Solutions – Physics HTGR Work

Topic 1

54×10^{6} 0.086×10^{-6} 753×10^{9} 23.87×10^{-3}

0.5 µm 93.09 Gm 3 200 kN 2.4 nm

s	ms	µs	ns	ps
0.00045	0.45	450	450 000 or 450×10^{3}	450×10^{6}
0.000000789	0.000789	0.789	789	789×10^{3}
0.000 000 000 64	0.000 000 64	0.000 64	0.64	640

mm	m	km	µm	Mm
1287360	1 287.360	1.28 7360	1 287 360 000	0. 001 287 360
295	0.295	0.000 295	295 000	0 .000 000 295

2. $v = f\lambda = 0.25 \times 10^{6} \times 5.6 \times 10^{-6} = 1400$ m s^{-1}

3. $\lambda = v/f = 330 / 3.0 \times 10^{9} = 1.1 \times 10^{-7}$ m

4. $f = v/\lambda = 300 \times 10^{6} / 0.050 \times 10^{-3} = 6.0 \times 10^{12}$ Hz = 6.0 THz

5. $f = v/\lambda = 300 \times 10^{6} / 6.0 \times 10^{-2} = 5.0 \times 10^{9}$ Hz = 5.0 GHz

Topic 2

Value	Sig Figs	Value	Sig Figs	Value	Sig Figs	Value	Sig Figs
2	1	1066	4	1800.45	7	0.070	2
2.0	2	82.42	4	2.483×10^{4}	4	69324.8	6
500	1	750000	2	0.0006	1	0.0063	2
0.136	3	310	2	5906.4291	8	9.81×10^{4}	3
0.0300	3	3.10×10^{4}	3	200000	1	40000.00	7
54.1	3	3.1×10^{2}	2	12.711	5	0.0004×10^{4}	1

Value 1	Value 2	Value 3	Total Value	Total to correct sig figs
51.4	1.67	3.23	56.3	56.3
7146	–32.54	12.8	7126.26	7126
20.8	18.72	0.851	40.371	40.4
1.4693	10.18	–1.062	10.5873	10.59
9.07	0.56	3.14	12.77	12.77
739762	26017	2.058	765781.058	765781
8.15	0.002	106	114.152	114
152	0.8	0.55	153.35	153

Value 1	Value 2	Total Value	Total to correct sig figs
0.91	1.23	1.1193	1.1
8.764	7.63	66.86932	66.9
2.6	31.7	82.42	82
937	40.01	37489.37	37 500
0.722	634.23	457.91406	458

Value 1	Value 2	Total Value	Total to correct sig figs
5.3	748	7.085561×10^{-3}	7.1×10^{-3}
3781	6.50	581.6923077	582
91×10^{2}	180	50.55555555556	51
5.56	22×10^{-3}	252.727272727	250
3.142	8.314	0.37791677	0.3779

Value 1	Value 2	Value 3	Mean Value	Mean to correct sig figs
1	1	2	1.3333	1
435	299	437	436	436
5.00	6.0	29.50	5.50	5.5
5.038	4.925	4.900	4.9543333333	4.954
720.00	728.0	725	724.3333333333	724
0.00040	0.00039	0.000380	0.000380	0.00038
31	30.314	29.7	30.338	30

Topic 3

$6\ m^2$	=	$60\ 000\ cm^2$
$0.002\ m^2$	=	$2000\ mm^2$
$24\ 000\ cm^2$	=	$2.4\ m^2$
$46\ 000\ 000\ mm^3$	=	$0.046\ m^3$
$0.56\ m^3$	=	$560\ 000\ cm^3$

$750\ mm^2$	=	$0.00075\ m^2$
$5 \times 10^{-4}\ cm^3$	=	$5.0 \times 10^{-10}\ m^3$
$8.3 \times 10^{-6}\ m^3$	=	$8300\ mm^3$
$3.5 \times 10^2\ m^2$	=	$3.5 \times 10^6\ cm^2$
$152000\ mm^2$	=	$0.152\ m^2$

$31 \times 10^8\ m^2$	=	$3100\ km^2$
$59\ cm^2$	=	$5900\ mm^2$
$24\ dm^3$	=	$24000\ cm^3$
$4\ 500\ mm^2$	=	$45\ cm^2$
$5 \times 10^{-4}\ km^3$	=	$500\ 000\ m^3$

A 2.0 m long solid copper cylinder has a cross-sectional area of $3.0 \times 10^2\ mm^2$. What is its volume in cm^3?

h= 2.0 m = 2.0×10^2 cm   csa = $3.0\ cm^2$

V = cross-section area x height = $2.0 \times 10^2 \times 3.0$= 600

Volume = _____600 cm^3

$5\ N\ cm^{-2}$	=	$50\ 000\ N\ m^{-2}$
$1150\ kg\ m^{-3}$	=	(1150 x1000 / 100x100x100) = $1.15\ g\ cm^{-3}$
$3.0\ m\ s^{-1}$	=	(3.0 /1000) x (60x60) = $10.8\ km\ h^{-1}$
$65\ kN\ cm^{-2}$	=	$650\ N\ mm^{-2}$
$7.86\ g\ cm^{-3}$	=	$7860\ kg\ m^{-3}$

Topic 4

$R = V/I$ $t = Q/I$ $A = \rho L/A$ $r = (\varepsilon - V)/I$

$u = 2s/t - v$ $f = (\Phi + E_K)/h$ $g = E_{P,}/mh$ $F = 2E/e$

$u = \sqrt{(v^2 - 2as)}$ $m = T^2 k/4\pi^2$

Topic 5

Case study 1

IV Mass of sphere   DV time to fall a set distance   CV drop distance, diameter of sphere

IV continuous   graph - line graph

Case Study 2

IV types of activities   DV number of children   CV time of day and day of the week

IV categoric / discrete   graph bar chart

Case study 3

IV Value of mass (g)   DV length of spring   CV same spring, spring stationary when measured

IV continuous   graph line

Case study 4

IV number of blades   DV output potential difference

CV same dist from fan, constant fan output, same blade design

IV discrete   graph bar chart

Topic 6.

Pd across resistor/V	Current through the resistor/A			
	I_1	I_2	I_3	$I_{average}$
1.0	0.11	0.10	0.12	0.11
2.0	0.21	0.18	0.24	0.21
3.0	0.33	0.60	0.30	0.32
4.0	0.35	0.40	0.45	0.40
5.0	0.50	5.10	0.48	0.49

Topic 7

1. Straight line positive gradient , constant
2. Curve, negative gradient, steep then getting shallower
3. Straight line, negative gradient, constant
4. Straight line positive gradient, constant
5. Curve , positive gradient, decreasing
6. Curve, positive gradient, increasing.

Topic 8

Use S L A P U (5 mark) criteria. Graphs will be reviewed in the new term.

Topic 9

Show construction lines on your graphs.

1. m = 124-0/50-0 = 2.5
2. m = 22.5 -2.0/5.0-0 = 4.1
3. m= 112 - 42/11-4 = 10
4. m = 0.07-0.14/24-17 = -0.01

Topic 10.

Construction lInes need to be drawn on graphs for the full method.

1. Gradient at point 2.0 m= 22-0/4-0 = 5.5 gradient at point 4.0 m= 46-0/5.0-1.8 = 14.4
2. Gradient at point 1.5 m= 424-0/4-1 = 14.7 gradient at point 3.5 m= 116-0/4-2 = 58

Topic 11- always show a full method with your solutions.

Top graph area = 39 m Bottom graph area = 33 +/- 1 m (to 2 sig fig)

Topic 12 All values approximate, your estimate should be within quoted error.
Left hand graph- 41 squares each square 1 m s^{-1} x 1 s = 1 m area = 41 m +/- 1 m

Right hand graph 31 squares each square 1 km s^{-1} x 60 s = 60 km area = 1860 km +/- 60 km

Topic 13

Graph 1- 0-10 minutes temperature rises at a constant rate from -20 ^{0}C to 0 ^{0}C of 2 ^{0}C min^{-1}.
Ice gaining thermal energy.
10-15 minutes temp is constant at 0 ^{0}C as a change of state occurs; solid to liquid.
15- 35 minutes temp rises at 5 ^{0}C min^{-1}, constant rate because gradient is constant.
35-75 minutes temp constant at 100 ^{0}C, change of state ; liquid to gas.
75-80 minutes rapid increase in temp, gradient steepest 8 ^{0} min^{-1}, gas phase.
(values are expected from the graph as is suitable theory; you are expected to recognise graphs).

Graph 2.
As the distance increases from Earth the (relative) value of g decreases. Large decrease initially seen by steep gradient with gradient decreasing as distance increases.
Taking values from graph:
relative dist 1.0, relative g =100 relative dist 2.0, relative g =25, double d , g drops by 4
relative dist 1.5, relative g = 44 relative dist 3.0, relative g =11, double d, g drops by 4
We are always looking for patterns in data, gradients, areas or values such as above.

In this case doubling the distance drops g by a factor of 4; called the inverse square law.
This is a very important law in Physics

Graph 3.
Section 1: At 0 ^{0}C activity low at 20 units (no units given so we use **units** as a term) rising to a max activity of 100 units at 40 ^{0}C. Section 2: From peak at 40 ^{0}C activity rapidly drops to a low of 4 units at 100 ^{0}C. Optimum activity is at 40 +/- 4 ^{0}C

Graph 4. 6- sections, but only 2 are described here. You need to write a description for all sections.
Section 1: Constant acceleration of 3/6=0.5 m s^{-2} for 6 seconds, covering a displacement from the start point of (3 x 6)/2 = 9m.
Section 2: constant velocity of 3 m s^{-1} for 4 seconds covering a displacement of 3 x 4 = 12m

Topic 14.

Average mass = 20.01/4 = 5.00 +/- 0.01g (uncertainty is +/- the resolution of instrument). Recorded values are precise as the repeat readings are close together but they are not accurate because the average value does not equal the true value. Do not confuse resolution with precise. There is possibly a zero error on the balance as all the recorded values are above the true value by a similar amount.

Topic 15

<table>
<tr><th>Measurement</th><th>Source of error</th><th>Type of error</th></tr>
<tr><td>A range of values are obtained for the length of a copper wire</td><td>RULER measuring length of wire</td><td>RANDOM</td></tr>
<tr><td colspan="3">Reduce this error by ensuring the wire is laid out straight, place the rules directly next to the wire, take repeat readings, remove anomalous readings and calculate an average length for the wire</td></tr>
<tr><td>The reading for the current through a wire is 0.74 A higher for one group in the class</td><td>Ammeter</td><td>SYSTEMATIC</td></tr>
<tr><td colspan="3">Zero error in the ammeter. Check reading before any current flows in the circuit. Subtract zero error reading from each value or calibrate/adjust ammeter to read zero.</td></tr>
<tr><td>A range of values are obtained for the rebound height of a ball dropped from the same start point onto the same surface.</td><td>Ruler / person measuring rebound height</td><td>RANDOM

SYSTEMATIC</td></tr>
<tr><td colspan="3">RANDOM because person recording the height looks at the rule from different positions and or doesn't use same part of ball to record max height.

SYSTEMATIC because rule might have a zero error.

Solution- put graph paper scale on a screen behind the ball. Drop the ball close to the screen and record the fall in slo-mo using a camera (smart phone). Analyse the play back to get accurate values.</td></tr>
<tr><td>A few groups obtain different graphs of resistance vs light intensity for an LDR. A light bulb placed at different distances from the LDR was used to vary the light intensity.</td><td>Additional light sources in the room</td><td>SYSTEMATIC</td></tr>
<tr><td colspan="3">Some groups may be near a window which will allow extra light onto the measuring equipment beyond that from the light bulb used in the initial experiment. Reduce error by using proper black out curtains and switch off additional light sources while taking readings or cover the apparatus with blackout material.</td></tr>
<tr><td>The time period (time of one oscillation) of a pendulum showing a range of values</td><td>Timing the oscillation</td><td>Random</td></tr>
</table>

Time 20 oscillations and divide by 20. Use a fiducial mark (pin as a point of reference) to help determine the point of one complete oscillation while counting the 20 oscillations. Release the pendulum at the same amplitude- should be a small angle of about 15^0 from vertical.

Topic 16

Measuring cylinder - Read the volume of water from the bottom of the meniscus and perpendicular to the scale to reduce parallax error. resolution/error +/- 2 ml

Top pan electronic balance - Ensure balance is zeroed before any reading are taken.

Make sure paper is not touch surfaces either side of the active top pan measuring surface.

Ensure no breeze or external forces are acting on the top pan.

resolution/error +/- 0.01g

Ruler - Place the ruler adjacent to the object being measured to reduce parallax error.

Make sure zero is placed at the start of the object being measured.

Ensure ruler is parallel to the measured surface.

resolution/error +/- 1 mm

Thermometer - Read the top of the active liquid and perpendicular to the scale to reduce parallax error.

resolution/error +/- 2^0C (estimate, we should be better than +/- 5^0C increments shown on the scale) .

Topic 17.

Some pointers.

Produce an equipment list; think of key/essential equipment .

IV height egg dropped from, m

DV diameter of splatter, m (area, m^2 , calculated from this value, we don't calculate the area directly)

CV size of egg, type of surface the egg is dropped onto.

Range of IV 0.50 to 4.00 m in 0.50 m increments.

Give a suitable table with heading /units

Graph plotted of height egg dropped (m) on x-axis v area of splatter (m^2)

Add more detail to your method and hand in with the rest of the notes.

Your method should be detailed enough to be followed and the experiment carried out.