6	**The only correct answer is C** (The initial horizontal velocity is equal to the final horizontal velocity) A is not correct because the horizontal component of velocity remains constant throughout the motion. A constant value does not have a minimum or maximum, so it is not appropriate to describe the horizontal velocity as minimum B is not correct because at maximum height the vertical velocity is 0 D is not correct because the final position is below the initial position	1

3	**D is the correct answer** A is not the correct answer as would be difference in velocities of cars descending to ground from standing starts at P and Q and is out by factor of √2 B is not the correct answer as would be difference in velocities of cars descending to ground from standing starts at P and Q C is not the correct answer as is out by a factor of √2	**(1)**

3	**The only correct answer is D 0.59 J**	1
	***A** is not correct because 0.045 J = ½ × 0.040 kg × (1.5 m)^2* ***B** is not correct because 0.060 J = 0.040 kg ×1.5 m* ***C** is not correct because 0.39J = 0.040 kg × 9.81 N kg^{-1}*	

1	**The only correct answer is D (J s^{-1})** A is not correct because this is equivalent to the joule B is not correct because this is the unit for stiffness C is not correct because the watt is the joule per second	1

6	**The only correct answer is C** ($\frac{5000}{42\times0.63}$) A is not correct because the useful output power should not be inverted B is not correct because the useful output power should not be inverted and should be divided by 0.63 D is not correct because the useful output power should be divided by 0.63	1

1	**The correct answer is A** $\left(\frac{180}{240}\right)$ B is incorrect because 60 kW is the wasted energy C is incorrect because 60 kW is the wasted energy and 180 kW is the useful energy D is incorrect because 300 kW is the sum of the wasted and input energy	1

5	**B is the correct answer** A is incorrect because the CW moment of the force could balancethe ACW moment of the weight C is incorrect because the CW moment of the force could balance theACW moment of the weight D is incorrect because the CW moment of the force could balance the ACW moment of the weight	1

2	**The only correct answer is B (Useful power output is constant; total energy output increases.)** A is not correct because total energy output would increase with time C is not correct because useful power output is constant D is not correct because useful power output is constant and total energy output would increase with time	1

8	**C is the correct answer** This is because the power needed is equal to the gravitational energy supplied per second (mgh) plus the kinetic energy given to the water per second ($\frac{1}{2}mv^2$).	**(1)**

D is incorrect because the displacement should be doubled

2	**C is the correct answer** A is incorrect because it takes no account of the k.e. B is incorrect because the energy dissipated would be greater than the original energy D is incorrect because the energy dissipated could not be negative	**(1)**

Question Number	Answer	Mark
13(a)	• Use of $\Sigma F = 0$, seen or implied (1) • $F = 11$ N (1) • Use of moment of force = Fx (with any corresponding force and known distance from an end, A or midpoint) (1) • Use of the principle of moments (1) • $x = 0.86$ m (1) Example of calculation $F_A + F_B = 8.5$ N + 14 N = 22.5 N $F_A = F_B$ $2F = 22.5$ N $F = 11.25$ N if moments taken from the left end (11.25 N × 0.15 m) + (11.25 N × x) = (8.5 N × 0.35 m) + (14 N × 0.60 m) $x = 0.861$ m if moments taken from midpoint (11.25 N × 0.45 m) = (11.25 N × x) + (8.5 N × 0.25 m) $x = 0.261$ m so distance = 0.261 m + 0.6 m = 0.861 m if moments taken from A (8.5 N × 0.20 m) + (14 N × 0.45 m) = (11.25 N × x) $x = 0.711$ m so distance = 0.711 + 0.15 m = 0.861 m	**5**
13(b)	The moment (of B) must be the same (1) For a smaller distance (from the left end of the shelf), the (normal contact) force must increase (1)	**2**
	Total for question 13	**7**

Question Number	Answer		Mark
12(a)	$W_{slope} = W \sin 3.0°$ **Or** $h = s \sin 3.0°$ **Or** $v = 2.5 \sin 3.0°$	(1)	
	Use of $W = mg$ (allow use of $E_{grav} = mg\Delta h$)	(1)	
	Use of power = work done/time taken (Allow use of power = E_{grav}/time)	(1)	
	Power = 103 W	(1)	**4**
	Example of calculation $W = 80.0 \text{ kg} \times g \times \sin 3.0° = 41.1 \text{ N}$ In 1 second, the distance travelled is 2.5 m $\Delta W = 41.1 \text{ N} \times 2.5 \text{ m} = 102.8 \text{ J}$ Power = $\frac{102.3 \text{ J}}{1 \text{ s}} = 102.8 \text{ W}$		
12(b)	An athlete running on a treadmill will have no/less air resistance **Or** there is no wind acting on the runner **Or** the surface of the treadmill is softer/springier/elastic **Or** there is less impact force on the runner	(1)	**1**
	Total for question 12		**5**