Summer **Bridging Work**

KWS SIXTH FORM

Physics A Level

You will be studying **Physics A Level - AQA** exam board.

It is important that you familiarise yourself with the course specifications over the summer, in order that you are ready to embark on your KS5 journey from day one.

For course specification: Please click here

Here are the details of your summer bridging work for Physics . This will need to be completed and submitted in your first Physics lesson in September. The bridging work will contribute to your first subject report at the end of September.

Task 1: Unit Prefixes
Complete the table of the unit prefixes on page 2.
This website will help: http://www.npl.co.uk/reference/measurement-units/
Convert the units in the questions.

Task 2: Standard form
Write the standard form the questions on page 3.

Task 3: Equation rearrangements
Write the rearrangements for the equations on page 3.

Task 4: Gradients
Find the gradients of the graphs on page 4 – show all working out.

Task 5: Forces
Complete the forces questions on pages 5 to 8, pages 5 to 7 is GCSE, 8 to is A-Level.

Task 6: Quantum essay
Write a 500 word report on how our model of the atomic structure has changed from the plum pudding model to the 'standard model' (including quarks), include diagrams as appropriate.
The FutureLearn course Discovering Science: Science writing could help with the structure of your report.
https://www.futurelearn.com/courses/discovering-science science-writing

Task 7: Learn triple content
Learn the triple content of the GCSE. All of you will have a short test on this in the first couple of weeks.

Useful things to do:
Read the Feynman Lectures: http://feynmanlectures.caltech.edu/
Watch the film 'Contact' based on the Carl Sagan book.
Download the AQA Physics Specification and read through it:
http://www.aqa.org.uk/subjects/science/as-and-a-level/physics-7407-7408
Choose some of the Become a better physicist tasks from pages 5 and 6.

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Task 1: **Unit Prefixes**

1. Prefixes are written in front of units to indicate multiplication or division by multiples factors of 1000. So mega means x1,000,000. (One exception is 'centi', as in cm, which means divide by 100)

YOU MUST LEARN THE PREFIXES BY HEART AND BECOME ADEPT AT WORKING WITH THEM.

Symbol		Multiplier	Which means...
	terra		
		X 10^{9}	
M			X 1,000,000
k			X 1,000
(none)	N/A	N/A	X 1
m			
	micro		/ 1,000,000
n			
		X 10^{-12}	
f			

2. Expand each of these quantities to write out the answer in full (i.e. without the prefixes)

a) 900 mV =
b) 12 MJ =
c) 1.67 mm =
d) 3.456 kg =
e) 700 nm =
f) 0.72 pA =

3. Write each of the following using an appropriate prefix:

a) 0.005 A =
b) 30000 s =
c) 5 × 105 m =
d) 1001 m =
e) 0.006 V =
f) 2,100,000 N =

4. Convert each of the following to the indicated units:

a) 34 nm = mm
b) 0.012 s = μs
c) 4.5 MJ = kJ

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Task 2: **Standard Form**

At A level quantity will be written in standard form, and it is expected that your answers will be too. This means answers should be written as ....x 10y. E.g. for an answer of 1200kg we would write 1.2 x 10^3kg. For more information visit:
https://www.bbc.co.uk/education/guides/zc2hsbk/revision

1. Write 2530 in standard form.
2. Write 280 in standard form.
3. Write 0.77 in standard form.
4. Write 0.0091 in standard form.
5. Write 1 872 000 in standard form.
6. Write 12.2 in standard form.
7. Write 2.4 x 10^2 as a normal number.
8. Write 3.505 x 10^1 as a normal number.
9. Write 8.31 x 10^6 as a normal number.
10. Write 6.002 x 10^2 as a normal number.
11. Write 1.5 x 10^{-4} as a normal number.
12. Write 4.3 x 10^3 as a normal number.

Task 3: **Equation rearrangements**

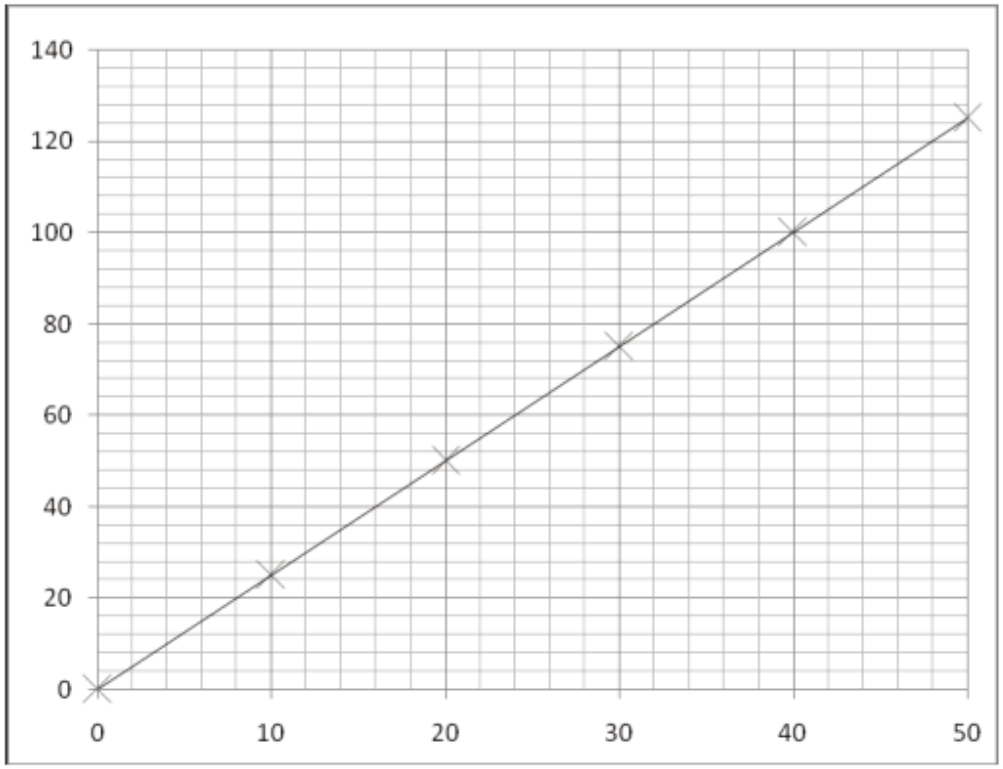
Rearrange these equations to express them in the terms that follow:

1.	$v = x / t$	a) x =	b) t =	
2.	$F = m a$	a) m =	b) a =	
3.	$a = (v - u) / t$	a) t =	b) v =	c) u =
4.	$v^2 = u^2 + 2as$	a) v =	b) a =	c) u =
5.	$s = ut + ½ a t^2$	a) u =	b) a =	c) t =
6.	$1/R_{tot} = 1/R_1 + 1/R_2$	a) R_{tot} =	b) R_1 =	

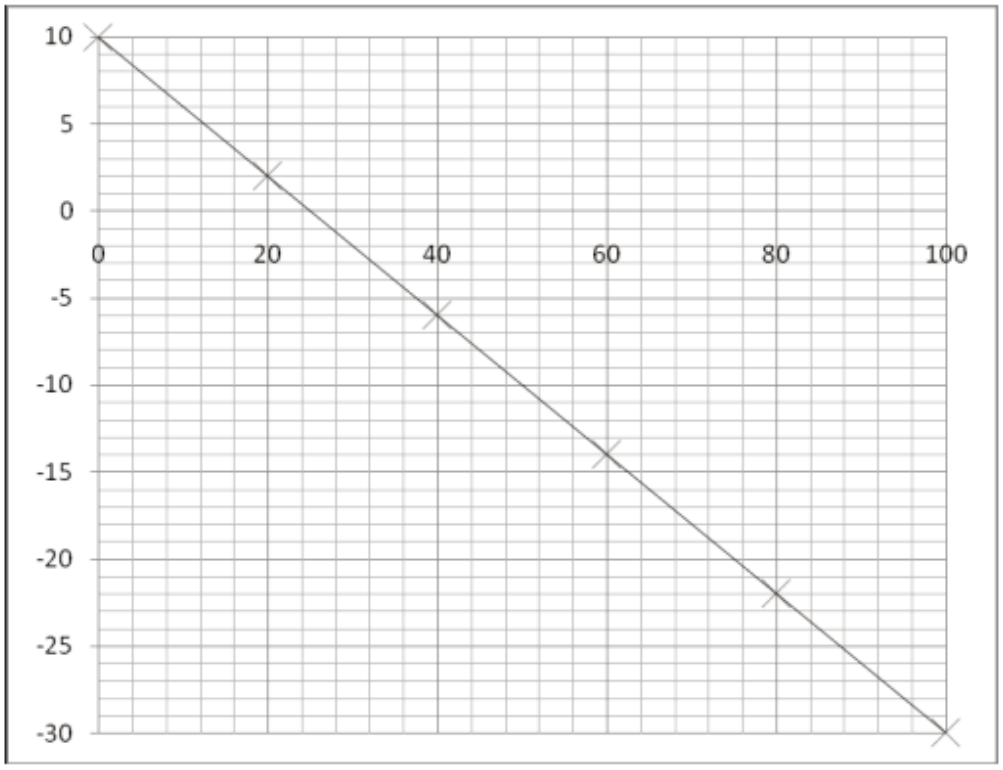
Task 4: **Gradients**

Find the gradients of the graphs – show all working out.

Graph A

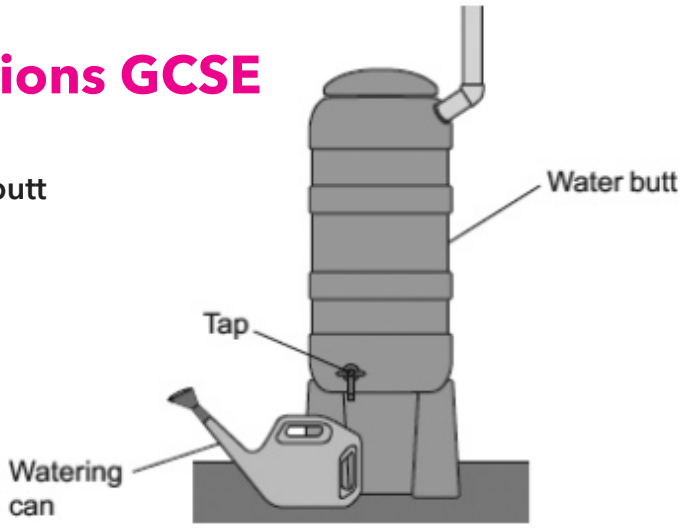


Graph B



Task 5: **Forces questions GCSE**

Q1. **The diagram shows a water butt used to collect rainwater.**



A tap allows water to be collected from the water butt in a watering can.

(a) If the tap was placed higher up on the water butt, what difference would it make to the rate of flow of water from the tap?
Explain your answer. **(2)**

(b) A hosepipe is now attached to the tap. The hosepipe takes water to where it is needed. A gardener did an investigation to see how the rate of flow of water through a hosepipe, from a water butt, varies with the length of the hosepipe.
His results are shown in below table.

Length of hosepipe in metres	Water collected in 10 seconds in cm^3
2.0	500
3.0	500
4.0	500
5.0	500
10.0	250
15.0	170

(i) What conclusions can you make based on the results in the table above? **(2)**

(ii) Suggest further readings that should be taken to improve the investigation.
Give reasons for your answers. **(4)**

(c) In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.
You are provided with a water butt and lengths of hosepipe of different diameter.
Describe how you would investigate how the rate of flow of water through a hosepipe varies with the diameter of the hosepipe.
In your description you should include:

- any additional equipment that you would use
- any measurements you would make using the equipment
- any variables that need to be controlled and how this would be achieved. **(6)**

(Total 14 marks)

Q2.

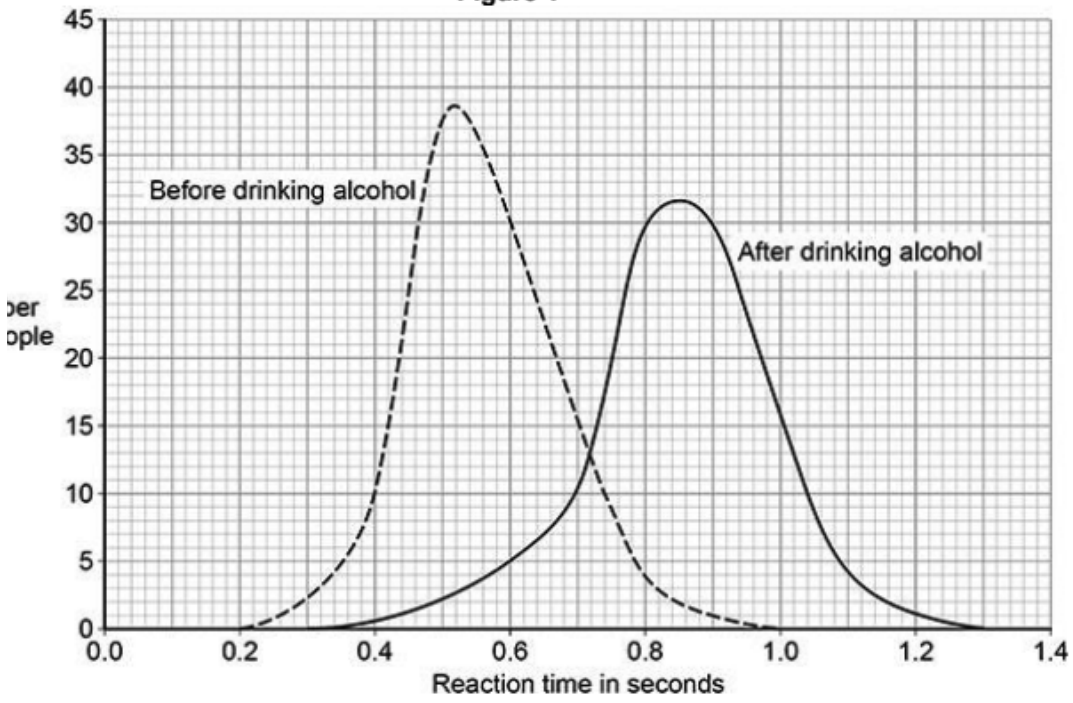
Speed limits on roads increase safety.

(a) The braking distance of a car increases as the speed of the car increases.
Give two **other** factors that **increase** the braking distance of a car. **(2)**

(b) Explain why the driver's reaction time affects the thinking distance of a car. **(2)**

(c) Scientists have investigated how drinking alcohol affects a person's reaction time.
Figure 1 shows the results of the investigation.

Figure 1



Which of the following conclusions can be made using Figure 1?
Tick (✓) **two** boxes.

Every person's reaction time increases after drinking alcohol. ☐

Mean reaction time increases after drinking alcohol. ☐

Some people's reaction time is not affected by drinking alcohol. ☐

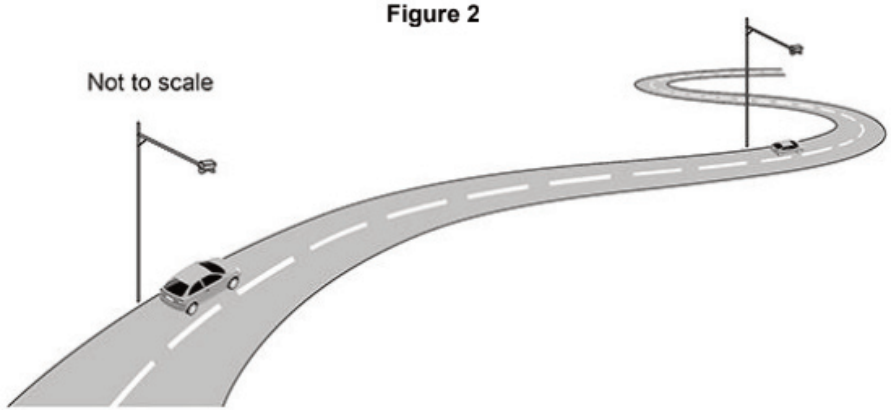
The change in reaction time is not the same for all people after drinking alcohol. ☐

There is a smaller range of reaction times after drinking alcohol ☐

(2)

Figure 2 shows some speed cameras on a road.
The speed cameras determine the average speed of cars on the road.

Figure 2



(d) The speed limit on the road in **Figure 2** is 20 m/s.
The cameras in **Figure 2** are 1.5 km apart.
Calculate the minimum time it takes to travel 1.5 km without breaking the speed limit.
Use the Physics Equations Sheet. **(4)**

(e) The average speed of a car between the cameras and the average velocity of the car between the cameras are different.
Explain why. **(4)**

(Total 13 marks)

Q3.

The image below shows two ice hockey players moving towards each other.
They collide and then move off together.

Before the collision

Player A
Mass = 78 kg
Velocity = +7.5 m/s

Player B
Mass = 91 kg
Velocity = –5.5 m/s

During the collision, the total momentum of the players is conserved.
(a) What is meant by 'momentum is conserved'? **(1)**

(b) Immediately after the collision the two players move together to the right.

Calculate the velocity of the two players immediately after the collision. **(4)**

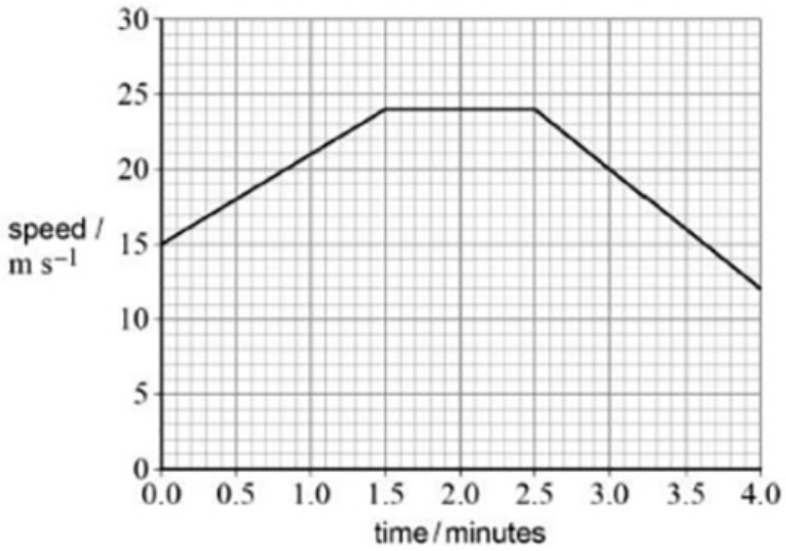
(c) The ice hockey players wear protective pads filled with foam.
Explain how the protective pads help to reduce injury when the players collide. **(3)**

(Total 8 marks)

Task 5: **Forces questions A-Level**

A pair of cameras is used on a motorway to help determine the average speed of vehicles travelling between the two cameras. Figure 1 shows the speed–time graph for a car moving between the two cameras.

Figure 1

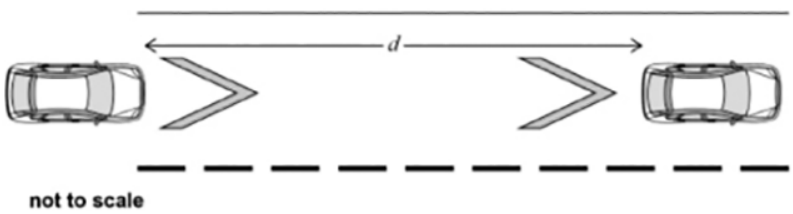


The speed limit for the motorway between the two cameras is 22 m s−1

a) Determine whether the average speed of the car exceeded this speed limit. **[3]**

b) Markings called chevrons are used on motorways. The chevron separation is designed to give a driver time torespond to any change in speed of the car in front. The driver is advised to keep a minimum distance d behind thecar in front, as shown in Figure 2.

Figure 2



Government research suggests that the typical time for a driver to respond is between 1.6 s and 2.0 s.

Suggest a value for d where the speed limit is 31 m s−1.

d = _____ m **[2]**

c) The chevron separation is based on the response time, not on the time taken for a car to stop. The brakes of a carare applied when its speed is 31 m s−1 and the car comes to rest. The total mass of the car is 1200 kg.

The average braking force acting on the car is 6.8 kN.

Calculate the time taken for the braking force to stop the car and the distance travelled by the car in this time.

time = _____ s distance = _____ m **[4]**

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Become a better physicist

Institute of Physics resources

Look at the resources and support given by the IoP.
https://www.iop.org/education/school-and-college-students

Read books

It will help to stand back and see physics in its wider context, and also to look in more detail at some areas of physics that you may currently know very little about. I consider reading the two books in bold below to be the easiest way for you to do this, and they're something that would be easy to obtain and simple for you to take away with you on holiday. Top 2 are highly recommended.

- A Short History of Nearly Everything by Bill Bryson
- Big Bang: The Most Important Scientific Discovery of All Time and Why You Need to Know About It by Simon Singh
- Baker, Joanne 50 Ideas you really need to know: Phyiscs
- Stannard, Russell The time and Space of Uncle Albert
- Stannard, Russell Black Holes and Uncle Albert
- Bloomfield, Louis How things work: The Physics of Everyday life
- Gamov and Stannard The New World of Mr Tompkins
- Panek, Richard The 4% Universe
- Kaku, Michio Physics of the Impossible
- Kumar, Manjit Quantum
- Feynmann, Richard QED: The strange theory of Light and Matter
- Randall, Lisa Knocking on Heaven's door
- Casti, John Paradigms Lost
- Kaku, Michio Parallel Worlds
- Close, Frank Antimatter, Neutrino
- Stephen Hawking A Brief History of Time, The Universe in a nutshell
- Richard Rhodes The Making of the Atomic Bomb
- Michael Collins Carrying the Fire: An Astronaut's Journeys

Don't forget, you can always find books in charity shops for small amounts if you don't want to pay full price for any of these books.

Watch TV documentaries about science

Channels on Freeview to keep an eye on are BBC2, BBC4, Quest and Dave. Specific programmes to look out for, in order of personal preference, are:

- **Horizon** (BBC2 and BB4) – fantastic, in-depth scientific documentaries, very often physics based. Usually have Professor Jim Al-Khalili

- **Mythbusters** (on Quest, but also on cable and satellite channels) – Arguably the best show about scientific investigation, with added rockets! Watch it.

- **The Sky at Night** (BBC4) – longest running science TV programme in the universe, everything current in space and astronomy with proper experts

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Listen to some audio (podcasts and similar)
Mainly BBC Radio 4 broadcasts / iplayer / podcasts. Usually archived so they don't expire! These are in order, starting with the most relevant...

• **In Our Time** - Melvyn Bragg and guests discuss the history of ideas. My favourite, usually four professors having a sensible discussion, frequently on physics topics. Vast archive going back years, and more being added all the time. Examples of relevant episodes: The Age of the Universe, Radiation, The Vacuum of Space, The Measurement Problem in Physics, The Multiverse, Gravitational Waves, The Speed of Light...

• **The Life Scientific** - Professor Jim Al-Khalili talks to leading scientists about their life and work, finding out what inspires and motivates them and asking what their discoveries might do for mankind.

• **Frontiers** - Programme exploring new ideas in science and meeting the scientists and researchers responsible for them, as well as hearing from their critics.

Use your computer to help out some science research

• **SETI@home** is a scientific experiment that uses Internet-connected computers in the Search for Extra-terrestrial Intelligence (SETI). You can participate by running a free program that downloads and analyses radio telescope data. http://setiathome.berkeley.edu/

• **Asteroid watch.** Search for Near Earth Objects (i.e. asteroids) in observations that have taken, and report back their positions.
http://www.schoolsobservatory.org.uk/activ/asteroidwatch

• **Galaxy zoo.** To understand how galaxies, and our own, formed we need your help to classify them according to their shapes – a task at which your brain is better than even the most advanced computer. If you're quick, you may even be the first person in history to see each of the galaxies you're asked to classify. http://www.galaxyzoo.org/

• **Zooniverse.** Many other projects similar to galaxy zoo: solar storm watch, planet hunters, the Milky Way project. https://www.zooniverse.org/

• **PhET interactive simulations.** Fun, interactive, research-based simulations of physical phenomena from the PhET project at the University of Colorado. This site will be used again and again during your A level course. http://phet.colorado.edu/
Interact with physicists in the real-world
Read magazines such as New scientist

Disclaimer: You are not expected to do everything in the "become a better physicist" section, it is merely there to enrich you. However, if you do nothing, you're unlikely to do as well as you should.