Work, Energy & Power

Mark Scheme 2

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Work, Energy & Power
Sub Topic	
Paper Type	Theory
Booklet	Mark Scheme 2

Time Allowed: **63 minutes**

Score: **/52**

Percentage: **/100**

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

1 **(a** work done is the product of force and the distance moved in the direction of the force
or product of force and displacement in the direction of the force B1 [1]

(b) (i) work done equals the decrease in GPE – gain in KE B1 [1]

(ii) 1. distance = area under line C1
= (7.4 × 2.5) / 2 = 9.3 m (9.25 m) [2]

or

acceleration from graph a = 7.4 / 2.5 (= 2.96) (C1)
and equation of motion $(7.4)^2 = 2 \times 2.96 \times s$ gives s = 9.3 (9.25) m (A1)

2. kinetic energy = $\frac{1}{2} mv^2$ C1

$= \frac{1}{2} \times 75 \times (7.4)^2$ C1

= 2100 J A1 [3]

3. potential energy = mgh C1
$h = 9.3 \sin 30°$ C1
PE = 75 × 9.81 × 9.3 sin 30 ° = 3400 J A1 [3]

4. work done = energy loss C1
R = (3421 – 2054) / 9.3
= 150 (147) N A1 [3]

2 **(a** (work =) force × distance moved / displacement in the direction of the force
OR when a force moves in the direction of the force work is done B1 [1]

(b) kinetic energy = ½ mv^2 C1
= ½ 0.4 $(2.5)^2$ = 1.25 / 1.3 J A1 [2]

(c) (i) area under graph is work done / work done = ½ Fx C1
1.25 = (14 x) / 2 C1
x = 0.18 (0.179) m [allow x = 0.19 m using kinetic energy = 1.3 J] A1 [3]

(ii) smooth curve from v = 2.5 at x = 0 to v = 0 at Q M1
curve with increasing gradient A1 [2]

3 **(a** gravitational PE is energy of a mass due to its position in a gravitational field B1
elastic PE energy stored (in an object) due to (a force) changing its shape / deformation / being compressed / stretched / strained B1 [2]

(b) (i) 1. kinetic energy = ½ mv^2 C1
= ½ × 0.065 × 16^2 = 8.3(2) J A1 [2]

2. $v^2 = 2gh$ OR PE = mgh C1
$h = 16^2 / (2 \times 9.81) = 13(.05)$ m A1 [2]

(ii) speed at t = ½ total time = 8 ($m\,s^{-1}$) or total t =1.63 or $t_{1/2}$ = 0.815 s C1
KE is ¼ or h at $t_{1/2}$ = 9.78 (m) C1
and PE is ¾ of max ratio = 3 or ratio = 9.78 / 3.26 = 3 A1 [3]

(iii) time is less because (average) acceleration is greater OR average force is greater B1 [1]

4 **(a)** loss in potential energy due to decrease in height (as P.E. = mgh) (B1
gain in kinetic energy due to increase in speed (as K.E. = ½ mv^2) (B1
special case 'as PE decreases KE increases' (1/2)
increase in thermal energy due to work done against air resistance (B1)
loss in P.E. equals gain in K.E. and thermal energy (B1)
max. 3 [3]

(b) (i) kinetic energy = ½ mv^2 C1
= ½ × 0.150 × $(25)^2$ C1
= 46.875 = 47 J A [3]

(ii) 1. potential energy (= mgh) = 0.150 × 9.81 × 21 C1
loss = KE – mgh = 46.875 – (30.9) C1
= 15.97 = 16 J A1 [3]

2. work done = 16 J
work done = force × distance C1
F = 16 / 21 = 0.76 N A [2]

5 (a) (i) accelerations (A to 8 and 8 to C) are same magnitude B1
accelerations (A to 8 and 8 to C) are opposite directions
or both accelerations are toward 8 B1
(A to 8 and 8 to C) the component of the weight down the slope provides
the acceleration B1 [3]

(ii) acceleration = $g\sin 15^\circ$ C1
$s = 0 + \frac{1}{2} a f$ $s = 0.26 / \sin 15^\circ = 1.0$ C1
$t^2 = \frac{1.0 \times 2}{9.8 \times \sin 15^\circ}$ $t = 0.89$s A1 [3]

(iii) $v = 0 + g\sin 15$ tor.; $= 0 + 2g\sin 15 \times 1.0$ C1
$v = 2.26 ms^{-1}$ A1 [2]
(using loss of GPE = gain KE can score full marks)

(b) loss of GPE at A = gain in GPE at C or loss of KE at 8 = gain in GPE at C B1
$h_1 = h_2 = 0.26$m or $\frac{1}{2} mv^2 = mgh$ $h_2 = 0.5 \times (2.26)^2 / 9.81 = 0.26$ m
$x = 0.261 \sin 30^\circ = 0.52$ m A1 [2]