AQA

A Level Physics

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Summer Work

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Please complete the activities in this booklet and hand in during your first Physics lesson in September

ASPIRE

SIR WILLIAM ROBERTSON ACADEMY

Welcome

After five years of hard work you have chosen to study Physics at A Level. You have decided to follow in the footsteps of Einstein, Newton, Planck, Faraday and many more. You have decided you want a challenge, but also understand the world around you. In our opinion you have decided to take the best subject in the world, we're not biased, we promise.

The purpose of this booklet is not to scare you, it aims to support your transition from GCSE to A Level. The booklet contains a potential reading list to broaden your knowledge, links to Physics YouTubers who are here to support, but also provides you with a list of books that we would recommend purchasing to support your study.

Throughout your time studying A Level Physics, we will support you every step of the way, answer your questions, but also share a love of the subject. The journey starts here, and we cannot wait to share the adventure with you.

Welcome to A Level Physics!

Contents

Course Outline

AS and A-level

1 Measurements and their errors

2 Particles and radiation

3 Waves

4 Mechanics and materials

5 Electricity

A-level only

6 Further mechanics and thermal physics

7 Fields and their consequences

8 Nuclear physics

9 Optional topics. You will study one of these: Astrophysics, Medical physics, Engineering physics, Turning points in physics or Electronics.

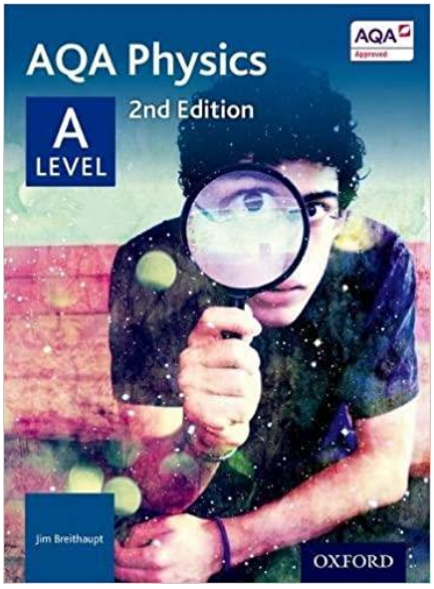
The assessment for the A-level consists of three exams

Paper 1	Paper 2	Paper 3
What's assessed Sections 1 – 5 and 6.1 (Periodic motion)	What's assessed Sections 6.2 (Thermal Physics), 7 and 8 Assumed knowledge from sections 1 to 6.1	What's assessed Section A: Compulsory section: Practical skills and data analysis Section B: Optional topic
Assessed • written exam: 2 hours • 85 marks • 34% of A-level	Assessed • written exam: 2 hours • 85 marks • 34% of A-level	Assessed • written exam: 2 hours • 80 marks • 32% of A-level
Questions 60 marks of short and long answer questions and 25 multiple choice questions on content.	Questions 60 marks of short and long answer questions and 25 multiple choice questions on content.	Questions 45 marks of short and long answer questions on practical experiments and data analysis. 35 marks of short and long answer questions on optional topic.

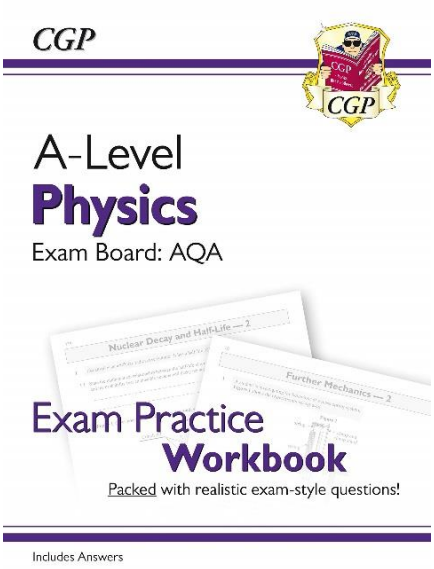
What we expect from you

- 4 hours of lesson time per week
- 3 hours of independent learning time per week
- 2 hours of homework per week
- To be adult learners. This means taking responsibility for your own learning.
- Monitor your progress, reflect upon any areas of difficulty and resolve these! If you need any more resources to practice any areas of weakness, please ask
- Use your resources and ASK QUESTIONS! Our job is to support you in your learning - don't forget this!
- To complete all homework to the best of your ability, on time
- To read around the subject
- A neat and organised folder with class learning/tests/HW and revision notes (this will be given to you on day 1, and will be checked monthly)
- To be prepared when you arrive in class (i.e. have a full pencil case including a protractor and a calculator)
- To challenge yourself and to try your best.

Resources Provided



You will have access to the course textbook via Kerboodle

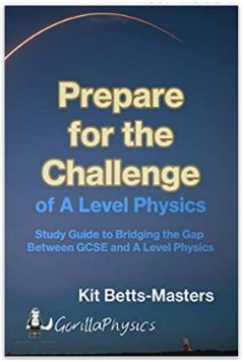


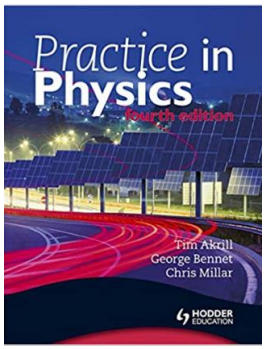
You will be given a copy of the CGP workbook for your independent learning

Other Textbooks & Workbooks

Prepare for the challenge of A Level Physics
Kit Betts-Masters

Miss Parsons has a pdf copy of this which is available on the A Level Physics Google Drive



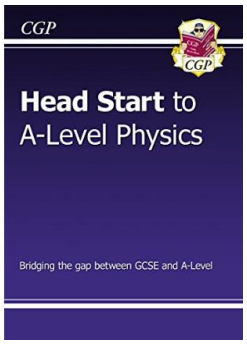


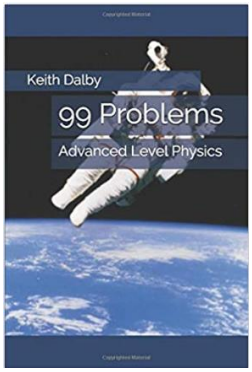
Practice in Physics
Akrill, Bennet and Millar

Will support with practice calculations.

New Head Start to A-level Physics
CGP A-Level Physics

Again, Miss Parsons has a pdf copy of this which is available on the A Level Physics Google Drive

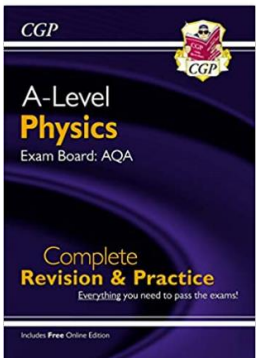


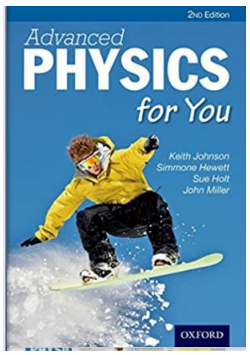


99 Problems: Advanced Level Physics
Dalby

Will support with practice calculations.

New A-Level Physics: AQA Year 1 & 2 Complete Revision & Practice with Online Edition
CGP





Advanced Physics for You
Johnson, Hewett, Holt and Miller

This book is not related to any exam board and offers alternative explanations and practice questions.

Do not buy these yet if you are thinking about it – Please have a browse through Miss Parsons' copies to see if you like them.

Online Resources

Google Drive:

- This links to Miss Parsons' Google Drive (a work in progress) where she will upload presentations, worksheets, exam questions etc for your own independent learning and revision
  https://bit.ly/ParsonsPhysicsDrive

YouTube:

- A Level Physics Online – A video for every lesson in the AS year. For £19.99 you can gain access to the A2 materials.
  https://www.alevelphysicsonline.com/aqa

- Science Shorts – Video tutorials going through topics and providing examples
  https://www.youtube.com/user/ScienceShorts

- Malmesbury Science – Sister channel to Science Shorts, with videos going through the required practicals
  https://www.youtube.com/channel/UC-TM-z1-tmX1iK_H4SxVhww

- Gorilla Physics – A range of videos around Physics and how to increase your grades.
  https://www.youtube.com/channel/UCDWYbhR94ZYFUXd4NJvAHYQ

Practice Questions:

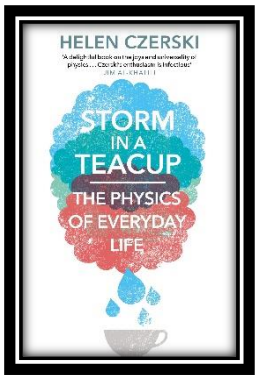
- Isaac Physics
  https://isaacphysics.org

- Physics and Maths Tutor
  https://www.physicsandmathstutor.com/physics-revision/a-level-aqa/

Book Recommendations

Below is a selection of books that should appeal to a physicist – someone with an enquiring mind who wants to understand the universe around us. None of the selections are textbooks full of equation work (there will be plenty of time for that!) instead each provides insight to either an application of physics or a new area of study that you will be meeting at A Level for the first time.

1. Storm in a Teacup: The Physics of Everyday Life

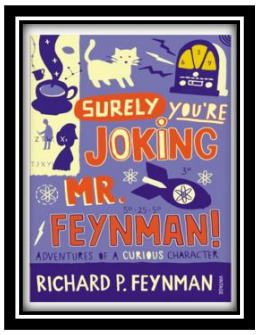


ISBN – 978-1784160753

In this book, Helen Czerski looks at how physics relates to various things in everyday life. She compares everyday things from lizards and high vis jackets to a cuppa and the clouds.

https://www.amazon.co.uk/Storm-Teacup-Physics-Everyday-Life/dp/178416075X

2. Surely You're Joking Mr Feynman: Adventures of a Curious Character

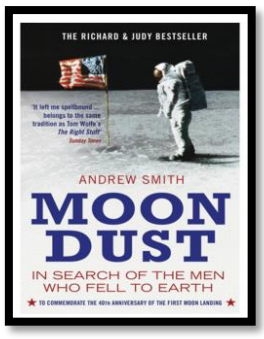


ISBN – 978-0393355628

Richard Feynman was a Nobel Prize winning Physicist. In my opinion he epitomises what a Physicist is. By reading this books you will get insight into his life's work including the creation of the first atomic bomb and his bongo playing adventures and his work in the field of particle physics.

https://www.amazon.co.uk/Surely-Youre-Joking-Mr-Feynman/dp/0393355624

3. Moondust: In Search of the Men Who Fell to Earth

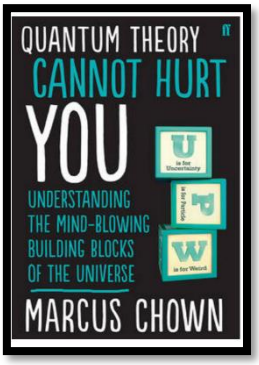


ISBN – 978-1408802380

One of the greatest scientific achievements of all time was putting mankind on the surface of the moon. Only 12 men made the trip to the surface, at the time of writing the book only 9 are still with us. The book does an excellent job of using the personal accounts of the 9 remaining astronauts and many others involved in the space program at looking at the whole space-race era, with hopefully a new era of space flight about to begin as we push on to put mankind on Mars in the next couple of decades.

https://www.amazon.co.uk/Moondust-Search-Men-Fell-Earth/dp/1408802384

4. Quantum Theory Cannot Hurt You: Understanding the Mind-Blowing Building Blocks of the Universe

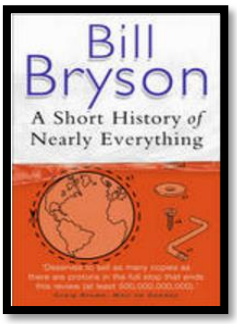


ISBN – 978-0571315024

Any Physics book by Marcus Chown is an excellent insight into some of the more exotic areas of Physics that require no prior knowledge. In your first year of A-Level study you will meet the quantum world for the first time. This book will fill you with interesting facts and handy analogies to whip out to impress your peers!

https://www.amazon.co.uk/Quantum-Theory-Cannot-Hurt-Understanding/dp/057131502X

5. A Short History of Nearly Everything

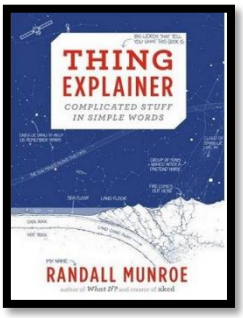


ISBN – 978-0552997041

A modern classic. Popular science writing at its best. A Short History of Nearly Everything Bill Bryson's quest to find out everything that has happened from the Big Bang to the rise of civilization - how we got from there, being nothing at all, to here, being us. Hopefully by reading it you will gain an awe-inspiring feeling of how everything in the universe is connected by some fundamental laws.

https://www.amazon.co.uk/Short-History-Nearly-Everything-Bryson/dp/0552997048

6. Thing Explainer: Complicated Stuff in Simple Words

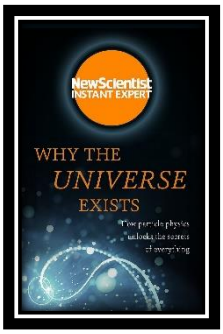


ISBN – 978-1473620919

This recommendation is a bit of a wild-card – a book of illustrated cartoon diagrams that should appeal to the scientific side of everyone. Written by the creator of online comic XTCD (a great source of science humour) is a book of blueprints from everyday objects such as a biro to the Saturn V rocket and an atom bomb, each one meticulously explained BUT only with the most common 1000 words in the English Language. This would be an excellent coffee table book in the home of every scientist.

https://www.amazon.co.uk/Thing-Explainer-Complicated-Stuff-Simple/dp/1473620910

7. Why the Universe Exists: How particle physics unlocks the secrets of everything



ISBN – 978-1473629684

If the reasonably recent discovery of the Higgs boson piqued your interest, then Why The Universe Exists will take you deeper into the world of particle physics, with leading physicists and New Scientist exploring how the universe functions at the smallest scales.

https://www.amazon.co.uk/Why-Universe-Exists-everything-Scientist/dp/1473629683

Film Recommendations

1. **Moon (2009)**
   With only three weeks left in his three year contract, Sam Bell is getting anxious to finally return to Earth. He is the only occupant of a Moon-based manufacturing facility along with his computer and assistant, GERTY. When he has an accident however, he wakens to find that he is not alone.

2. **Gravity (2013)**
   Two astronauts work together to survive after an accident which leaves them stranded in space.

3. **Interstellar (2014)**
   A team of explorers travel through a wormhole in space in an attempt to ensure humanity's survival

4. **The Imitation Game (2015)**
   Based on a true story. During World War II, the English mathematical genius Alan Turing tries to crack the German Enigma code with help from fellow mathematicians.

5. **Apollo 13 (1995)**
   Based on a true story. NASA must devise a strategy to return Apollo 13 to Earth safely after the spacecraft undergoes massive internal damage putting the lives of the three astronauts on board in jeopardy.

TV Series Recommendations

1. Chernobyl (HBO & Sky) I CANNOT RECOMMEND THIS ONE ENOUGH !!!
2. Wonders of the Universe (BBC)
3. Wonders of the Solar System (BBC)
4. The Secrets Of Quantum Physics (Spark)
5. Shock and Awe, The Story of Electricity (BBC)
6. Cosmos (National Geographic)

YouTube & TED Talk Recommendations

1. From mach-20 glider to hummingbird drone (TED Talk)
   https://www.ted.com/talks/regina_dugan_from_mach_20_glider_to_humming_bird_drone/up-next?language=en
2. Is our universe the only universe? (TED Talk)
   https://www.ted.com/talks/brian_greene_why_is_our_universe_fine_tuned_for_life?language=en
3. The fascinating physics of everyday life (TED Talk, from the author of book recommendation 1)
   https://www.ted.com/talks/helen_czerski_fun_home_experiments_that_teach_you_physics?language=en
4. We need nuclear power to solve climate change (TED Talk)
   https://www.ted.com/talks/joe_lassiter_we_need_nuclear_power_to_solve_climate_change?language=en
5. Minute Physics (YouTube Channel)
   https://www.youtube.com/user/minutephysics
6. NASA TV
   http://www.nasa.gov/multimedia/nasatv/
7. The Fantastic Mr. Feynman – YouTube Documentary
   https://www.youtube.com/watch?v=H9fjhQMsDW4

Ideas for Day/Weekend Trips

In Order of Distance:

1. Woolsthorpe Manor, Lincolnshire (Where Isaac Newton lived)
2. National Space Centre, Leicester
3. National Science and Media Museum, Bradford
4. Thinktank Science Museum, Birmingham
5. Bletchley Park, Milton Keynes
6. The Rutherford Building, University of Manchester
7. Jodrell Bank Observatory, Macclesfield
8. Science Museum, London
9. Royal Observatory, Greenwich, London
10. The Royal Society, London

Activities

The next part of this workbook has a range of activities for you to have a go at. This work is designed to help prepare you for A-level physics. It covers some of the basic skills that will be used throughout the course. Many of these extend and develop ideas you will have come across at GCSE in science and maths. You will need to use a combination of **careful reading**, **research**, **logic** and **persistence**. You should expect to find some parts difficult, but if you persevere you will often find you can do them! The recommendation is to do a page every couple of days

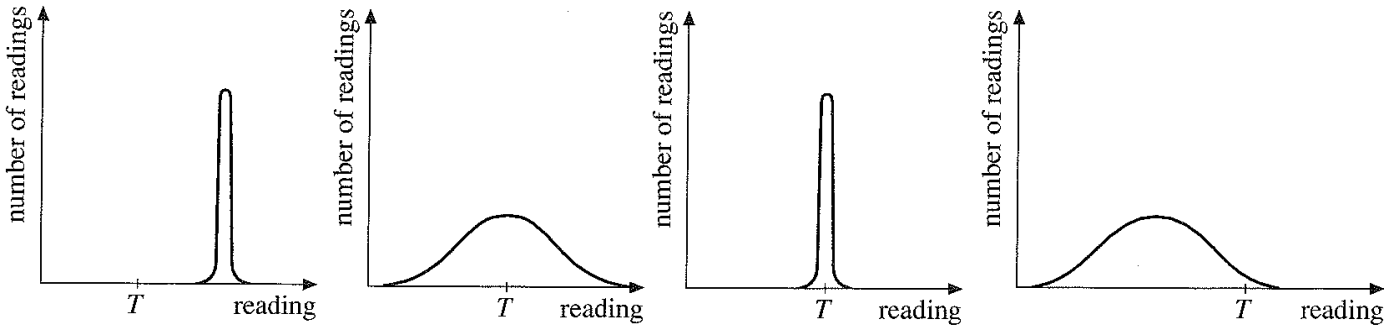
YOU MAY USE A CALCULATOR THROUGHOUT

Please complete as much of this booklet as possible, including the self-assessment below, then hand in during the first week of teaching in September. The aim is to have the model answers available on the Google Drive soon!

Confidence: **A = all understood** **C = mostly understood** **E = poorly understood**	**Self Assessment**		
	Mark	**Confidence (A-E)**	**ISSUES / COMMENTS**
Definitions	/ 46		
Prefixes	/ 48		
Means and Anomalous Results	/ 58		
Significant Figures	/ 60		
Significant Figures 2	/ 70		
Trigonometry	/ 8		
Calculating Uncertainty	/ 35		
Calculating Uncertainty 2	/ 58		
Identifying Errors	/ 24		
Graph Plotting	/ 24		
Lines of Best Fit	/ 6		
Gradients	/ 16		
Gradient Equations	/ 39		
Gradient Equations 2	/ 39		
Interpreting Graphs	n/a		
Tangents	/ 20		
Vernier Callipers and Micrometers	/ 12		
Describing Experiments	/ 60		
Rearranging & Deriving Equations	/ 20		
Rearranging & Deriving Equations 2	/ 17		
Units	/ 52		
Units - Challenge	/ 26		

Skills	Definitions	Marks
Literacy		/ 46

1. Define the following words:
   a. Independent variable
   b. Dependent variable
   c. Control variable
   d. Continuous variable
   e. Discrete variable
   f. Ordered variable
   g. Categoric variable
   h. Accuracy
   i. Precision
   j. Reliability
   k. Calibration
   l. Random error
   m. Systematic error
   n. Zero error
   o. Mean value
   p. Anomalous results
   q. Line of best fit
   r. Gradient
   s. Y-Intercept
2. How do you improve the precision of a reading?
3. How could you improve the reliability of your results?
4. If a weighing scale read 20g when nothing was placed on it how would you describe it?
5. If you used this to find the masses of different samples of metal what type of error would it produce?
6. How could you calculate the true value for each of the masses?
7. How do you calculate a mean value of 4 readings?
8. If all your readings are to 2 significant figures how many sig fig can your mean value be? Why?
9. Which type of variable would the following be classed as:
   a. Height in cm?
   b. Gender?
   c. Dress size?
   d. Weight?
   e. Distance in m?
   f. Brightness?
   g. Volume of CO_2 produced in m^3?
   h. Temperature in Fahrenheit?
   i. Favourite chocolate bar?
   j. Current in Amps?
   k. Smelliness?
   l. Age in days?
   m. pH?
   n. Pressure in Pa?
   o. Loudness?
   p. Birth month?
10. If T represents the true value which of the graphs below represents:
    a. Precise and accurate?
    b. Precise but not accurate?
    c. Accurate but not precise?
    d. Neither accurate nor precise?



Skills	Prefixes	Marks
Mathematical		/ 48

In Physics we have to deal with quantities from the very large to the very small. A prefix is something that goes in front of a unit and acts as a multiplier. This sheet will give you practice at converting figures between prefixes.

Symbol	Name	What it means		How to convert	
P	peta	10^{15}	1000000000000000	-	↓ x1000
T	tera	10^{12}	1000000000000	↑ ÷ 1000	↓ x1000
G	giga	10^{9}	1000000000	↑ ÷ 1000	↓ x1000
M	mega	10^{6}	1000000	↑ ÷ 1000	↓ x1000
k	kilo	10^{3}	1000	↑ ÷ 1000	↓ x1000
-	-	-	1	↑ ÷ 1000	↓ x1000
m	milli	10^{-3}	0.001	↑ ÷ 1000	↓ x1000
µ	micro	10^{-6}	0.000001	↑ ÷ 1000	↓ x1000
n	nano	10^{-9}	0.000000001	↑ ÷ 1000	↓ x1000
p	pico	10^{-12}	0.000000000001	↑ ÷ 1000	↓ x1000
f	femto	10^{-15}	0.000000000000001	↑ ÷ 1000	-

Convert the figures into the prefixes required.

s	ms	µs	ns	ps
134.6				
96.21				
0.773				

m	km	mm	Mm	Gm
12873				
0.295				
57.23				

kg	Mg	mg	g	Gg
94.76				
0.000765				
823.46				

A	mA	µA	nA	kA
0.000000678				
3.56				
0.00092				

Skills	Means and Anomalous Results	Marks
Mathematical		/ 58

For each set of values calculate the mean and then calculate the mean ignoring any anomalous results.

1	2	3	Mean	
4152	2996	4018		
935.5	925.8	926.7		
16.2	19.1	17.4		
80.1316	80.1324	80.1466		
2229	2011	1610		
127.664	127.416	127.489		
55.88	11.97	37.59		
3.767	3.763	3.751		
375.5	511.5	463.4		
0.507	0.415	0.230		
27145	25157	26017		
1450	1014	2238		
9104.32	10529.45	9160.97		

1	2	3	4	Mean	
63.10	62.97	62.53	62.99		
465.98	463.40	466.96	155.56		
3.61	7.39	3.55	3.64		
73.71	70.98	74.19	72.38		
2.058	1.566	2.078	1.787		
416	402	189	986		
700653	739762	742471	726161		
2670887	2670901	2669942	2670733		
110.4	260.1	1044.2	488.8		

1	2	3	4	5	Mean	
140	220	90	180	140		
56300	41200	58600	48300	53800		
0.186	0.341	0.276	0.216	0.314		
1.427	0.235	0.488	1.922	1.620		
34	62	46	12	39		
326.19	360.22	314.20	352.22	400.18		
1.4	5.3	2.7	3.9	2.6		

Skills	Significant Figures	Marks
Mathematical		/ 60

For each value state how many significant figures it is stated to.

Value	Sig Figs	Value	Sig Figs	Value	Sig Figs	Value	Sig Figs
2		1066		1800.45		0.07	
2.0		82.42		2.483×10^4		69324.8	
2.00		750000		2.483		0.0063	
0.136		310		5906.4291		9.81×10^4	
0.34		3.10×10^2		200000		6717	
54.1		3.1×10^2		12.711		0.91	

Add the values below then write the answer to the appropriate number of significant figures. If a question doesn't tell you how many significant figures to write your answer to, use the same number of significant figures as they do in the question. If they use a different number of significant figures in the question, use the most common first. If it's totally random then use the average

Value 1	Value 2	Value 3	Total Value	Total to correct sig figs
51.4	1.67	3.23		
7146	–32.54	12.8		
20.8	18.72	0.851		
1.4693	10.18	–1.062		
9.07	0.56	3.14		
739762	26017	2.058		
8.15	0.002	106		
132.303	4.123	53800		
152	0.8	0.55		
0.1142	4922388	132000		

Multiply the values below then write the answer to the appropriate number of significant figures

Value 1	Value 2	Total Value	Total to correct sig figs
0.91	1.23		
8.764	7.63		
2.6	31.7		
937	40.01		

Divide value1 by value 2 then write the answer to the appropriate number of significant figures

Value 1	Value 2	Total Value	Total to correct sig figs
5.3	748		
3781	6.434		
91×10^2	180		
5.56	22×10^{-3}		

Skills	Significant Figures 2	Marks
Mathematical		/ 70

For each value state how many significant figures it is stated to.

Value	Sig Figs	Value	Sig Figs	Value	Sig Figs	Value	Sig Figs
2.863		689671.49		100000		6.4981×10^{7}	
100		356865		8.5×10^{-3}		7.85	
24.92		13		6400		17.99	
5.18×10^{27}		182.15		875.4		3.189×10^{6}	
2.8		4.267		94		0.053	
2.9970		0.02		94.0		0.422	

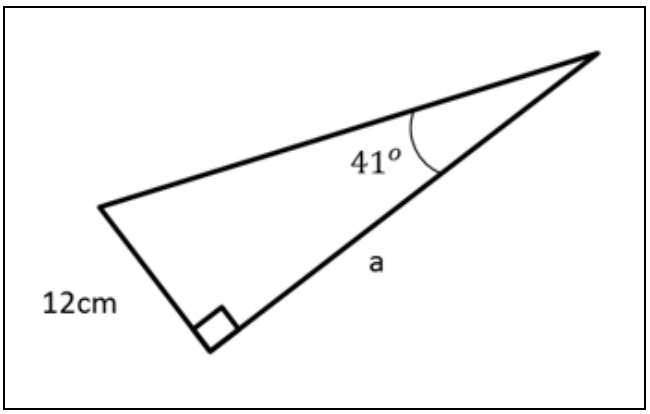
Calculate the mean of the values below then write the answer to the appropriate number of significant figures

Value 1	Value 2	Value 3	Mean Value	Mean to correct sig figs
1	1	2		
435	299	4130		
500	600	900		
3.038	4.925	3.6		
720	498	168		
1655	2996	140		
0.230	925.8	56300		
2238	80.1324	1.427		
9160.97	2011	34		
62.99	127.416	326.19		
155.56	11.97	1.4		
3.64	3.763	700653		
72.38	511.5	2670887		
1.787	888	110.4		
986	0.415	62.97		
726161	25157	463.40		
488.8	10529.45	70.98		
0.186	140	1.566		
1.427	53800	402		
34	0.314	739762		
326.19	1.620	2670901		
1.4	39	260.1		
2670733	1014	7.39		

Skills	Trigonometry	Marks
Mathematical		/ 8

Calculate the length of the missing side and/or angles.

1.



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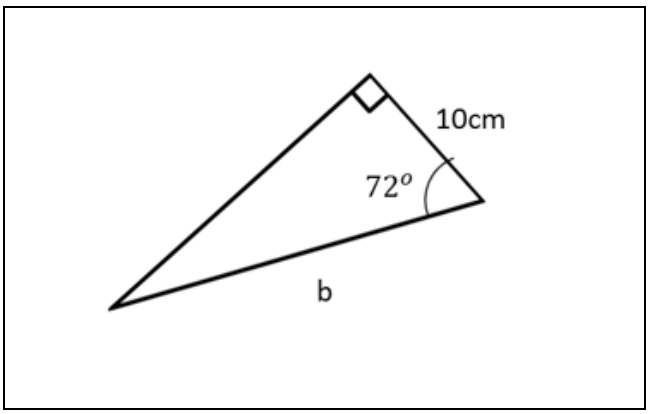

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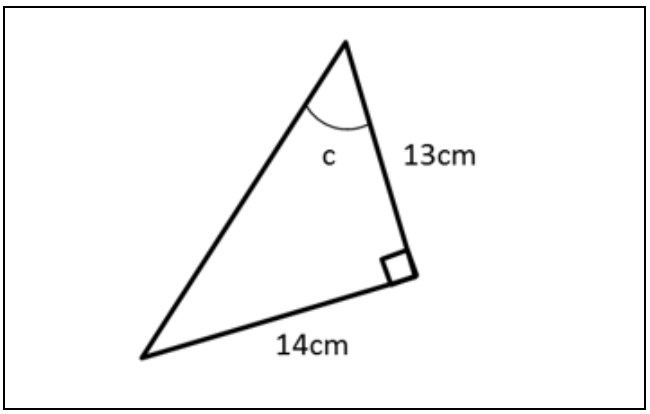

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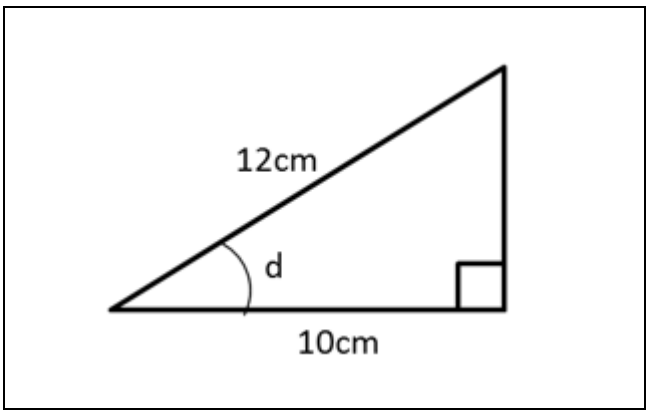

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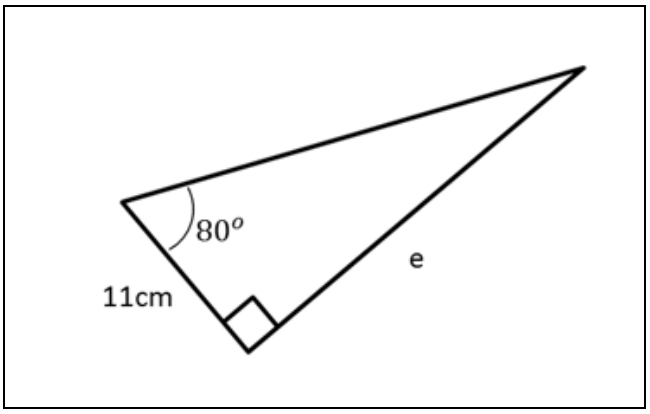

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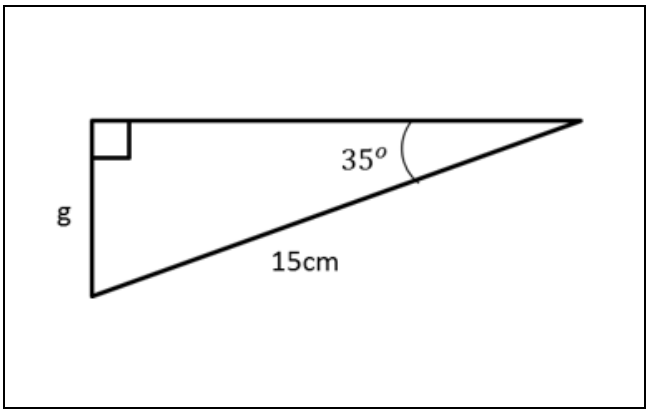

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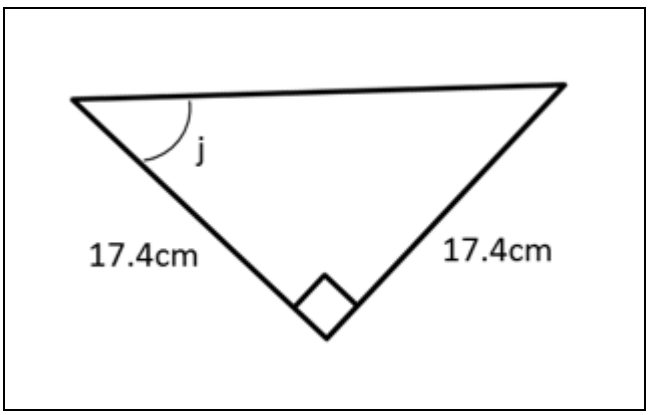

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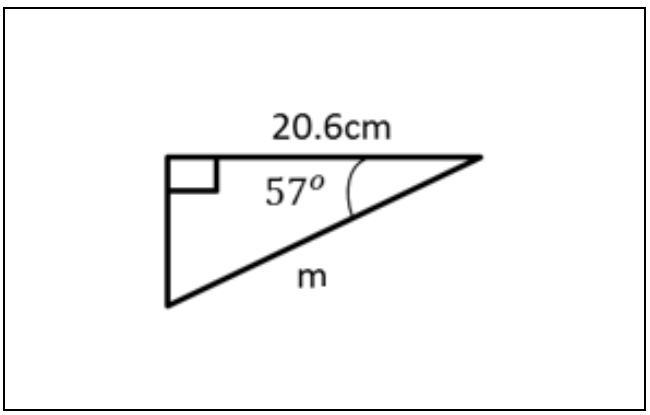


Skills	Calculating Uncertainty	Marks
Mathematical		/ 35

Absolute uncertainty (also just called uncertainty) is calculated using the equation $uncertainty = \frac{range}{2}$

Percentage uncertainty is calculated using the equation $uncertainty = \frac{absolute\ uncertainty}{mean\ value} \times 100$

Uncertainty can also be written in the format "mean value ± uncertainty" e.g. 36 ± 2 mm

Complete the table.

Variable	Reading 1	Reading 2	Reading 3	Mean Value	Uncertainty	% Uncertainty
A	121	118	119			
B	599	623	593			
C	3.3	3.6	3.2			

*When you add or subtract variables, the total **absolute uncertainty** is the sum of the absolute uncertainties*

eg. 5.0 ± 0.1 mm + 2.0 ± 0.1 mm = 7.0 ± 0.2 mm

5.0 ± 0.1 mm - 2.0 ± 0.1 mm = 3.0 ± 0.2 mm

Based on your answers in the table above, what would be the absolute uncertainty in the following quantities?

$A + B$		$A - B$	
$A + C$		$C + B$	
$A + C - B$		$B + A - C$	

Complete the table.

Variable	Reading 1	Reading 2	Reading 3	Mean Value	Uncertainty	% Uncertainty
D	17	17	17			
E	42.5	42.8	42.1			
F	3.60	3.28	3.73			
G	757	714	739			

*When you multiply one variable by a constant, the total **absolute uncertainty** is also multiplied by that constant*

eg. 2 x (5.0 ± 0.1 mm) = 10.0 ± 0.2 mm

Based on your answers in the tables above, what would be the absolute uncertainty in the following quantities?

$3D$		$3G$	
$2E$		$3D + F$	
$2G - E$		$D - 4E$	
$2A + 3F$		$2F + 2B - G$	

Skills	Calculating Uncertainty 2	Marks
Mathematical		/ 58

Complete the table.

Variable	Reading 1	Reading 2	Reading 3	Mean Value	Uncertainty	% Uncertainty
H	58205	58309	58193			
I	82.3	81.4	82.8			
J	1985	1988	1980			
K	43	19	27			

*When you multiply or divide two or more variables, the total **percentage uncertainty** is the sum of the percentage uncertainties*
eg. (5.0 ± 2%) x (2.0 ± 5%) = 10.0 ± 7%

Based on your answers in the tables above, what would be the absolute uncertainty in the following quantities?

$\frac{G^2}{DE}$		$J^3\frac{HI}{K}$	
KFC		JFK	
K^4I		I^2JK	
$\frac{A^2C}{B}$		F^2B^2G	

Complete the table.

Variable	1	2	3	4	Mean Value	Uncertainty	% Uncertainty
L	11.49	11.56	11.63	10.53			
M	385	322	408	328			
N	2736	2729	2743	2643			
O	5101	5108	5003	5098			
P	125	137	167	142			
Q	6124	6118	6510	6123			
R	3.29	3.29	3.29	3.29			
S	4589	4606	4644	4596			

What would be the percentage error in the following quantities?

MO		MO^2N	
$OMLM$		N^3O	
$\frac{L}{M}$		$\frac{NO^2}{L}$	
NML		$LMON$	
P^2R		QPR	
SNO^2P		$(QR)^2S$	
$\frac{SR}{PM}$		$\frac{R^2S}{N^2}$	

Skills	Identifying Errors	Marks
Practical		/ 24

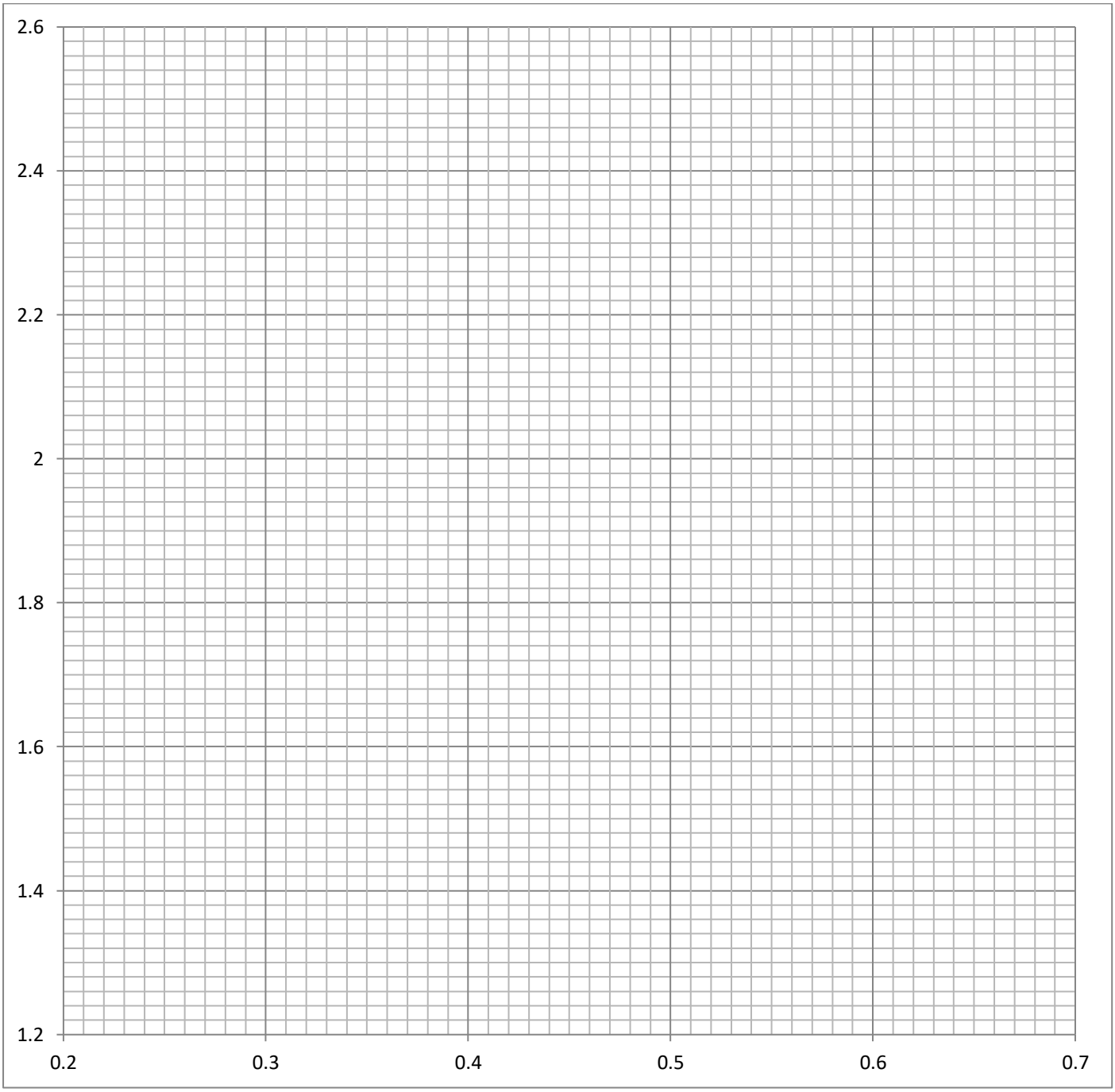
For each of the measurements listed below identify the most likely source of error what type of error this is and one method of reducing it.

Measurement	Source	Type
A range of values are obtained for the length of a copper wire		
Method to reduce error:		
The reading for the current through a wire is 0.74A higher for one group in the class		
Method to reduce error:		
A beaker of hot water left on the desk appears to have gained temperature		
Method to reduce error:		
A mass of a beaker shows different values on different balances		
Method to reduce error:		
A range of values are obtained for the bounce back height of a dropped ball		
Method to reduce error:		
A few groups obtain different graphs of resistance vs light intensity for an LDR		
Method to reduce error:		
The time period (time of one oscillation) of a pendulum		
Method to reduce error:		
A range of values are obtained for the time a parachute takes to reach the ground from 0.5m		
Method to reduce error:		

Skills	Graph Plotting	Marks
Mathematical		/ 24

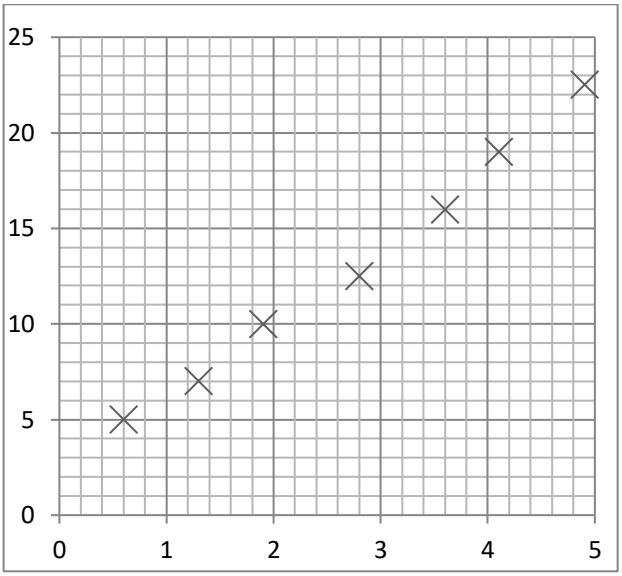
You are going to practice plotting points on a graph. This skill can carry several marks, especially in Paper 3.

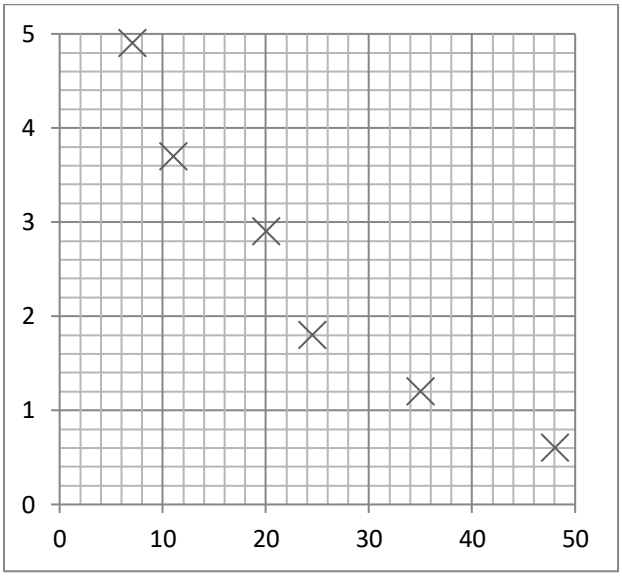
x axis	y axis	x axis	y axis	x axis	y axis
0.44	2.44	0.34	1.75	0.67	2.12
0.27	1.39	0.49	1.99	0.58	1.64
0.39	2.13	0.26	2.22	0.65	2.52
0.62	1.23	0.31	2.49	0.29	1.92
0.37	1.52	0.52	2.36	0.45	1.47
0.22	2.56	0.61	2.23	0.53	1.27
0.42	1.84	0.64	1.83	0.24	1.71
0.48	1.70	0.55	2.15	0.67	1.45

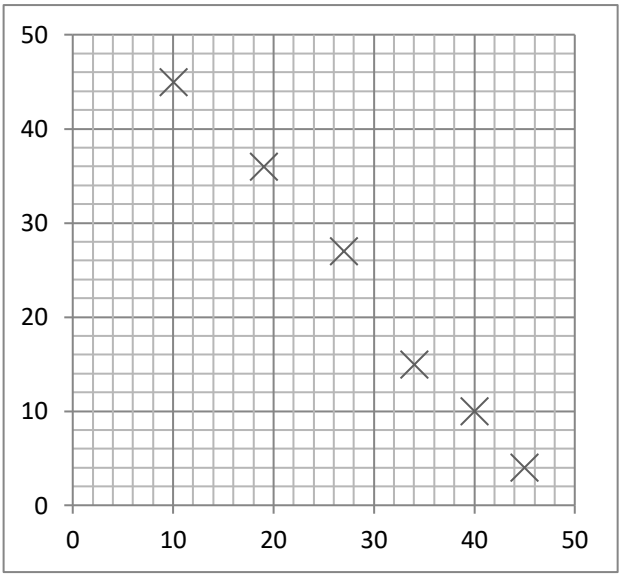


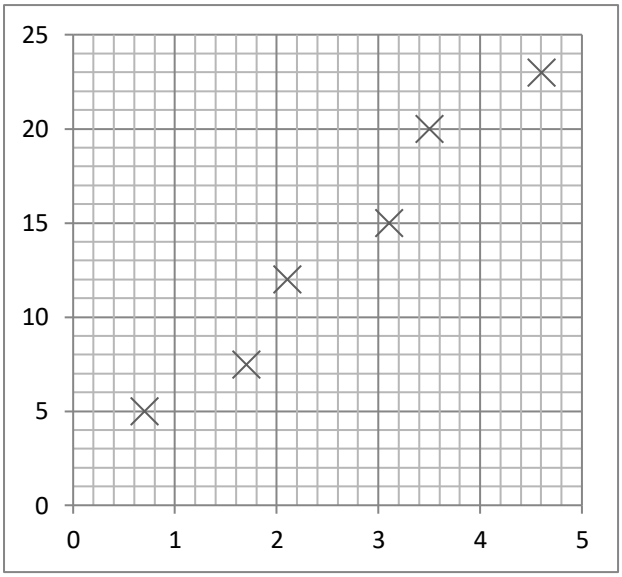
Skills	Lines of Best Fit	Marks
Mathematical		/ 6

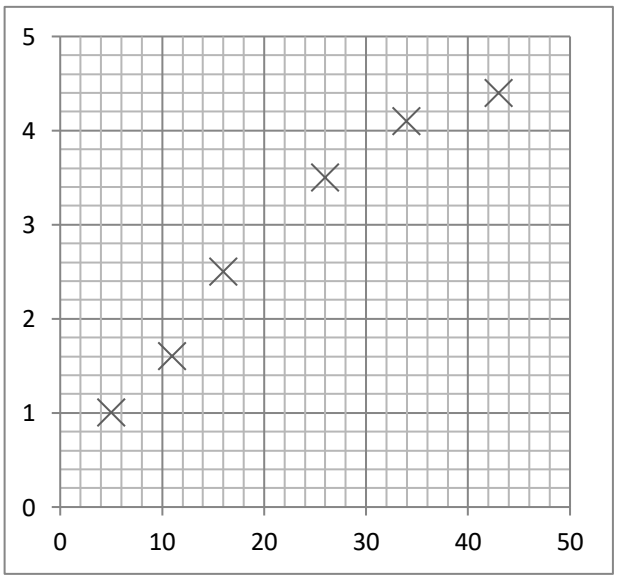
Draw a line of best fit for each of the graphs.

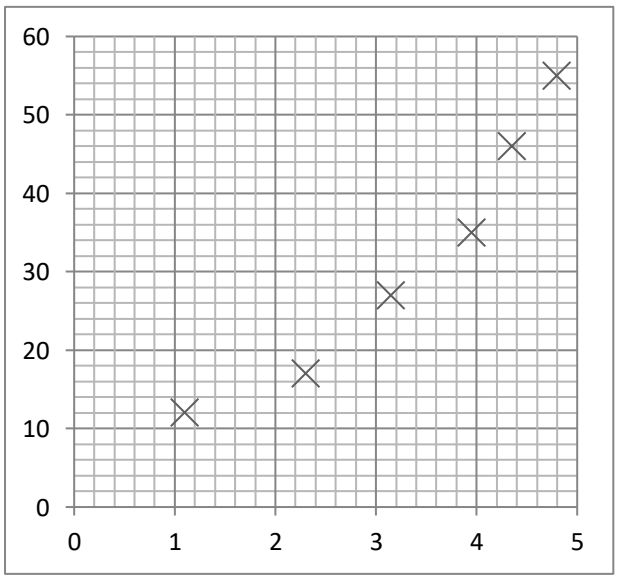








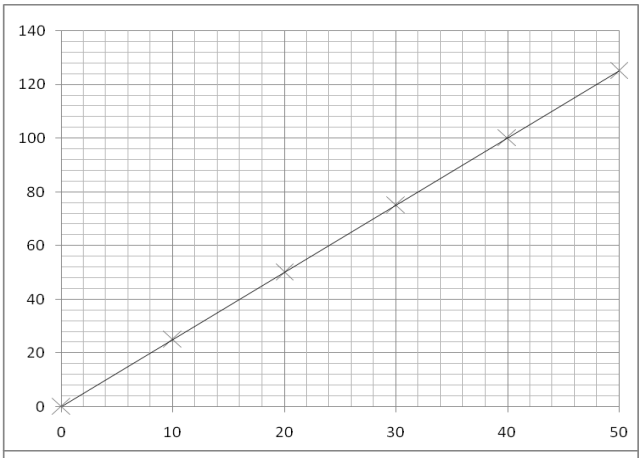




Skills	Gradients	Marks
Mathematical		/ 16

Calculate the gradients of the graphs below. Work out the equation for the line.

1.



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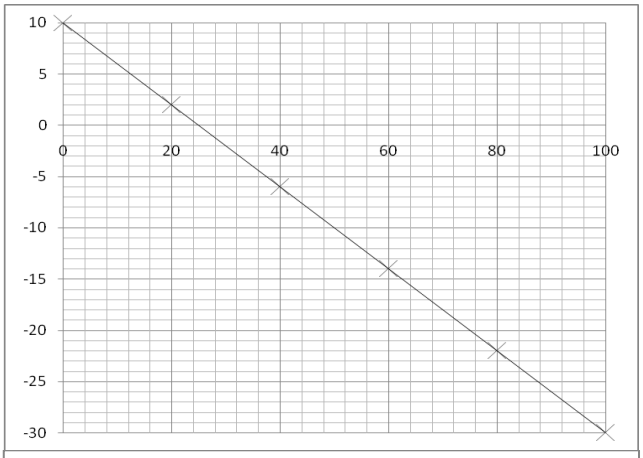

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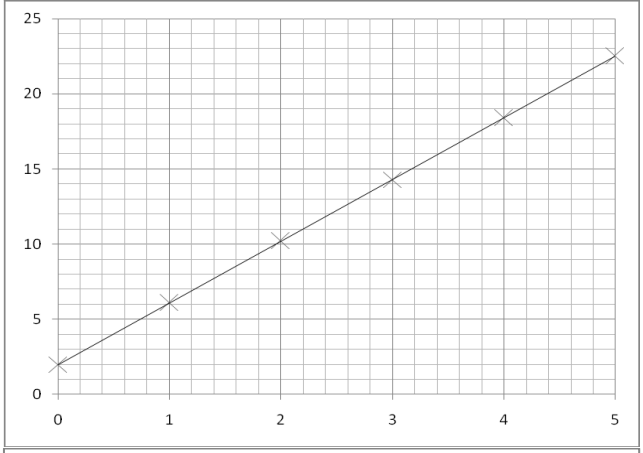

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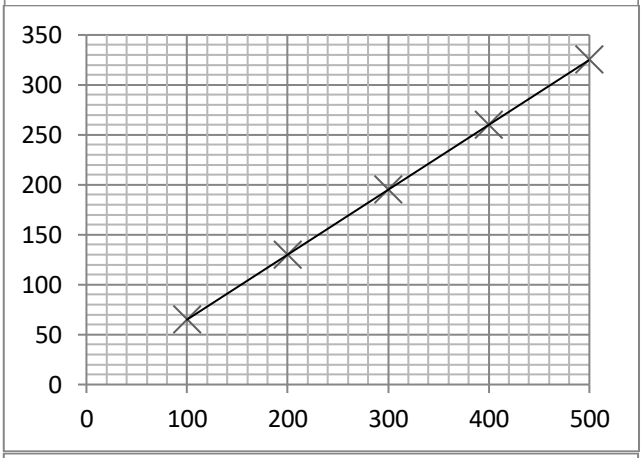

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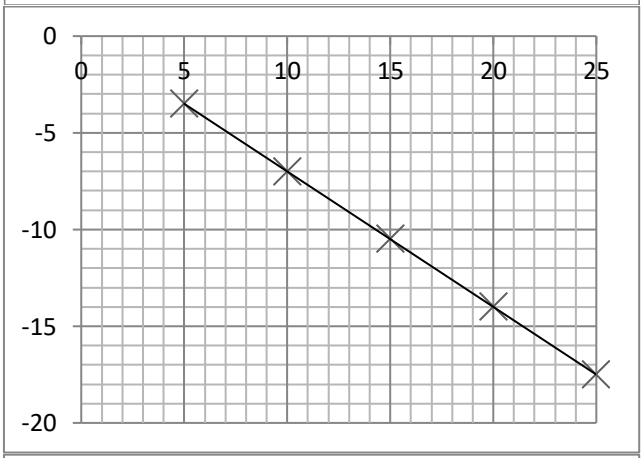
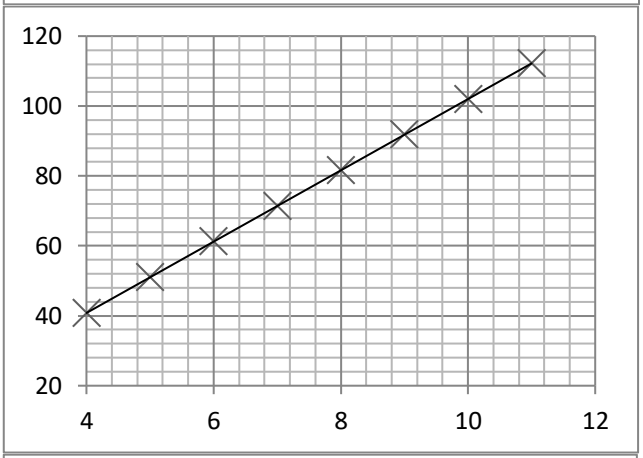
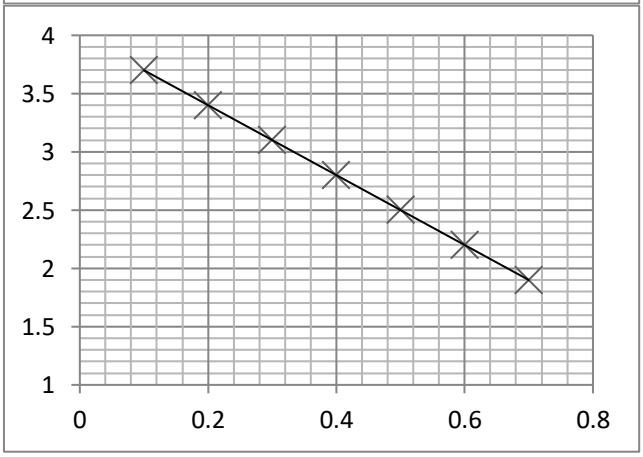


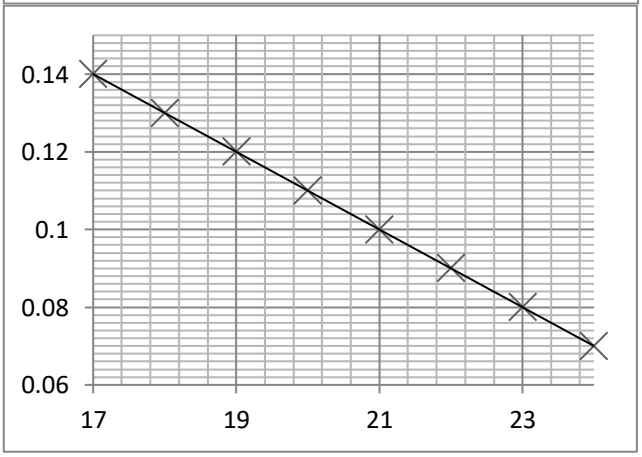
6.



7.



8.



Skills	Gradient Equations	Marks
Mathematical		/ 39

Complete the table below about graphs and gradients

Equation	Graph	Rearrange Equation	Gradient	Intercept
$y = mx + c$	y plotted on the y axis x plotted on the x axis	$y = mx + c$	m	c
$V = IR$	y axis = V x axis = I	$V = RI$	R	0
$I = \frac{Q}{t}$	y axis = t x axis = Q			
$\rho = \frac{RA}{l}$	y axis = l x axis = R			
$\varepsilon = V + Ir$	y axis = V x axis = I			
$E = VIt$	y axis = E/t x axis = V			
$hf = \phi + E_K$	y axis = E_K x axis = f			
$\lambda = \frac{h}{mv}$	y axis = $1/v$ x axis = m			
$E_P = mgh$	y axis = mg x axis = E_P			
$E = \frac{1}{2}Fe$	y axis = e x axis = $1/F$			
$c = f\lambda$	y axis = $1/\lambda$ x axis = f			
$v = u + at$	y axis = a x axis = $1/t$			
$v^2 = u^2 + 2as$	y axis = v^2 x axis = s			
$s = \frac{(u+v)}{2}t$	y axis = v x axis = s			
$w = \frac{\lambda D}{s}$	y axis = λ x axis = w			

Skills	Gradient Equations 2	Marks
Mathematical		/ 39

Complete the table below about graphs and gradients

Equation	Graph	Rearrange Equation	Gradient	Intercept
$y = mx + c$	y plotted on the y axis x plotted on the x axis	$y = mx + c$	m	c
$V = IR$	y axis = V x axis = I	$V = RI$	R	0
$F = \frac{\Delta(mv)}{\Delta t}$	y axis = v x axis = F/m			
$F = m\omega^2 r$	y axis = r x axis = F/m			
$T = 2\pi\sqrt{\frac{l}{g}}$	y axis = l x axis = g			
$T = 2\pi\sqrt{\frac{m}{k}}$	y axis = T^2 x axis = m			
$g = -\frac{GM}{r^2}$	y axis = M x axis = g			
$F = \frac{Qq}{4\pi\varepsilon_0 r^2}$	y axis = F x axis = q/r^2			
$C = \frac{Q}{V}$	y axis = V x axis = Q			
$Q = Q_0 e^{-t/RC}$	y axis = $\ln(Q/Q_0)$ x axis = t			
$\varepsilon = N\frac{\Delta\phi}{\Delta t}$	y axis = ε x axis = $N\phi$			
$\frac{N_S}{N_P} = \frac{V_S}{V_P}$	y axis = N_P x axis = N_S			
$R = r_0 A^{1/3}$	y axis = R^3 x axis = A			
$pV = nRT$	y axis = T x axis = V			
$Q = mc\Delta T$	y axis = T x axis = Q			

Skills	Interpreting Graphs	Marks
Mathematical		n/a

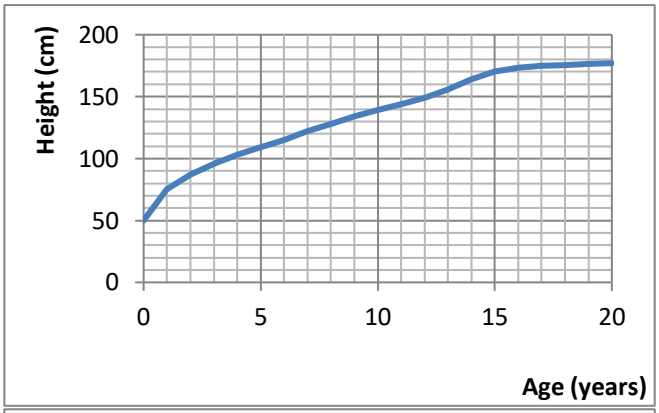
Explain the relationship between the two variables shown in the graphs below.

Describe the general trend/relationship
Quote any significant numerical values

Identify sections of highest/lowest gradient
Calculate any gradients you can

E.g. The graph shows a linear relationship with a gradient of 1.65 up to a force of 7 N. At this point, the gradient begins to decrease, reaching a gradient of zero at 10 N.

1.



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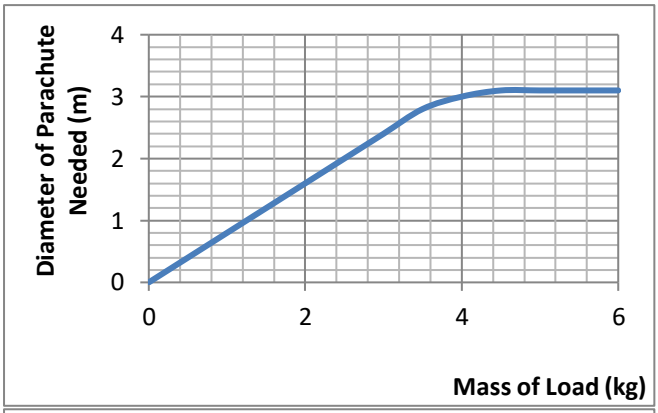

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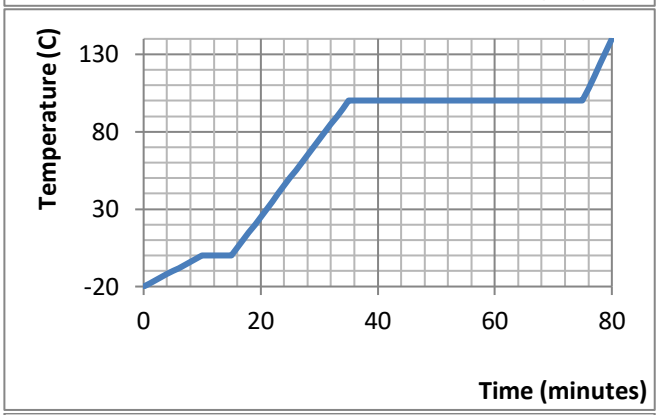

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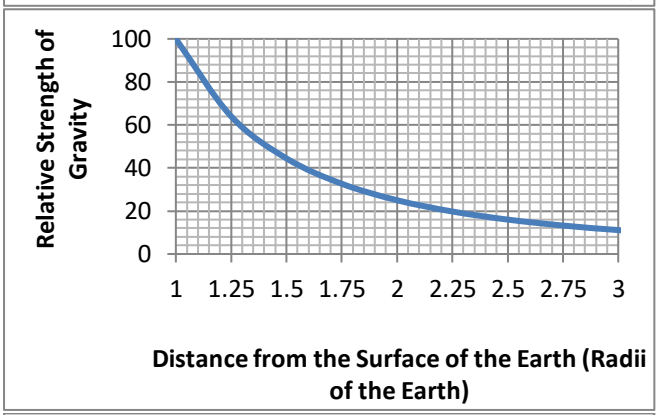

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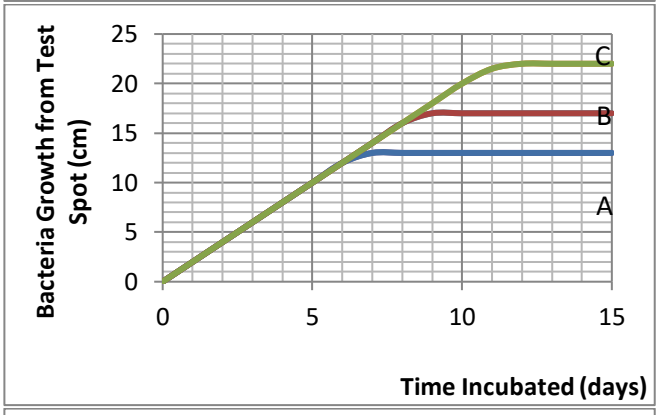

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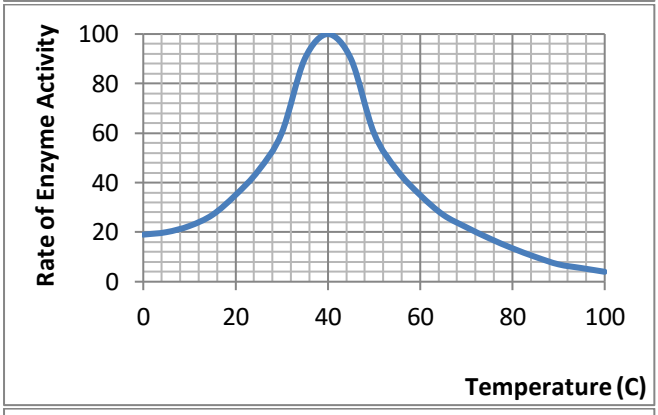

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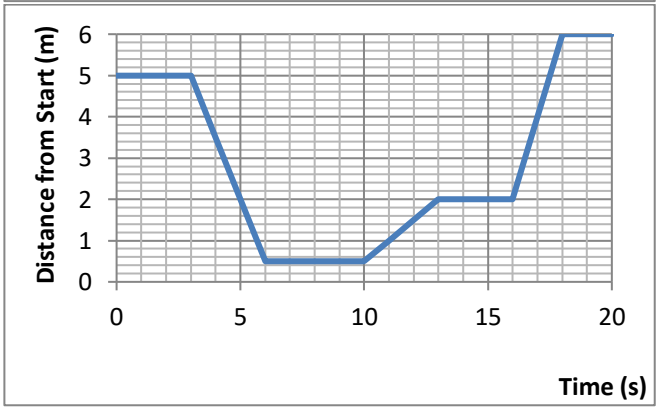
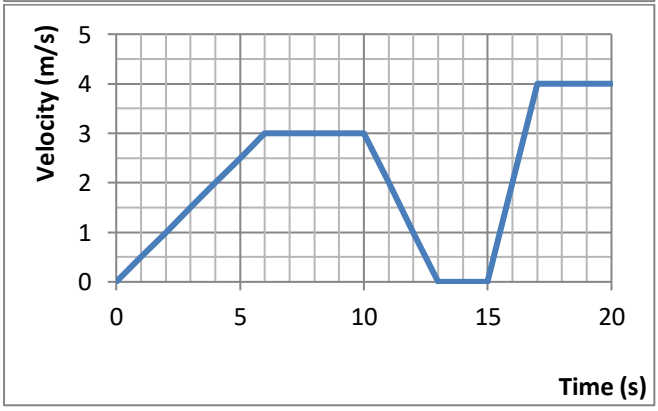
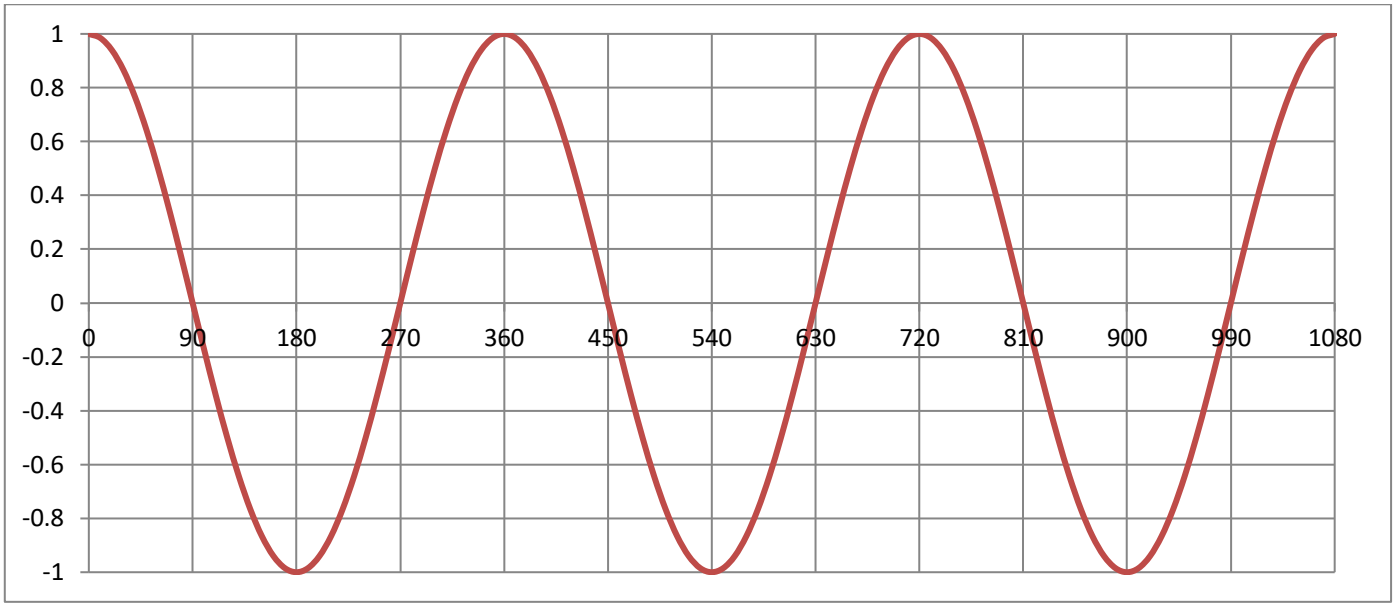


8.

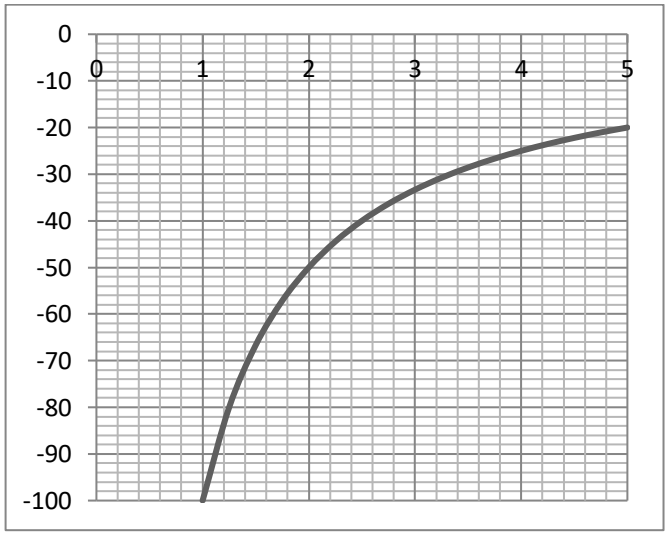


Skills	Tangents	Marks
Mathematical		/ 20

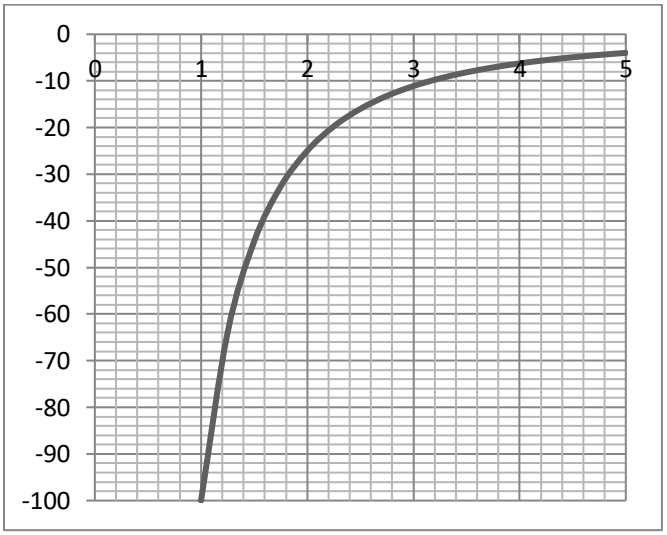
Q1. Draw tangents to the line at the following values along the x-axis: (a) 225, (b) 360, (c) 630 and (d) 1035



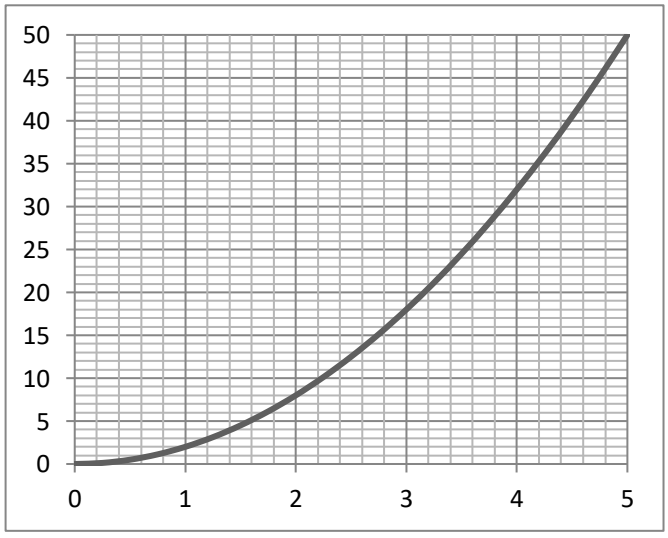
Draw a tangent to the line and calculate its gradient at the following x-axis values:



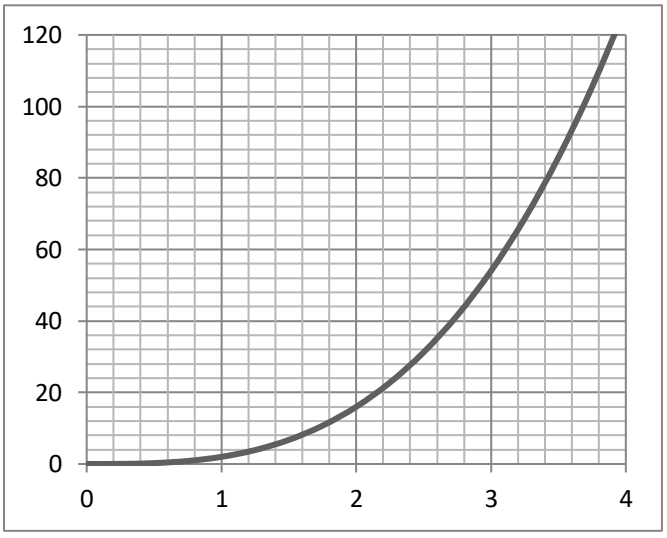
Q2. (a) 2.0 and (b) 3.9



Q3. (a) 1.5 and (b) 3.0



Q4. (a) 2.2 and (b) 4.0

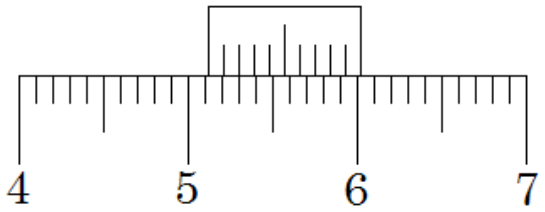


Q5. (a) 1.6 and (b) 3.4

Skills	Vernier Callipers and Micrometers	Marks
Practical		/ 12

State the reading on the Vernier Callipers to the left and the micrometers to the right
(you might need a bit of help from Google here)

1.



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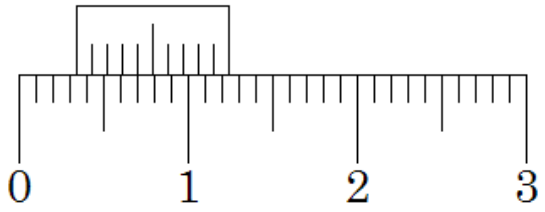
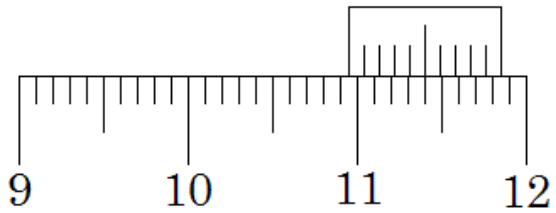


3.



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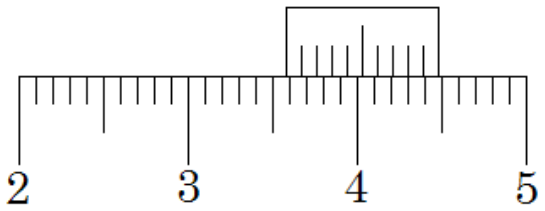

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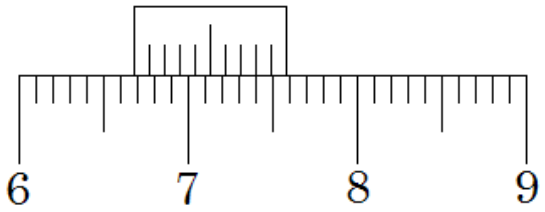

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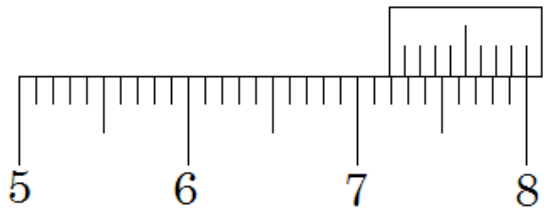

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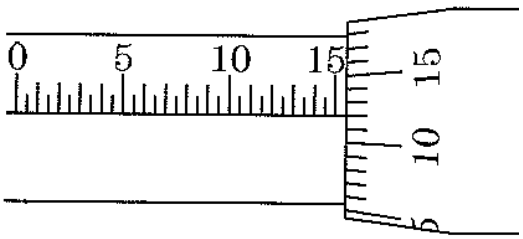

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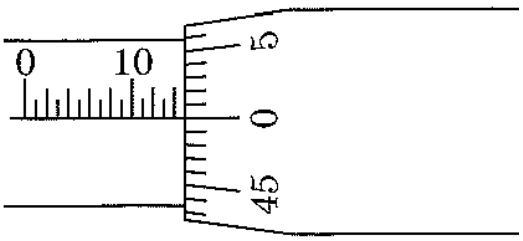

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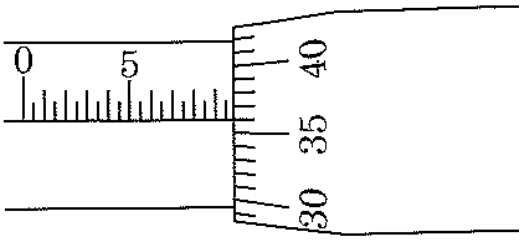

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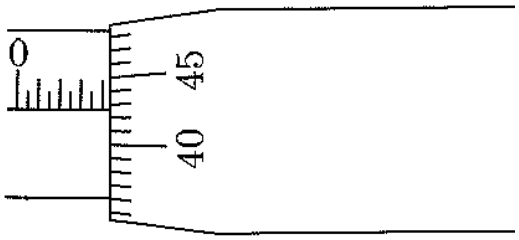

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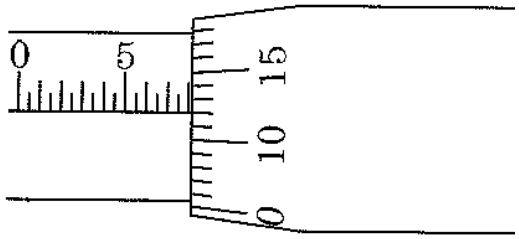

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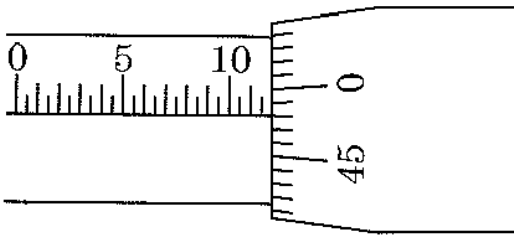

Skills	Describing Experiments	Marks
Literacy		/ 60

Paper 3 sometimes requires the description of an experiment to investigate a theory/question, which is usually worth 5-6 marks
Variables – Which variables will you change, which will you measure, which will you keep the same?
Range – Give specific values for the variables you will use.
Calculate – What will you calculate or plot?
Conclude – What result will help you either prove or disprove the theory?

Describe an experiment you would use to investigate the below theories or questions

1. A student suggests that if an egg was dropped from different heights the area of splatter would increase as the height increases but only until a certain point.

2. Is the flight time of a paper plane directly proportional to the angle of the nose (θ), the sine of the angle ($\sin\theta$) or neither?

3. What is the relationship between the time that a fizzy pop bottle is shook up for and the volume of liquid that is lost when the bottle is opened?

4. How could you investigate the theory that the surface temperature of a resistor is directly proportional to the current flowing through it?

5. How could you investigate the connection between the temperature at which a resistor stops obeying Ohm's law and the value of the resistor?

6. Water is placed in a plastic tray, one end it raised, dropped and the speed of the water wave is measured. A student suggests that the speed of the wave depends on the height of the water in the tray. How could you prove this?

7. A cylinder of solid metal is rolled down a ramp and the speed is calculated from the distance rolled and the time taken to roll. There is a suggestion that if the cylinder was hollow it would be affected more by the air resistance. How could you investigate this?

8. Explain how to find the spring constant of a metal spring with five 100g masses and a 30 cm ruler.

9. With the use of a block of ice, a temperature probe and Bunsen burner that provides a constant energy supply, explain how you could find out how many times bigger the specific latent heat of vaporisation is than the specific latent heat of fusion.

10. A student states that copper is less dense than steel. You have a large steel ball and a small copper cube. Explain how you could prove or disprove the student's theory

Skills	Rearranging & Deriving Equations	Marks
Mathematical		/20

Rearrange $v^2 = u^2 + 2as$ to make *a* the subject	
Substitute this into $F = ma$	
Substitute this into the equation $P = Fv$	
Substitute this into the equation $E = Pt$	
Use $v = \frac{s}{t}$ to simplify the equation	

Substitute $v = u + at$ into the equation $\lambda = \frac{h}{mv}$	
Multiply out the brackets	
Substitute this into the equation $d \sin\theta = n\lambda$	
Rearrange the equation to find the angle θ	

Substitute $R = \frac{V}{I}$ into the equation $\rho = \frac{RA}{l}$	
Substitute $V = \frac{E}{Q}$ into the equation	
Substitute $E = Pt$ into the equation	
Use $I = \frac{Q}{t}$ to remove *t* from the equation	
Simplify this	

Elastic energy is converted into kinetic energy	
Make v^2 the subject	
Replace this with $v^2 = u^2 + 2as$	
If *u*=0 rearrange the equation to make *a* the subject	
Use $F = ma$ to make F the subject	
Calculate the energy stored using $E = Fs$ if the distance moved is *e*	

Skills	Rearranging & Deriving Equations 2	Marks
Mathematical		/ 17

The centripetal force of a satellite is due to the gravitational force between it and the planet	$\frac{mv^2}{r} = \frac{GMm}{r^2}$
Simplify the equation and much as you can and rearrange to make *r* the subject	
Use $\omega = \frac{v}{r}$ to remove *v* from the equation	
Simplify the equation and use $\omega = 2\pi f$ to replace ω	
Use $f = \frac{1}{T}$ to remove f from the equation	

Rearrange $Q = Q_0 e^{-t/RC}$ to make $e^{-t/RC}$ the subject	
Make $-\frac{t}{RC}$ the subject	
Rearrange the equation to make *t* the subject	

The centripetal force of a charged particle is due to the magnetic force acting on it	$\frac{mv^2}{r} = BQv$
Rearrange the equation to make Q the subject	
Substitute $\frac{Q}{t} = I$ into the equation	
Use $\phi = BA$ to remove B from the equation	

Rearrange $N = N_0 e^{-\lambda t}$ to make $e^{-\lambda t}$ the subject	
Make $-\lambda t$ the subject	
Substitute $T_{½} = \frac{\ln 2}{\lambda}$ into the equation	

Rearrange $E = mcT$ to make T the subject	
Substitute this into the equation $pV = nRT$	
Substitute $p = \frac{F}{A}$ into the equation	
If the V is volume of a cube of side l, rearrange the equation to make F the subject	

Skills	Units	Marks
Scientific		/ 52

*Write down the **standard** units (full name AND symbol) for the following quantities*

Energy		**Work done**	
Wavelength		**Current**	
Frequency		**Potential Difference**	
Time period		**Resistance**	
Moment		**EMF**	
Velocity		**Power**	
Acceleration		**Force**	
Mass		**Density**	
Weight		**Magnetic Flux Density**	
Momentum		**Activity**	
Pressure		**Half Life**	
Volume		**Specific Latent Heat**	
Temperature		**Specific Heat Capacity**	

Skills	Units - Challenge	Marks
Scientific		/ 26

There are 7 base units (SI units) which all other units can be derived from.

Length in metre, m Mass in kilogram, kg Time in second, s Electric Current in ampere, A
Absolute Temperature in kelvin, K Amount of Substance in mole, mol Luminous Intensity in candela, cd

Write down the units for the following quantities in SI units (hint: use equations to build up from the easier ones. I've been nice and put them in a moderately logical order – go down column 1 first.)

Mass		**Pressure**	
Volume		**Moment**	
Density		**Energy**	
Wavelength		**Work done**	
Time period		**Power**	
Frequency		**Current**	
Half Life		**Potential Difference**	
Activity		**EMF**	
Velocity		**Resistance**	
Acceleration		**Specific Latent Heat**	
Momentum		**Temperature**	
Force		**Specific Heat Capacity**	
Weight		**Magnetic Flux Density**	