INTERNATIONAL BACCALAUREATE
BACCALAURÉAT INTERNATIONAL
BACHILLERATO INTERNACIONAL
IBO

MARKSCHEME

May 2002

PHYSICS

Standard Level

Paper 2

Subject Details: Physics SL Paper 2 Markscheme

General

A markscheme often has more specific points worthy of a mark than the total allows. This is intentional. Do not award more than the maximum marks allowed for part of a question.

When deciding upon alternative answers by candidates to those given in the markscheme, consider the following points:

- Each marking point has a separate line and the end is signified by means of a semicolon (;).
- An alternative answer or wording is indicated in the markscheme by a "/"; either wording can be accepted.
- Words in (…) in the markscheme are not necessary to gain the mark.
- The order of points does not have to be as written (unless stated otherwise).
- If the candidate's answer has the same "meaning" or can be clearly interpreted as being the same as that in the markscheme then award the mark.
- Mark positively. Give candidates credit for what they have achieved, and for what they have got correct, rather than penalising them for what they have not achieved or what they have got wrong.
- Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
- Occasionally, a part of a question may require a calculation whose answer is required for subsequent parts. If an error is made in the first part then it should be penalised. However, if the incorrect answer is used correctly in subsequent parts then **follow through** marks should be awarded. Indicate this with **"ECF"**, error carried forward.
- Units should always be given where appropriate. Omission of units should only be penalised once. Indicate this by **"U-1"** at the first point it occurs. Ignore this, if marks for units are already specified in the markscheme.
- Deduct **1 mark in the paper** for gross sig dig error *i.e.* for an **error of 2 or more digits**.

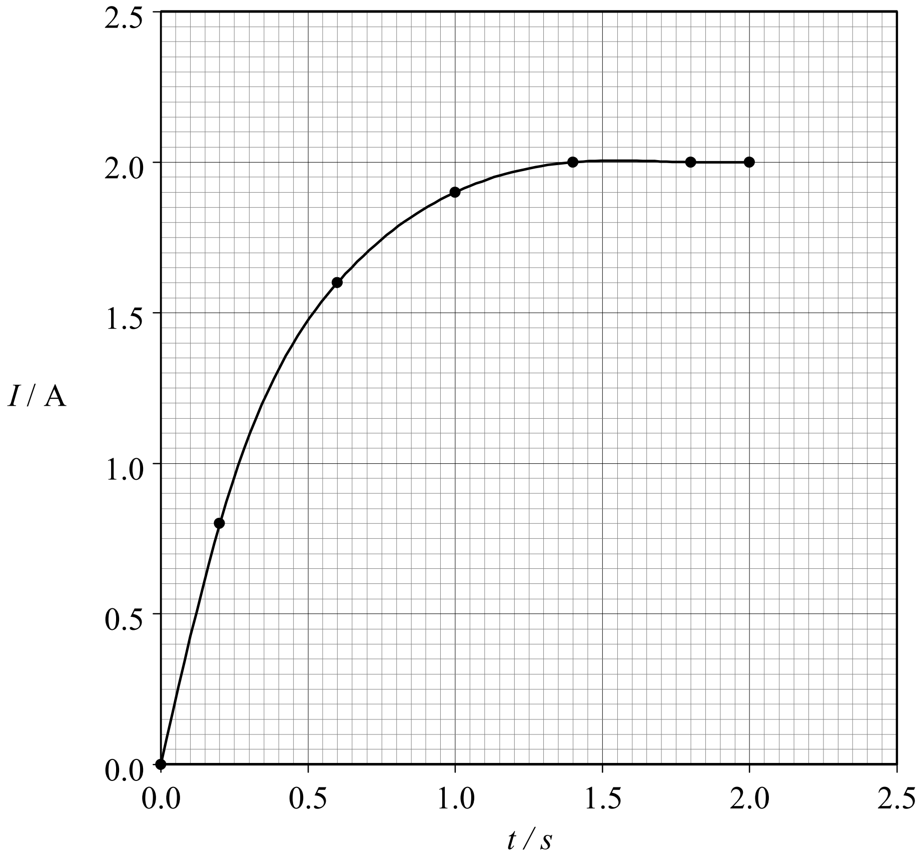
e.g. if the answer is 1.63:

2	*reject*
1.6	accept
1.63	accept
1.631	accept
1.6314	*reject*

Indicate the mark deduction by **'SD-1'**. However if a question specifically deals with uncertainties and significant digits, and marks for sig digs are already specified in the markscheme, then do <u>not</u> deduct again.

SECTION A

A1. (a)



appropriate size (at least half of grid); *[1]*
axes labels (including units); *[1]*
scale; *[1]*
data points; *[1]*
best fit line; *[1]*
[max 5]

(b) 2.0 A *[max 1]*

(c) 2.0 Ω *[max 1]*

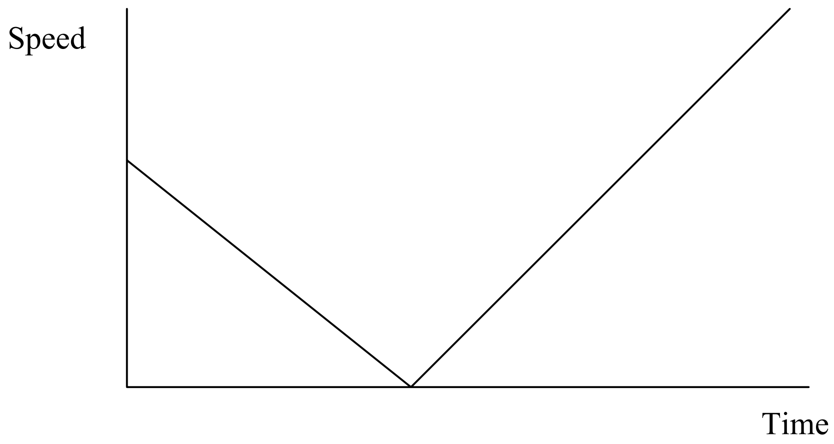
(d) suitable construction; *[1]*
to give 0.4 s (allow ± 0.1); *[1]*
[max 2]

(e) $0.4 = \frac{L}{2.0}$;
to give L = 0.8 Ω s; *[max 1]*

A2. (a) use $v^2 = 2gh$
to give h = 7.2 m; ***[1]***
above sea-level = 37.2 m; ***[1]***
[max 2]

(b) use $v = u + gt$ to find time to reach maximum height; ***[1]***
t = 1.2 s; ***[1]***
use $v^2 = u^2 + 2gh$ to find the speed with which stone hits the sea
gives $v = 27.3\ \mathrm{m\,s^{-1}}$; ***[1]***
use $v = u + gt$ to give t = 1.52 s; ***[1]***
total time = 1.52 + 2.4 = 3.9 s; ***[1]***
or they might use $-30 = 12t - 5t^2$; ***[1]***
[max 5]

(c)



same slopes; ***[1]***
greater final speed at sea; ***[1]***
if velocity-time drawn then; ***[1]***
[max 2]

A3. (a) (i) 6 V divides equally between R_B, R_C and R_D; *[1]*
therefore voltage across $R_C = 2$ V; *[1]*
or they might do it via current, total current $\frac{6}{7.5}$; *[1]*
$\frac{1}{4}$ of this flows through R_C therefore voltage across $R_C = \left(\frac{6}{7.5}\right) \times \frac{1}{4} \times 10 = 2$ V; *[1]*
[max 2]

(ii) 3 V ***[max 1]***

(iii) connect voltmeter across R_B and then R_D; *[1]*
the connection that gives a zero reading indicates which resistor is short circuit; *[1]*
OWTTE
[max 2]

(b) R_C has gone open circuit; *[1]*
or R_B and R_D have both gone short circuit; *[1]*
[max 1]

SECTION B

B1. (a) $t_1 = 0.6\,\text{s}$ position; ***[1]***
$t_2 = 0.7\,\text{s}$ position; ***[1]***
[max 2]

(b) (i) g = slope of graph; ***[1]***
slope of graph $= \dfrac{6.0}{0.6}$; ***[1]***
$= 10.0(\pm 0.3)\,\text{m}\,\text{s}^{-2}$; ***[1]***
[max 3]

(ii) $h = \dfrac{v^2}{2g}$; ***[1]***
$= \dfrac{16}{(2 \times 10.0)}$; ***[1]***
= 0.8 m; ***[1]***
or from the graph time to reach maximum height of rebound = 0.4 s; ***[1]***
$h = \dfrac{1}{2} g t^2$; ***[1]***
$\dfrac{1}{2} \times 10.0 \times 0.16 = 0.8\,\text{m}$; ***[1]***
[max 3]

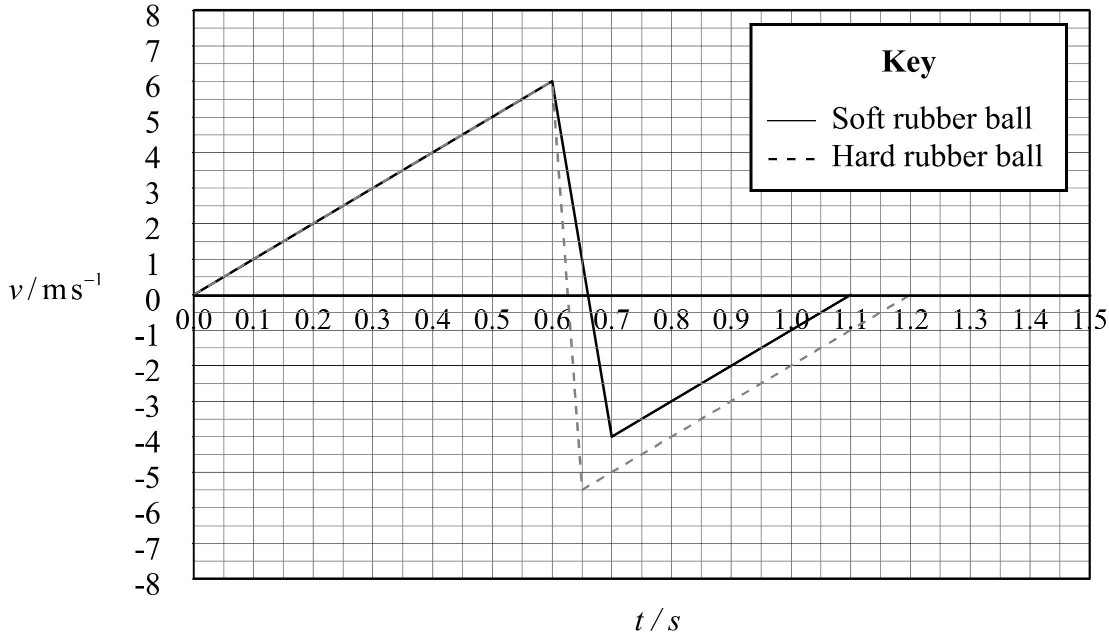
(c) momentum at $t_1 = 0.2 \times 6.0 = 1.2\,\text{N}\,\text{s}$; ***[1]***
momentum at $t_2 = 0.2 \times -4.0 = -0.8\,\text{N}\,\text{s}$; ***[1]***
change in momentum = 2.0 N s; ***[1]***
[max 3]

(d) F = rate of change of momentum; ***[1]***
from the graph time = 0.1 s; ***[1]***
therefore $F = \dfrac{2.0}{0.1}$; ***[1]***
= 20 N; ***[1]***
(ECF Δp = 0.4 N s F = 4 N)
[max 4]

(e) Look for an answer which shows that they understand that it is the system comprising the ball and the Earth in which momentum is conserved. If they recognise that the collision is inelastic but can get no further award ***[1]***.
[max 2]

(f) equal; ***[1]***
Newton 3; ***[1]***
states forces are equal (and opposite); ***[1]***
OWTTE
Look for an appreciation of Newton 3
[max 3]

(g)



0 → 0.6 s is the same; *[1]*
shorter contact time; *[1]*
speed greater leaving floor; *[1]*
same slope for rebound; *[1]*
longer time to reach max rebound height; *[1]*

[max 5]

B2. Part 1. Ideal gas behaviour

(a) (i) *Award **[1]** if **measure** is omitted, **[1]** if **average** is omitted and **[1]** if **kinetic** is omitted.*
temperature is a measure of the average kinetic energy of the molecules; ***[2]***

*Award **[1]** if **total** is omitted.*
internal energy is the total energy of the molecules; ***[2]***
[max 4]

(ii) *Look for an answer along these lines:*
when the molecules collide with the moving piston they rebound with a greater speed; ***[1]***
their KE is therefore increased and since KE measures temperature, the temperature increases / energy is transferred to the molecules by the moving piston *etc.*; ***[1]***
[max 2]

(b) (i) longer arrows; ***[1]***
but not all the same length ***or*** in the same direction; ***[1]***
[max 2]

(ii) $\frac{p_1}{p_2} = \frac{T_1}{T_2}$ with $T_1 = 300\,\text{K}$; ***[1]***
to give $T_2 = 600\,\text{K}$; ***[1]***
*Award **[1]** if K not used, $54\,^\circ C$.*
[max 2]

(iii) recognise that change in internal energy $= ms\Delta\theta$; ***[1]***
$= 4.0\times10^{-3}\times3.1\times10^{3}\times300$; ***[1]***
$= 3.7\times10^{3}$ J; ***[1]***
*335 J if 27 °C used, 7.4×10^{3} J if 600 K used – award **[2]**, award **[1]** if 54 °C used – 670 J.*
[max 3]

(c) $p_1V_1 = p_2V_2$; ***[1]***
with $p_1 = 2.0\times10^{5}$ Pa; ***[1]***
to give $p_2 = 4.0\times10^{5}$ Pa; ***[1]***
[max 3]

B2. Part 2. Magnetic forces

(a) $v\Delta t$ ***[max 1]***

(b) number of particles per unit length $= \dfrac{N}{L}$; ***[1]***

therefore number in length $v\Delta t = \dfrac{Nv\Delta t}{L}$; ***[1]***

[max 2]

(c) $\Delta q = \dfrac{Nvq\Delta t}{L}$; ***[1]***

$I = \dfrac{\Delta q}{\Delta t} = \dfrac{Nvq}{L}$; ***[1]***

[max 2]

(d) upwards ***[max 1]***

(e) force on N particles $= NBqv$; ***[1]***
but from (c) $Nqv = IL$; ***[1]***
substitute to get $F = BIL$; ***[1]***
[max 3]

B3. Part 1. Waves in a rubber cord

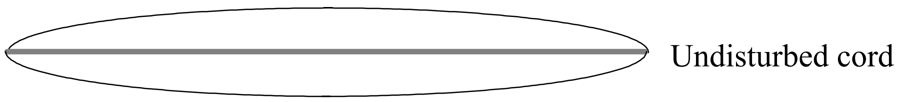
(a) (i) 10 cm ***[max 1]***

(ii) 60 cm ***[max 1]***

(b) $v = f\lambda = \frac{\lambda}{T}$; ***[1]***
$= 3.0\ \text{m s}^{-1}$; ***[1]***
[max 2]

(c) 0.1 s is half a period; ***[1]***
therefore wave has moved forward 30 cm; ***[1]***
therefore –ve sine; ***[1]***
i.e. ***[1]*** *for correct sketch.*
[max 3]

(d) (i)



[max 1]

(ii) λ = 5.0 m; ***[1]***
$f = \frac{c}{\lambda}$; ***[1]***
= 2.0 Hz; ***[1]***
[max 3]

(iii) 4.0 Hz ***[max 1]***

B3. Part 2. Radioactive decay

(a) (i) same atomic ***number***; ***[1]***
but different mass number; ***[1]***
or in terms of numbers of protons and neutrons ***[max 2]***

(ii) the time for activity of a radioactive sample to decrease to half its initial activity;
OWTTE
[max 1]

(b) (i) Z = 84 ***[max 1]***

(ii) A = 216; ***[1]***
A – Z = 132; ***[1]***
[max 2]

(c) the radiation "knocks off" electrons from neutral atoms; ***[1]***
thus creating an ion pair-free electron and positive ion; ***[1]***
OWTTE
[max 2]

(d) (i) $I = ne$; ***[1]***
to give $n = 2.5\times10^{8}\ \text{s}^{-1}$; ***[1]***
[max 2]

(ii) $\dfrac{1.5\times10^{6}}{30} = 5\times10^{4}$

number of ions $= 1.0\times10^{5}$ ***[max 1]***

(iii) number of α-particles produced = initial activity; ***[1]***
$\dfrac{2.5\times10^{8}}{5.\times10^{4}} = 5\times10^{3}\ \text{s}^{-1}$; ***[1]***
[max 2]