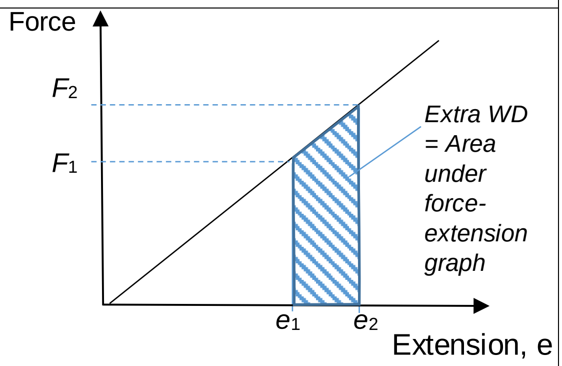
Topic 5 Work Energy Power

Suggested Solutions to Self Review Questions

Qn	Ans	Explanation
S1	**D**	**[H1 2007 P1 Q14]** To answer this particular MCQ, we are forced to assume that the mass is travelling at a very slow speed. By definition, Work done by force F = F x <u>displacement in the direction of F</u> = Fz Note that for the mass to start and finish at rest, the force F actually cannot be constant.
S2	**C**	**[NYJC 2011 Prelim P1 Q10]** (Note that the graph does not starts at origin!) a = 10.5/2.0 = 2.5 m s^{-2} $F = ma$ = 5.0 N s = 0.5 (2)(10+5) = 15 m Work done = F x d = 5.0 x 15 = 75 J
S3	**A**	**[H2 2011 P1Q10]** Assuming it obeys Hooke's Law, $F \propto e$ Thus $\dfrac{F_2}{F_1} = \dfrac{e_2}{e_1}$ $\dfrac{250}{200} = \dfrac{e_2}{0.004}$  e_2 = 0.005 m Extra work done is the area under the force-extension graph from e_1 to e_2. = $\dfrac{1}{2}(F_1 + F_2)(e_2 - e_1)$ = ½ (200 +250) (0.005 – 0.004) = 0.225 J
S4	**A**	**H1 2007P1Q15** Since frictional forces are negligible, we can assume that the total mechanical energy is conserved. The only energy conversion is gravitational potential energy (GPE) to kinetic energy (KE). The top of the track is the same vertical height above the ground, therefore initial GPE is the same for all 3 cars, hence final KE will be the same.
S5	**B**	***Concept:*** *GPE(in uniform Gravitational field); KE; Conservation of energy* KE is continuously converted into gravitational potential energy as the particle is on the way up and vice-versa. Hence at B, the KE will be the minimum as the height is maximum. Mathematically, $E_T = E_K + E_P$ $E_T = E_K + mgh$ $E_K = E_T - mgh$ Since E_T, m, and g are constant, minimum E_K is achieved when h is at maximum.

		Alternatively, At the maximum height, velocity is only horizontal component of the initial velocity $v_H = 30 \cos 60°$ Thus KE = ½ mv^2 must be minimum.
S6	**B**	**[H1/2012/1/15]** Since speed is constant, there is no change in KE. By conservation of energy, $W_{driving} + W_{friction} = \Delta E_P$ $W_{driving} - Fs = mg\Delta h$ $W_{driving} - (580)(500) = (1000)(9.81)(87)$ $W_{driving} = 1.14 \times 10^6$ J Note: the amount of heat produced is the work done against friction, W = friction x distance.
S7	**C**	**[J77/2/30]** By conservation of energy, Change in kinetic energy = work done by friction $\Delta E_k = W_{friction}$ $0 - \frac{1}{2}mv^2 = -500000$ $\frac{1}{2}(1600)v^2 = 500000$ $v = 25$ m s^{-1} Alternatively, Loss in kinetic energy of the car = work done against friction (which manifests as heat and sound), $\frac{1}{2}mv^2 - 0 = 500000$ $\frac{1}{2}(1600)v^2 = 500000$ $v = 25$ m s^{-1}
S8	**A**	**[N1981/P1/Q2]** After first impact, it rises to a height of $(0.8)h$ After 3 impacts, it rises to a height of $(0.8)^3h$ Hence its KE after 3rd = GPE gain after 3rd impact = $mg(0.8)^3h$
S9	**C**	**[J94/1/6]** Instantaneous power = $\frac{dE}{dt}$ (which is equal to gradient of an *E*-*t* graph) The maximum instantaneous power corresponds to the steepest part of the graph from t = 2 s to t = 3 s $P = \frac{\Delta E}{\Delta t} = \frac{0.4 - 0.1}{3 - 2} = 0.30$ W
S10	**D**	**[NYJC/2007/Prelim/P1/Q10]** The total resistive force on the car = 600 N Power is used to overcome the resistive force to allow the car to travel at constant speed.

		$P = Fv$ $25\,000 = (600)\, v \quad \Rightarrow \quad v = 42 \text{ m s}^{-1}$
S11	**D**	**[H1/N2009/1/12]** For the car to travel at a constant speed, the driving force is equal to the drag force. $F = F_D = kv^2$ Hence, $Power,\ P = Fv = kv^3$ $\frac{P_1}{P_2} = \left(\frac{v_1}{v_2}\right)^3$ $\frac{4800}{P_2} = \left(\frac{20}{25}\right)^3 = \left(\frac{4}{5}\right)^3$ $P_2 = 4800\left(\frac{5}{4}\right)^3 = 9400 \text{ W}$
S12	**A**	**[J93/1/6]** Since the metal sphere reached terminal velocity, its KE must have remained constant ($\frac{1}{2}mv^2$). rate of change of GPE $= \frac{dE_P}{dt} = \frac{d(mgh)}{dt} = mg\left(\frac{dh}{dt}\right) = mgv$