Work, Energy & Power

Mark Scheme 3

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Work, Energy & Power
Sub Topic	
Paper Type	Theory
Booklet	Mark Scheme 3

Time Allowed: **56 minutes**

Score: **/46**

Percentage: **/100**

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1	**(a)**	electrical potential energy (stored) when charge moved and gravitational potential energy (stored) when mass moved	B1	
		due to work done in electric field and work done in gravitational field	B1	[2]
	(b)	work done = force × distance moved (in direction of force) and force = mg	M1	
		$mg \times h$ or $mg \times \Delta h$	A1	[2]
	(c) (i)	$0.1 \times mgh = ½\, mv^2$	B1	
		$0.1 \times m \times 9.81 \times 120 = 0.5 \times m \times v^2$	B1	
		$v = 15.3\,\text{m s}^{-1}$	A0	[2]
	(ii)	$P = 0.5\, m\, v^2 / t$	C1	
		$m / t = 110 \times 10^3 / [0.25 \times 0.5 \times (15.3)^2]$	C	
		$= 3740\,\text{kg s}^{-1}$	A1	[3]
2	**(a (i)**	force is rate of change of momentum	B1	[1]
	(ii)	work done is the product of the force and the distance <u>moved</u> in the direction of the force	B1	[1]
	(b) (i)	$W = Fs$ **or** $W = mas$ **or** $W = m(v^2 - u^2) / 2$ **or** W = force × distance s	A1	[1]
	(ii)	$as = (v^2 - u^2) / 2$ any subject	M1	
		$W = mas$ hence $W = m(v^2 - u^2) / 2$	M1	
		RHS represents terms of energy **or** with $u = 0$ KE = $½mv^2$	A1	[3]
	(c) (i)	work done = $½ \times 1500 \times [(30)^2 - (15)^2]$ (=506250)	C1	
		distance = WD / F = 506250 / 3800 = 133 m	A1	[2]
		or $F = ma$ $a = 2.533\ (\text{m s}^{-2})$	C1	
		$v^2 = u^2 + 2as$ $s = 133\,\text{m}$	A1	
	(ii)	the change in kinetic energy is greater or the work done by the force has to be greater, hence distance is greater (for same force)	A1	[1
		allow: same acceleration, same time, so greater average speed and greater distance		

3 **(a** work done is the force × the distance moved / displacement in the direction of the force
or
work is done when a force moves in the direction of the force — B1 [1]

(b) component of weight = 850 × 9.81 × sin 7.5° — C1
= 1090 N — A1 [2]
(*use of incorrect trigonometric function, 0/2*)

(c) ΣF = 4600 – 1090 = (3510) — M1
deceleration = 3510 / 850 — A1
= 4.1 m s^{-2} — A0 [2]

(ii) $v^2 = u^2 + 2as$
$0 = 25^2 + 2 \times -4.1 \times s$ — C1
s = 625 / 8.2
= 76 m — A1 [2]
(*allow full credit for calculation of time (6.05 s) & then s*)

(iii) **1.** kinetic energy = ½ mv^2 — C1
= 0.5 × 850 × 25^2
= 2.7 × 10^5 J — A1 [2]

2. work done = 4600 × 75.7
= 3.5 × 10^5 J — A1 [1]

(iv) difference is the loss in potential energy (*owtte*) — B [1]

4	**(a**	**(i)**	work done equals force × distance moved / displacement in the direction of the force	B1	[1]
		(ii)	power is the rate of doing work / work done per unit time	B1	[1]
	(b)	**(i)**	kinetic energy $= \frac{1}{2} mv^2$	C1	
			$= 0.5 \times 600\ (9.5)^2$	C1	
			= 27075 (J) = 27 kJ	A1	[3]
		(ii)	potential energy $= mgh$		
			= 600 × 9.81 × 4.1	M1	
			= 24132 (J)	A1	
			= 24 kJ	A0	[2]
		(iii)	work done = 27 – 24 = 3.0 kJ	A1	[1]
		(iv)	resistive force = 3000 / 8.2 (distance along slope = 4.1 / sin 30°)	C1	
			= 366 N	A1	[2]
5	**(a**	**(i)**	potential energy: stored energy available to do work	B1	[1]
		(ii)	gravitational: due to height/position of mass OR distance from mass OR moving mass from one point to another	B1	
			elastic: due to deformation/stretching/compressing	B1	[2]
	(b)		height raised = (61 – {61 cos18} =) 3.0 cm	C1	
			energy = (mgh = 0.051 × 9.8 × 0.030 =) 1.5×10^{-2} J	A1	[2]
		(ii)	moment = force × perpendicular distance		
			= 0.051 × 9.8 × 0.61 × sin18	C1	
			= 0.094 N m	A1	[2]