ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme June 2003

GCE

Physics A

Unit PA02

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Registered address: Addleshaw Booth & Co., Sovereign House, PO Box 8, Sovereign Street, Leeds LS1 1HQ
Kathleen Tattersall: *Director General*

Unit 2

1

(a)(i) (use of $\Delta Q = mc\Delta\theta$ gives) energy lost by water = $0.20 \times 4200 \times 20$ ✓
$= 1.7 \times 10^4$ J ✓ $(1.68 \times 10^4$ J)

(a)(ii) rate of loss of energy = $\dfrac{1.68 \times 10^4}{10 \times 60} = 28$ (W) ✓
(allow C.E. for value of energy lost in (i)) (*3*)

(b)(i) (use of $\Delta Q = ml$ gives) $(28 \times t) = 0.20 \times 3.3 \times 10^5$ ✓
$t = 2.4 \times 10^3$ s ✓ $(2.36 \times 10^3$ s)
(allow C.E. for value of rate of loss of energy in (a)(ii)

(b)(ii) e.g. constant rate of heat loss ✓
ice remains at 0°C ✓ max*3*)
(*6*)

2

(a)(i) (gravitational) potential energy to kinetic energy ✓

(ii) kinetic energy to heat energy
[or work done against friction] ✓ (*2*)

(b) e.g. when using light gates
place piece of card on trolley of measured length ✓
card obscures light gate just before trolley strikes block ✓
calculate speed from length of card/time obscured ✓

alternative 1: measured horizontal distance ✓
speed = distance/time ✓
time ✓

alternative 2: measure *h* ✓
equate potential and kinetic energy ✓
$v^2 = gh$ ✓

alternative 3: data logger + sensor ✓
how data processed ✓
how speed found ✓ (*3*)

(c) vary starting height of trolley
[or change angle] ✓
the greater the height the greater the speed of impact ✓

[or alter friction of surface ✓
greater friction, lower speed ✓] (2)
(7)

3

(i) weight greater than air resistance
[or (initially only) weight/gravity acting] ✓
hence resultant force downwards or therefore acceleration (2nd law) ✓
air resistance or upward force increases with speed ✓
until air resistance equals weight or resultant force is zero ✓
leaf moves at constant velocity (1st law)
[or 1st law applied correctly] ✓

(ii) air resistance depends on shape
[or other correct statement about air resistance] ✓
air resistance less significant ✓
air resistance less, therefore greater velocity
[or average velocity greater
or accelerates for longer] ✓ max(5)
(5)

4

(a)(i) horizontal component of the tension in the cable ✓

(a)(ii) vertical component of the tension in the cable ✓ (2)

(b)(i) $T_{vert} = 250 \times 9.81 = 2500$ N ✓ (2452 N)

(b)(ii) $T_{horiz} = 1200$ N ✓

(b)(iii) $T^2 = (1200)^2 + (2500)^2$ ✓
$T = (1.44 \times 10^6 + 6.25 \times 10^6)^{1/2} = 2800$ N ✓ (2773 N)
(if use of $T_{vert} = 2450$ N then $T = 2730$ N)
(allow C.E. for values from (b)(i) and (b)(ii))

(b)(iv) $\tan \theta = \dfrac{1200}{2500}$ ✓
$\theta = 26^\circ$ ✓
(allow C.E. for values from (b)(i) and (b)(ii)) (6)
(8)

5

(a)(i) acceleration ✓

(a)(ii) both represent acceleration of free fall
[or same acceleration] ✓

(a)(iii) height/distance ball is dropped from above the ground
[or displacement] ✓

(a)(iv) moving in the opposite direction ✓

(a)(v) kinetic energy is lost in the collision
[or inelastic collision] ✓ *(5)*

(b)(i) $v^2 = 2 \times 9.81 \times 1.2$ ✓
$v = 4.9\ \text{m s}^{-1}$ ✓ $(4.85\ \text{m s}^{-1})$

(b)(ii) $u^2 = 2 \times 9.81 \times 0.75$ ✓
$u = 3.8\ \text{m s}^{-1}$ ✓ $(3.84\ \text{m s}^{-1})$

(b)(iii) change in momentum $= 0.15 \times 3.84 - 0.15 \times 4.85$ ✓
$= -1.3\ \text{kg m s}^{-1}$ ✓ $(1.25\ \text{kg m s}^{-1})$
(allow C.E. from (b)(i) and (b)(ii))

(b)(iv) $F = \dfrac{1.3}{0.10}$ ✓
$= 13\ \text{N}$ ✓
(allow C.E. from (b)(iii)) *(8)*
(13)

6

(a)(i) $pV = nRT$ ✓

(a)(ii) all particles identical or have same mass ✓
collisions of gas molecules are elastic ✓
inter molecular forces are negligible (except during collisions) ✓
volume of molecules is negligible (compared to volume of container) ✓
time of collisions is negligible ✓
motion of molecules is random ✓
large number of molecules present
(therefore statistical analysis applies) ✓
monamatic gas ✓
Newtonian mechanics applies ✓ $_{\text{max}}$*(4)*

(b) $E_k = \dfrac{3RT}{2N_A}$ or $\dfrac{3}{2}kT$ ✓

$= \dfrac{3 \times 8.31 \times 293}{2 \times 6.02 \times 10^{23}}$ ✓

$= 6.1 \times 10^{-21}$ J ✓ $(6.07 \times 10^{-21}$ J) (*3*)

(c) masses are different ✓
hence because E_k is the same, mean square speeds must be different ✓ (*2*)
(*9*)

Quality of Written Communication (Q2(b) and Q3) ✓✓ (*2*)
(*2*)