M12/4/PHYSI/SP2/ENG/TZ1/XX

22126511

International Baccalaureate®
Baccalauréat International
Bachillerato Internacional

PHYSICS
STANDARD LEVEL
PAPER 2

Thursday 10 May 2012 (afternoon)

1 hour 15 minutes

Candidate session number

0	0							

Examination code

2	2	1	2	–	6	5	1	1

INSTRUCTIONS TO CANDIDATES

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer one question.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- A clean copy of the ***Physics** Data Booklet* is required for this paper.
- The maximum mark for this examination paper is *[50 marks]*.

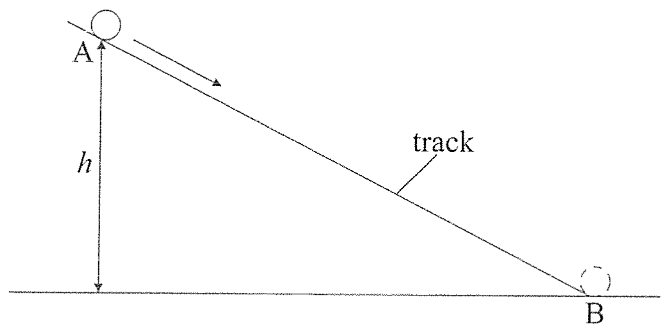
28 pages

SECTION A

*Answer **all** questions. Write your answers in the boxes provided.*

A1. Data analysis question.

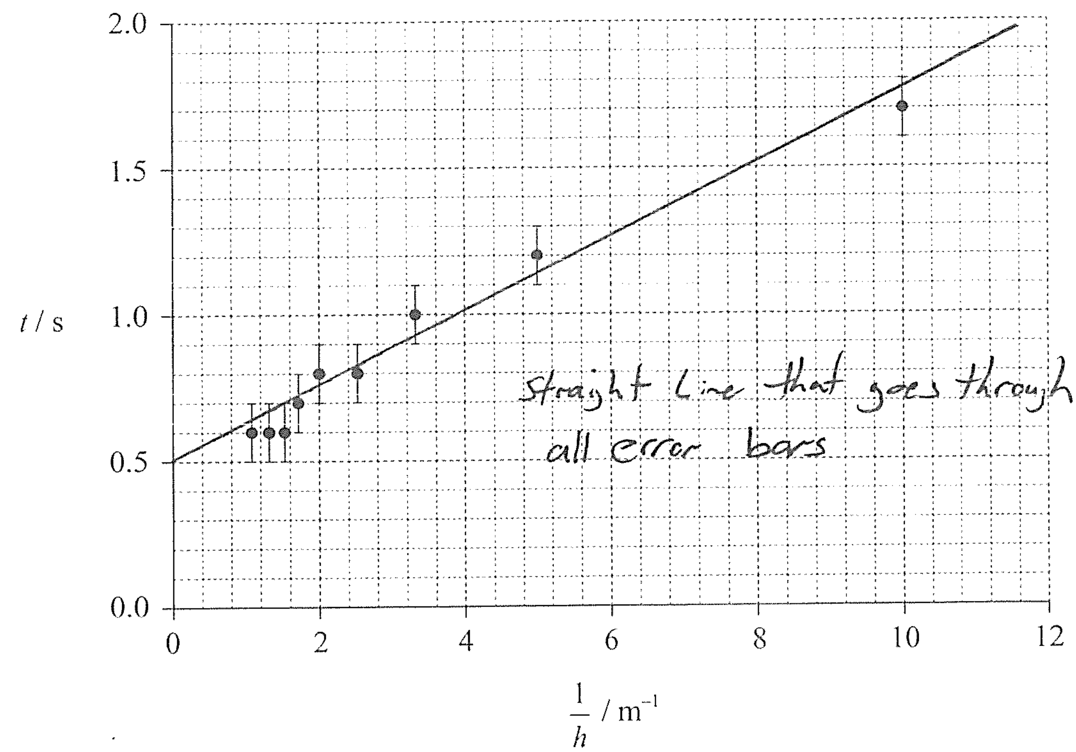
A small sphere rolls down a track of constant length AB. The sphere is released from rest at A. The time t that the sphere takes to roll from A to B is measured for different values of height h.



(This question continues on the following page)

(Question A1 continued)

A student suggests that t is proportional to $\frac{1}{h}$. To test this hypothesis a graph of t against $\frac{1}{h}$ is plotted as shown on the axes below. The uncertainty in t is shown and the uncertainty in $\frac{1}{h}$ is negligible.



(a) (i) Draw the straight line that best fits the data. *[1]*

(ii) State why the data do not support the hypothesis. *[1]*

Line does not go through the origin

(This question continues on the following page)

(Question A1 continued)

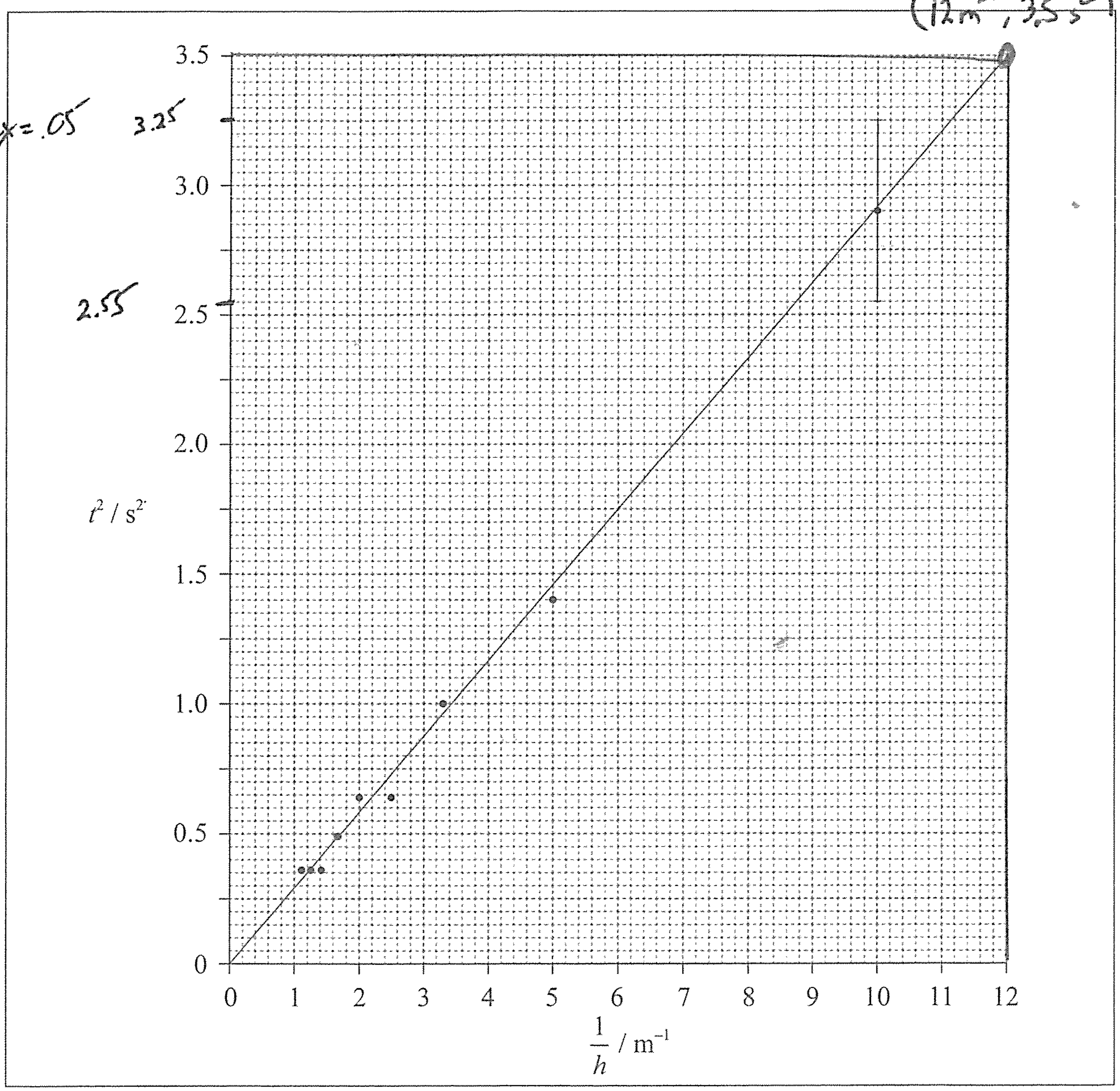
(b) Another student suggests that the relationship between t and h is of the form

$$t = k\sqrt{\frac{1}{h}}$$

where k is a constant.

To test whether or not the data support this relationship, a graph of t^2 against $\frac{1}{h}$ is plotted as shown below.

The best-fit line takes into account the uncertainties for all data points.



(This question continues on the following page)

(Question A1 continued)

The uncertainty in t^2 for the data point where $\frac{1}{h} = 10.0\,\text{m}^{-1}$ is shown as an error bar on the graph.

(i) State the value of the uncertainty in t^2 for $\frac{1}{h} = 10.0\,\text{m}^{-1}$. *[1]*

$\frac{3.25s^2 - 2.55s^2}{2} = \frac{.70s^2}{2} = \pm .35s^2$

(ii) Calculate the uncertainty in t^2 when $t = 0.8 \pm 0.1$ s. Give your answer to an appropriate number of significant digits. *[4]*

$t^2 = (0.8 \pm 0.1s) \times (0.8 \pm 0.1s)$ From Area & Perimeter Errors on E-Board

0.8s 1SF
0.8s 1SF
.64s² = .6s²

$\frac{\Delta Y}{.6s^2} = \frac{.1}{0.8} + \frac{.1}{0.8}$

$\frac{\Delta Y}{.6} = .25$ $\Delta Y = .15s^2 = .2s^2$ 1SF

$0.6s^2 \pm .2s^2$ Uncertainty $= .2s^2$

(iii) Use the graph to determine the value of k. Do not calculate its uncertainty. *[3]*

-Solve with equation or slope $(t)^2 = \left(K\sqrt{\frac{1}{h}}\right)^2$ $\sqrt{K^2} = \sqrt{.29}$

-Plug in point from graph $t^2 = K^2\left(\frac{1}{h}\right)$ $K = .54$

Accept .53-.57 $\frac{3.5s^2}{12m^{-1}} = \frac{K^2(12m^{-1})}{12m^{-1}}$

(iv) State the unit of k. *[1]*

$K^2 = \frac{s^2}{m^{-1}}$ $\sqrt{K^2} = \sqrt{m}\sqrt{s^2}$ $K = m^{1/2}s$

A2. This question is about the greenhouse effect.

The following data are available for use in this question:

Quantity	Symbol	Value
Power emitted by the Sun	P	3.8×10^{26} W
Distance from the Sun to the Earth	d	1.5×10^{11} m
Radius of the Earth	r	6.4×10^{6} m
Albedo of the Earth's atmosphere	α	0.31
Stefan–Boltzmann constant	σ	5.7×10^{-8} W m^{-2} K^{-4}

(a) Explain why the power absorbed by the Earth is

Need to explain each part of the equation for a point

$$\frac{P}{4\pi d^2} \times (1-\alpha) \times \pi r^2$$

[3]

Intensity of Sun's radiation at the Earth's orbit $= \frac{P}{4\pi d^2}$

Fraction absorbed by the earth $(1-\alpha)$

Surface area of the earth absorbing the radiation $\pi . r^2$

(This question continues on the following page)

(Question A2 continued)

(b) The equation in (a) leads to the following expression which can be used to predict the Earth's average surface temperature T.

$$T = \sqrt[4]{\frac{(1-\alpha)P}{16\pi\sigma d^2}}$$

(i) Calculate the predicted temperature of the Earth. *[2]*

$$T = \left(\frac{(1-.31)(3.8\times10^{26}\,W)}{16\pi\,(5.7\times10^{-8}\,Wm^{-2}K^{-4})(1.5\times10^{11}\,m)^2}\right)^{1/4}$$

$$T = \left(\frac{2.6\times10^{26}}{6.4\times10^{16}}\right)^{1/4} = 252K \text{ or } 250K \ (2SF)$$

(ii) Explain why the actual average surface temperature of the Earth is in fact higher than the answer to (b)(i). *[2]*

Green House gases in the atmosphere trap some energy radiated by the earth and prevent it from leaving our earth.

A3. This question is about thermal energy transfer.

A hot piece of iron is placed into a container of cold water. After a time the iron and water reach thermal equilibrium. The heat capacity of the container is negligible.

(a) Define *specific heat capacity*. *[2]*

Q = mcΔT c = specific heat
= Amount of heat / energy required to raise the temp
1°C per unit mass

(b) The following data are available.

Mass of water	= 0.35 kg
Mass of iron	= 0.58 kg
Specific heat capacity of water	= 4200 J kg^{-1} K^{-1}
Initial temperature of water	= 20 °C
Final temperature of water	= 44 °C
Initial temperature of iron	= 180 °C

(i) Determine the specific heat capacity of iron. *[3]*

Iron = Water

Q iron = Q water mcΔT (iron) mcΔT (Water)

2SF

0.58 kg (c) (44°C − 180°C) = .35 kg (4200 J kg^{-1} K^{-1}) (44°C − 20°C)

c = 447 J kg^{-1} K^{-1} ≈ 450 J kg^{-1} K^{-1}

(ii) Explain why the value calculated in (b)(i) is likely to be different from the accepted value. *[2]*

Not a closed system – energy would be given off to the surroundings ie. the container

Final temp of iron would be less, so the specific heat of the iron would be greater.