.45 J A1
- (b) idea of max KE at lowest point OR $h = 0.1$ C1
idea of PE lost = KE gained C1
 $0.15 \times 10 \times 0.1$ OR $0.15 \times 10 \times 0.2$ C1
0.15 J c.a.o. A1
- (ii) (KE =) $\frac{1}{2}mv^2$ OR $0.15 = \frac{1}{2} \times 0.15 \times v^2$ e.c.f.
OR $gh = \frac{1}{2}v^2$ OR $10 \times 0.1 = \frac{1}{2}v^2$ e.c.f. C1

($v =$) 1.4 m/s e.c.f. as long as mass correct A1
- (iii) 0.3 m B1
- (iv) cord straight B1
bob at same height as original M1
straight cord at approx 30° to vertical, by eye A1

[Total: 12]

- 4 (a) mgh OR $0.5 \times 10 \times 1.1$ C1
5.5 J A1
- (b) 1.5 (J) B1
- (ii) energy used to deform ball/ground
OR strain energy stored in (deformed) ball/ground
OR heat generated in deformed ball/ground B1
- (c) (initial energy =) 9 + answer to (a), correctly evaluated C1
use of $\frac{1}{2}mv^2$ C1
7.6 m/s B1

[Total: 7]

- 5 (a) (i) $\frac{1}{2}mv^2$ C1
 $\frac{1}{2} \times 7500 \times 12 \times 12$ C1
540 000 J OR 540 kJ
- (ii) $W = E/t$ in any form B1
10% \times his (a) C1
54 000 W OR 54 kW e.c.f. A1
- (b) (i) 3750 kg
- (ii) [If ecf from (i) and no other errors, maximum mark is 2]
mass: $\frac{1}{2}$ OR correct sub in $\frac{1}{2}mv^2$ C1
speed: $\frac{1}{2}$ OR 6750 (J) J
fraction = $\frac{1}{8} / 0.125 / 1:8 ? 12.5 \%$ (c.a.o.) A1 [10]
- 6 (a) (P.E.) = mgh C1
 $12 \times 10 \times 3$ Accept $g = 9$ C1
360 J $g = 9.8$ gives 352.8 J (minimum 2 s.f.) A1
 $g = 9.81$ gives 353.16 J (minimum 2 s.f.)
- (b) (P =) E/t C1
360/60 C1
6 W 352.8 J gives 5.88 W 353.16 J gives 5.886 W (minimum 2 s.f.) A1

[6]

- 7 (a) fusion (of nuclei) CARE: NOT fission or fision ACCEPT fussion
condone radiation as an extra B1
- (b) radiant/heat energy from Sun or radiation from Sun)
energy from Sun raises temperature of water/heats water/melts ice)
energy from Sun evaporates water) any 3 B1 × 3
PE in cloud)
rain)
stored water has PE)
- (c) (i) 25/100 for gas-fired or 30/90 for hydroelectric
or energy out/energy in or power out/power in B1
- (ii) 30/90 or 1/3 or 33% is more than 25/100 or ¼ or 25%
OR lower input into hydroelectric station, but more output than gas-fired station B1
IGNORE hydroelectric losses less than gas-fired losses
- [6]
- 8 (a) mgh or $90 \times 10 \times 14$ accept 9.8 or 9.81 instead of 10 C1
12 600 J or 12348 J or 12360.6 J nothing else A1
- (b) PE lost = KE gained or $mgh = \frac{1}{2}mv^2$ C1
($v^2 =$) 280 e.c.f. or 274.4 or 274.68 C1
16.7 m/s e.c.f. or 16.565 m/s or 16.573 m/s NOTE: 16.8 m/s gets A0 A1
- (c) energy lost or friction/air resistance/drag/wind resistance B1
- [6]