A Level Bridging Work
Physics

The tasks below are designed to support you as you prepare to start A Level Physics.

These tasks have been developed to build on your GCSE knowledge and help with the transition into sixth form, using your time wisely over the coming months to ensure you maintain a level of education that will be needed to be successful in your subject when you enrol into the sixth form in August/ September.

Plan how you will use your time over the next 3 months – below is a summary of all the tasks, approximately how long they will take and what you need to hand in. All tasks need to be complete before your first lesson in September but not necessarily in the order below.

Task	**Approximate time**	**To hand in**
Task 1: Folder task	1 hour	Folders
Task 2: GCSE Physics Revision	At least 10 hours – possibly a lot more to make up for revision you would have done for the GCSE exam.	Tasks for Atomic Structure, Waves, Forces and Motion, Energy, Electricity
Task 3: Preparation for Mechanics	5 hours	GCSE Mechanics Questions
Task 4: Data Handling Skills	6 hours	Nothing – but you will be tested on these skills in your first few lessons
Task 5: Research Activity	8 hours	Notes on each area.
Task 6: Further study	Optional	

Leading the way WELLSWAY MULTI ACADEMY TRUST www.wellswaymat.com

Task 1: Folder Preparation

Being organised is a key part to your success at A Level.

So you are ready for September please get yourself 2 folders. One a smaller ring binder, this will be your day-to-day folder that you must bring to each and every lesson, and a larger A4 lever arch file, this will be for the long term storage of your notes. **Please bring these folders along with your other bridging work to the first lesson.**

Inside your lever arch file you will need dividers for the following topics: 1. Measurements and their Errors 2. Particles and Radiation 3. Waves 4. Mechanics and Materials 5. Electricity 6. Further Mechanics and Thermal Physics 7. Fields and their Consequences 8. Nuclear Physics 9. Astrophysics	Keep all your bridging work in your day-to-day folder Please split your physics day-to-day folder into 3 sections: **Teacher 1** **Teacher 2** **Assessments**

Task 2 – <u>GCSE Physics Revision</u>

We will expect your knowledge and skills from the GCSE content to be secure when you start A Level.
For each topic area listed below:

1) Revise the content using BBC bitesize/revision guide/workbook/PiXL independence* – it may be useful to spend considerable time on this as you may not have spent as much time reviewing and practicing this content as previous students will have done. In Appendix A are some multiple choice questions to test your understanding of each topic.
2) Look at the additional resources
3) Complete the task **which should be handed in on the first lesson**

Your student login details for PiXL Independence are: -
Link: https://students.pixl.org.uk
PiXL School Number: 602929
Password: Indep127

Atomic Structure

You will study nuclear decay in more detail at A Level covering the topics of radioactivity and particle physics. In order to explain what happens you need to have a good understanding of the model of the atom. You need to know what the atom is made up of, relative charges and masses and how sub atomic particles are arranged.

Bitesize Link: https://www.bbc.co.uk/bitesize/topics/zshssrd

Additional Resources:

The following video explains how the current model was discovered www.youtube.com/watch?v=wzALbzTdnc8

Task:

Describe the model used for the structure of an atom including details of the individual particles that make up an atom and the relative charges and masses of these particles.
Explain how this model was discovered by Rutherford.

Forces and Motion

At GCSE you studied forces and motion and at A Level you will explore this topic in more detail so it is essential you have a good understanding of the content covered at GCSE. You will be expected to describe, explain and carry calculations concerning the motion of objects.

Bitesize Link: https://www.bbc.co.uk/bitesize/topics/ztmttv4

Additional Resources:

The websites below cover Newton's laws of motion and have links to these in action.
http://www.physicsclassroom.com/Physics-Tutorial/Newton-s-Laws
http://www.sciencechannel.com/games-and-interactives/newtons-laws-of-motion-interactive/

Task:

Sketch a velocity-time graph showing the journey of a skydiver after leaving the plane to reaching the ground.
Mark on terminal velocity.
Draw free-body diagram of the forces on the skydiver at each stage.
Describe how each of Newton's Laws relate to the skydiver.

Energy

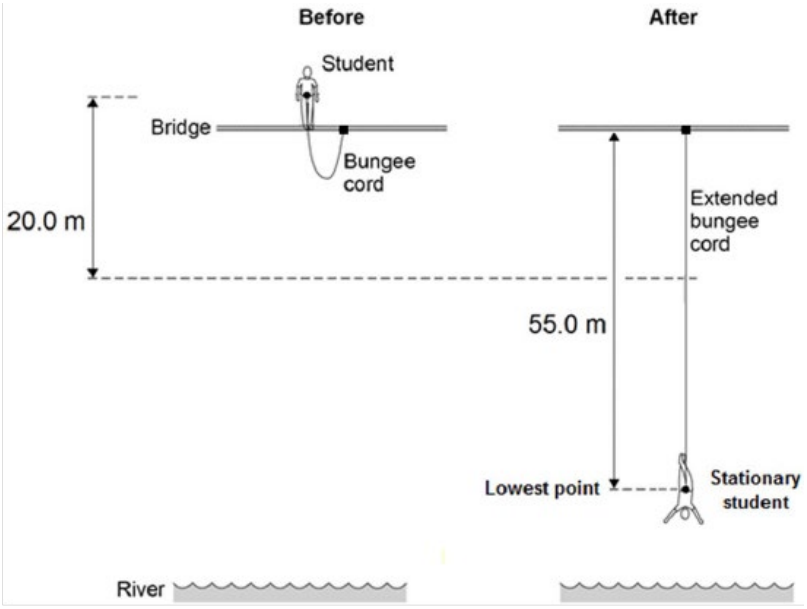
At GCSE you learned about the principle of Conservation of Energy and how to calculate the energy transferred to and from various different stores. At A Level, energy is an important part of every topic you study, it turns up again and again.

Bitesize link: https://www.bbc.co.uk/bitesize/topics/z89ddxs

Additional Resources: https://www.youtube.com/watch?v=w4QFJb9a8vo

Task: The figure below shows a student before and after a bungee jump.

The bungee cord has an unstretched length of 20.0 m.



The mass of the student is 50.0 kg.

The gravitational field strength is 9.8 N / kg.

(a) Describe the energy changes that happen after the student jumps.

(b) Calculate the change in gravitational potential energy from the position where the student jumps to the point 20.0 m below.

(c) 80% of this change in gravitational potential energy has been transferred to the student's kinetic energy store.

How much has the student's kinetic energy store increased after falling 20.0 m?

(d) Calculate the speed of the student after falling 20.0 m.

(e) At the lowest point in the jump, the energy stored by the stretched bungee cord is 24.5 kJ.

Assuming the bungee cord behaves like a spring, calculate the spring constant of the bungee cord.

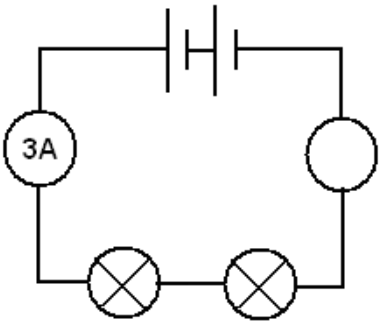
Electricity
At A Level you will learn more about how current and voltage behave in different circuits containing different components. You should be familiar with current and voltage rules in a series and parallel circuit as well as calculating the resistance of a device.

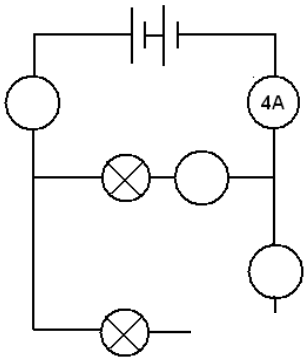
Bitesize Link: https://www.bbc.co.uk/bitesize/topics/zcg44qt

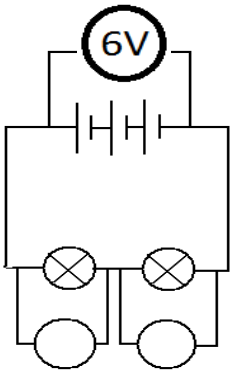
Additional Resources:
http://www.allaboutcircuits.com/textbook/direct-current/chpt-1/electric-circuits/
http://www.physicsclassroom.com/class/circuits

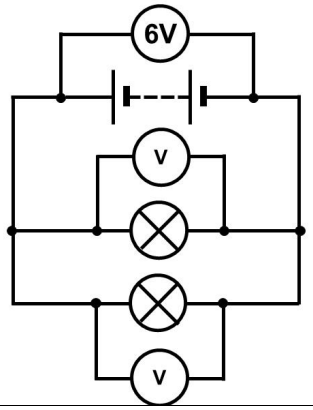
Task:

1a) Add the missing ammeter readings on the circuits below.









Waves
You have studied different types of waves and used the wave equation to calculate speed, frequency and wavelength. You will also have studied reflection and refraction.

Bitesize Link: https://www.bbc.co.uk/bitesize/topics/z2j22nb

Additional Resources:
http://www.bbc.co.uk/education/clips/zb7gkqt
https://www.khanacademy.org/science/physics/mechanical-waves-and-sound/mechanical-waves/v/introduction-to-waves
https://www.khanacademy.org/science/physics/mechanical-waves-and-sound/mechanical-waves/v/introduction-to-waves

Tasks:
1) Draw a diagram showing the refraction of a wave through a rectangular glass block. Explain why the ray of light takes this path.

2) Describe the difference between a longitudinal and transverse waves and give an example of each

3) Draw a wave and label the wavelength and amplitude

Task 3: Mechanics Preparation

Mechanics is one of the first topic you will study in A Level Physics. It builds on the GCSE content of Forces and Motion and Energy.

In Appendix B is the GCSE learning checklist for the relevant parts of these topics.
Make sure you are confident with all the skills on the checklist – use your GCSE revision guide or BBC bitesize.
When you are ready, have a go at "**GCSE Mechanics Questions**" in Appendix C– they are top level GCSE questions.
These are to be handed in on your first lesson.

Task 4: Data Handling Skills

There are some basic skills that you will use throughout Physics A Level that you need to be confident of before you start.

Complete the Data Handling Tasks in Appendix D, the answers are at the end so you can check your understanding.

You will be assessed on these skills in a short test in one of your first lessons.

Task 5: Research Activity

To get the best grades in A Level Physics you will have to get good at completing independent research and making your own notes on difficult topics. Below are links to 5 websites that cover some interesting Physics topics.
Using the Cornell notes system: http://coe.jmu.edu/learningtoolbox/cornellnotes.html make 1 page of notes **from each site** covering a topic of your choice.

a) http://home.cern/about
   CERN encompasses the Large Hadron Collider (LHC) and is the largest collaborative science experiment ever undertaken. Find out about it here and make a page of suitable notes on the accelerator.
b) http://joshworth.com/dev/pixelspace/pixelspace_solarsystem.html
   The solar system is massive and its scale is hard to comprehend. Have a look at this award winning website and make a page of suitable notes.
c) https://phet.colorado.edu/en/simulations/category/html
   PhET create online Physics simulations when you can complete some simple experiments online. Open up the resistance of a wire html5 simulation. Conduct a simple experiment and make a one-page summary of the experiment and your findings.
d) http://climate.nasa.gov/
   NASA's Jet Propulsion Laboratory has lots of information on Climate Change and Engineering Solutions to combat it. Have a look and make notes on an article of your choice.

Task 6: Further Study (Optional)

Appendix E has a list of books, films and TV programs that might appeal to you.

Appendix A: Multiple Choice Questions for Revision.

Atomic Structure

1. A radioactive substance contains…
   a. unstable electrons that become stable by emitting radiation.
   b. unstable atoms that become stable by emitting radiation.
   c. unstable protons that become stable by emitting radiation.
   d. unstable nuclei that become stable by emitting radiation.

2. Rutherford used what kind of particles to conduct his particle scattering experiment?
   a. α
   b. β
   c. γ
   d. λ

3. Which ONE of the following statements was NOT a result from Rutherford's experiment?
   a. Most of the particles passed straight through the gold foil.
   b. Most of the particles reduced speed significantly as they passed through the gold foil.
   c. Some of the particles were deflected back through large angles.
   d. A very small number of particles were deflected backwards.

4. Isotopes are atoms of the same element with…
   a. the same number of protons, different numbers of neutrons.
   b. different numbers of protons, the same number of neutrons.
   c. different numbers of protons and neutrons.
   d. the same number of protons, different numbers of electrons.

5. Which equation represents the decay of potassium to calcium by emitting a beta particle?
   a. ${}^{40}_{19}K \rightarrow {}^{41}_{19}Ca + {}^{-1}_{0}\beta$
   b. ${}^{40}_{19}K \rightarrow {}^{36}_{17}Ca + {}^{4}_{2}\beta$
   c. ${}^{40}_{19}K \rightarrow {}^{40}_{20}Ca + {}^{0}_{-1}\beta$
   d. ${}^{40}_{19}K \rightarrow {}^{38}_{16}Ca + {}^{2}_{4}\beta$

6. When using a Geiger counter to measure radiation, you must also consider what?
   a. Contamination radiation
   b. CMBR
   c. Incidental radiation
   d. Background radiation

7. The radiation from a radioactive substance can knock electrons out of an atom. This process is called…
   a. extraction.
   b. ionisation.
   c. irradiation.
   d. penetration.

8. Smoke alarms contain which radioactive source?
   a. Alpha
   b. Beta
   c. Gamma
   d. None of these

9. The half-life of a radioactive isotope is the average time it takes for the number of…
   a. neutrons in the radioactive sample to halve.
   b. atoms in the radioactive sample to halve.
   c. radioactive nuclei in the sample to halve.
   d. electrons in the radioactive sample to halve.

10. A sealed tube containing 8 mg of a radioactive isotope has a half-life of 10 hours. Calculate what mass of the isotope is in the tube after 30 hours.
   a. 6 mg
   b. 4 mg
   c. 0.5 mg
   d. 1 mg

11. Which ONE of these medical applications can radioactive isotopes NOT be used for?
   a. The breakdown of kidney stones.
   b. Medical imaging.
   c. Treatment of cancer.
   d. Tracers to monitor organs.

12. Nuclear fission is…
   a. the joining of an atom's nucleus into two smaller nuclei, two or three neutrons and the release of energy.
   b. the splitting of an atom's nucleus into two smaller nuclei, two or three neutrons and the release of energy.
   c. the splitting of an atom into two smaller atoms, two or three neutrons and the release of energy.
   d. the splitting of an atom's nucleus into two smaller nuclei, two or three protons and the release of energy.

13. The fuel in a nuclear reactor must contain isotopes capable of undergoing nuclear fission. The most common type of fuel used is…
   a. Uranuim-238.
   b. Uranuim-235.
   c. Plutonium-239.
   d. Thorium-232.

14. When nuclear fission occurs, several neutrons can be released which can cause other fissionable isotopes to split. This is called…
   a. a spontaneous reaction.
   b. a fission reaction.
   c. an uncontrollable reaction.
   d. a chain reaction.

15. The reaction described in question 14 can be prevented in a nuclear reactor core by using…
   a. lead shielding.
   b. control rods.
   c. a moderator.
   d. coolant.

16. Fusion reactions take place when…
   a. two small nuclei are fused together and release energy.
   b. two small atoms are fused together and release energy.

c. two large nuclei are fused together and release energy.
d. two small nuclei are fused together and release neutrons.

17. Which ONE of the following would NOT be an advantage of a fusion reactor?
    a. Heavy hydrogen fuel is easily available in sea water.
    b. The reaction product, helium, is a non-radioactive gas.
    c. The energy released could be used to generate electricity.
    d. Fusion reactors have a short start up time.

18. An alpha emitting isotope that seeps into houses through the ground in some areas is called…
    a. uranium gas.
    b. radon gas.
    c. thorium gas.
    d. plutonium gas.

19. Nuclear waste must be stored securely for many years. The radiation it emits is dangerous because…
    a. it ionises the air we breathe.
    b. it will irradiate the soil.
    c. it can cause cancer.
    d. it will start a chain reaction.

20. Radiation can be found naturally in the environment. The most common source of this radiation is from…
    a. radon gas.
    b. rocks.
    c. cosmic rays
    d. plants.

Forces and Motion

1. The gradient of a line on a distance-time graph represents…
    a. change in time.
    b. speed.
    c. acceleration.
    d. distance travelled.

2. Choose the correct equation for speed
    a. $v = \frac{s}{t}$
    b. $s = \frac{v}{t}$
    c. $v = s.t$
    d. $t = v.s$

3. What speed would a car be travelling at if it covered 60 km in 80 minutes?
   a. 0.75 m/s
   b. 750 m/s
   c. 12.5 m/s
   d. 0.01 m/s

4. Calculate the acceleration of a train travelling from rest to 24 m/s in 12 seconds.
   a. 2 m/s^2
   b. 288 m/s^2
   c. 0.5 m/s^2
   d. 12 m/s^2

5. The area under the line of a velocity- time graph represents…
   a. change in time.
   b. acceleration.
   c. change in velocity.
   d. distance travelled in a given direction.

6. When an object is decelerating (slowing down), the gradient of the line on a velocity – time graph will be…
   a. positive.
   b. negative.
   c. zero.
   d. proportional.

7. Which ONE of the following is the correct way to find the instantaneous speed of an object from a graph?
   a. Draw a tangent to the line on its distance – time graph.
   b. Use the averages of the distance travelled and the time taken.
   c. Use the speed equation instead.
   d. Draw a tangent to the line on its velocity – time graph.

8. Newton's 2nd law of motion is represented by the equation…
   e. $F = a\ v$
   f. $F = \frac{m}{a}$
   g. $F = m\ v$
   h. $F = m\ a$

9. The tendency of an object to stay at rest or moving at a constant speed is called…
   a. terminal velocity.
   b. torque.
   c. inertia.
   d. resultant force.

10. A 20 kg sack of corn accelerates at 0.80 m/s^2 into the back of a truck. What is its resultant force?
    a. 19.2 N
    b. 16 N
    c. 25 N

d. 0.04 N

11. The Earth's gravitational field strength at its surface is approximately…
    a. 10 N/kg
    b. 11 N/kg
    c. 1.6 N/kg
    d. 8 N/kg

12. Select the correct statement to describe the resultant force and acceleration of an object travelling at terminal velocity.
    a. The resultant force is zero, acceleration is at its maximum value.
    b. The resultant force is at its maximum value, acceleration is zero.
    c. The resultant force is zero, acceleration is zero.
    d. The resultant force is at its minimum value, acceleration is zero.

13. Which ONE of the following statements about stopping distances is incorrect?
    a. Stopping distance = thinking distance + braking distance.
    b. Braking distance is the distance travelled by the vehicle whilst the braking force is acting.
    c. Thinking distance is the time taken for the driver to react.
    d. The greater the speed that the vehicle is travelling at, the longer the stopping distance will be.

14. The law of the conservation of momentum states that…
    a. in a closed system, the total momentum before a collision will equal the total momentum after a collision.
    b. in an open system, the total momentum before a collision will equal the total momentum after a collision.
    c. in an inelastic collision, the total momentum before a collision will equal the total momentum after a collision.
    d. in any system, the total momentum before a collision will equal the total momentum after a collision.

15. Calculate the momentum of a 60 kg rugby player running at a velocity of 5 m/s.
    a. 3000 kg m/s
    b. 300 kg m/s
    c. 12 kg m/s
    d. 120 kg m/s

16. A 10 kg trolley moving at a velocity of 2 m/s collides with a stationary 10 kg trolley. The trolleys move off together after the collision. Calculate the velocity of the trolleys after the collision.
    a. 40 m/s
    b. 2 m/s
    c. 20 m/s
    d. 1 m/s

17. What effect does changing the impact time in a collision have on impact force?
    a. The longer the impact time, the less the impact force is reduced.
    b. Changing the impact time will not have any effect on the impact force.
    c. The longer the impact time, the more the impact force is reduced.
    d. The shorter the impact time, the more the impact force is reduced.

18. Identify the correct equation for impact force.
    a. $F = \frac{m\Delta t}{\Delta v}$
    b. $F = \frac{m\,\Delta v}{\Delta t}$
    c. $F = m\,v\,t$
    d. $F = \frac{m\,\Delta v}{a}$

19. Hooke's Law states that the extension of a steel spring is directly proportional to the force applied to it. If the spring stretches more than expected, the spring is said to have stretched beyond its…
    a. plastic limit.
    b. yield strength.
    c. spring constant.
    d. limit of proportionality.

Energy

1. When a falling object hits the ground without bouncing back, it's kinetic energy store decreases. The kinetic energy has been transferred to…
    a. the surroundings
    b. its gravitational potential energy store
    c. its elastic potential energy store
    d. its chemical energy store.

2. Which of the following statements about the conservation of energy is FALSE?
    a. Energy cannot be created or destroyed.
    b. Conservation of energy applies to all energy changes.
    c. Conservation of energy refers to an open system where energy can transfer in and out of the system's energy stores.
    d. When applying the principles of the conservation of energy, there would be no net changes to the energy stored in the system.

3. A force of 2 kN is applied to an object to make it move 3.6 m in the direction of the force.
   Select the correct value of work done on the object.
    a. 1.8 J
    b. 7200 J
    c. 7.2 J
    d. 555.6 J

4. Identify the correct equation to calculate gravitational potential energy.
    a. $E_P = m\,W\,h$
    b. $E_P = m\,g\,\Delta h$
    c. $E_P = m\ v^2$
    d. $E_P = \frac{1}{2}m\,v^2$

5. Running blades for Paralympic athletes are commonly made from carbon fibre polymers. They are designed to store elastic potential energy as the blade is pressed against the ground. The spring constant of the blade is 14 kN/m. Which of the following is the value of the elastic potential energy stored in the blade when it is compressed by 0.05 m?
    a. 17.5 J
    b. 1.4 J

c. 700 J
d. 0.35 J

6. When a cyclist applied their brakes, a force acts between the brake blocks and the wheels. That force is called…
   a. air resistance
   b. weight
   c. friction
   d. driving force.

7. Which ONE of the following options would be most useful in increasing the efficiency of a very loud machine?
   a. Streamline the shape of the machine.
   b. Lubricate the moving parts to reduce friction.
   c. Tighten loose parts to reduce vibration.
   d. Use wires with low electrical resistance.

8. A laptop battery stores energy with an efficiency of 80%. If 16 000 J of energy are transferred to the laptop from the battery, how much energy must have been transferred to the battery?
   i. 20 kJ
   j. 20 J
   k. 1.28 kJ
   l. 12 800 J

9. A lift motor transfers 24 000J of energy in 1-minute travelling between floors.
   Calculate the power of the motor.
   a. 1440 W
   b. 1.44 MW
   c. 24 kW
   d. 400 W

10. Choose the correct statement below about thermal conductivity.
    a. The higher the thermal conductivity of a material, the higher the rate of energy transfer through it.
    b. The greater the thermal conductivity of a material the less energy is transferred per second.
    c. Wool and fibreglass have a higher value of thermal conductivity than metals.
    d. To increase energy transfer, insulating material in a house should have a high value of thermal conductivity.

11. Identify the TRUE statement about infrared radiation.
    a. Not all objects emit and absorb infrared radiation.
    b. The hotter an object is, the more infrared radiation it emits in a given time.
    c. A good absorber of infrared radiation is always a poor emitter.
    d. A body at a constant temperature is absorbing more infrared radiation than it is emitting.

12. The SI units of specific heat capacity are…
    a. kg/ J ^{o}C
    b. J/kg ^{o}C
    c. J/ g ^{o}C

d. J/kg °F

13. The symbol for specific heat capacity is…
    a. α
    b. Θ
    c. Δ
    d. c

14. Which of the following is not a renewable energy resource?
    a. Hydroelectric power
    b. Tidal power
    c. Geothermal
    d. Nuclear power

16. Which of these power stations will NOT release greenhouse gases into the atmosphere?
    a. Gas
    b. Oil
    c. Coal
    d. Nuclear

17. Which ONE of the following renewable energy sources would be MOST suitable for a small remote island in Scotland?
    a. Solar power
    b. Wind power
    c. Wave power
    d. Tidal power

18. In order to do work, an energy store is…
    a. used up.
    b. lost
    c. transferred
    d. burnt

19. The potential energy of a box on a shelf, relative to the floor, is a measure of?
    a. The work done putting the box on the shelf from the floor.
    b. The weight of the box times the distance above the floor.
    c. The energy the box has because of its position above the floor.
    d. Any of these.

20. Select the power station with the shortest start up time.
    a. Coal
    b. Nuclear
    c. Gas
    d. Oil

Electricity

1. A charged atom is called …

a. a neutron.
b. a proton.
c. an electron.
d. an ion.

2. Charging by friction involves…
   a. rubbing an insulator and a conductor together, electrons are transferred from one material to another.
   b. rubbing two insulators together, electrons are transferred from one material to another.
   c. rubbing two insulators together, electrons are shared between the two materials.
   d. rubbing an insulator and a conductor together, electrons are shared between the two materials.

3. The force between two charged objects is…
   a. a non-contact force.
   b. an electric field.
   c. a charged force.
   d. an electrical potential force.

4. Electric current is a flow of…
   a. protons.
   b. neutrons.
   c. charge.
   d. energy.

5. Why would you use a variable resistor in an electrical circuit?
   a. To change the energy in the circuit.
   b. To vary the amount of voltage flowing.
   c. To change the resistance of a bulb.
   d. To vary the amount of current flowing.

6. Electric charge is measured in…
   a. Volts, V.
   b. Amps, A.
   c. Coulombs, C.
   d. Ohms, Ω.

7. To calculate the size of electric current from the flow rate of charge, the formula used is…
   a. $I = \frac{Q}{t}$
   b. $I = Qt$
   c. $I = \frac{t}{Q}$
   d. $Q = \frac{I}{t}$

8. What is the potential difference across a component if the energy transferred to the component is 400 J when 80 C of charge passes through it?
   m. 32,000 V
   n. 5 V
   o. 0.2 V
   p. 32 V

9. Which ONE of the following statements correctly describes Ohm's Law?
   a. The current through a resistor at constant temperature is directly proportional to the potential difference across the resistor.
   b. The current through a resistor at constant temperature is inversely proportional to the potential difference across the resistor.
   c. The current through a resistor at constant temperature has a non-linear relationship with the potential difference across the resistor.
   d. The current through a resistor at constant temperature has no relationship with the potential difference across the resistor.

10. The current through a diode flows in…
    a. the reverse direction only, called reverse direction.
    b. one direction only, called the forward direction.
    c. both directions, called the multi direction.
    d. one direction only, called the forward resistance.

11. Which ONE statement about components in series is FALSE?
    a. The same current passes through each component.

b. The potential difference of the power supply is shared between its components.
c. The total potential difference of cells in series is the sum of the potential difference of each cell.
d. The sum of resistors in series is equal to $\frac{1}{The\ sum\ of\ the\ resistors}$.

12. A 6 V battery is connected in series with a 2 Ω bulb. What is the value of the current through the bulb?
    a. 4 A
    b. 3 A
    c. 12 A
    d. 0.33 A

13. Mains electricity is…
    a. an alternating current (a.c) supply.
    b. a direct current supply (d.c.) supply.
    c. a variable current (v. c) supply.
    d. a continuous current (c. c) supply.

14. The pins of a 13 A plug are usually made from…
    a. gold.
    b. aluminum.
    c. brass.
    d. copper.

15. Two-core cables are used for appliances that have…
    a. metal cases.
    b. plastic cases.
    c. low wattage.
    d. low resistance.

16. A 100 W light bulb is switched on for 30 minutes. Calculate the energy it transfers.
    a. 0.05 J
    b. 180 000 J
    c. 3.3 J
    d. 300 J

17. Which fuse would you use for a 1000 W heater connected to a 230 V supply?
    a. 13 A because it is a heater and they have high resistance.
    b. 1 A because the current value is 0.23 A.
    c. 3A because the current value is 2.3 A.
    d. 5 A because the current value is 4.35 A.

18. Appliances are often not 100% efficient. Which ONE of the following is NOT a reason for this?
    a. Current in wires and components causes a heating effect due to resistance.
    b. Energy loss due to friction between moving parts.
    c. Appliances transferring heat to the surroundings.
    d. Mains electricity has a variable supply.

19. 1500 J of energy is supplied to an appliance that has an efficiency of 80%. The appliance transfers how much output energy?
    a. 1200 J
    b. 120 000 J
    c. 1875 J

d. 375 J

20. Which ONE of the following statements about conventional current flow and electron flow is correct?
    a. Conventional current flow and electron flow are inversely proportional to each other.
    b. Conventional current flow and electron flow are perpendicular to each other.
    c. Conventional current flow and electron flow are in opposite directions.

Waves

1. Which ONE of the following types of waves is NOT an example of a mechanical wave?
    a. Sound waves
    b. Light waves
    c. Water waves
    d. Seismic waves

2. Select the correct definition from the list below for a transverse wave.
    a. The oscillations of a transverse wave are perpendicular to the direction in which the waves transfer energy.
    b. The oscillations of a transverse wave are parallel to the direction in which the waves transfer energy.
    c. The oscillations of a transverse wave are at 45^{o} to the direction in which the waves transfer energy.
    d. The oscillations of a transverse wave are in the same direction in which the waves transfer energy.

3. Which of the following statements about longitudinal waves is FALSE?
    a. Sound waves are an example of a longitudinal wave.
    b. A slinky spring can be used to demonstrate how longitudinal waves travel.
    c. Longitudinal waves have areas of compression and rarefaction.
    d. All electromagnetic waves are longitudinal waves.

4. What is the relationship between amplitude and energy?
    a. The bigger the amplitude of the waves, the more energy the waves carry.
    b. The smaller the amplitude of the waves, the more energy the waves carry.
    c. Amplitude and energy are not related, they have no effect on each other.
    d. Doubling the amplitude of the waves, reduces the amount of energy the wave carries by half.

5. If the time period of a wave is 4 secs, what is the frequency of the wave?
    a. 4 Hz
    b. 25 Hz
    c. 0.25 Hz
    d. 40 Hz

6. Identify the correct equation to calculate wave speed.
    a. $v = \frac{f}{\lambda}$
    b. $v = F.\lambda$
    c. $v = \frac{\lambda}{F}$
    d. $v = f.\lambda$

7. Sound waves in air travel at an approximate speed of …
   a. 34 m/s
   b. 340 m/s
   c. 3400 m/s
   d. 3×10^8 m/s

8. Which piece of apparatus would be most suitable for investigating waves?
   q. A beaker of water.
   r. A mirror.
   s. A Ripple tank.
   t. A flat piece of wood.

9. Refraction occurs at a boundary between two mediums because…
   a. the speed and wavelength of the waves change.
   b. the speed of the waves change.
   c. the speed and amplitude of the waves change.
   d. the wavelength and the amplitude of the waves change.

10. Sound waves cannot travel through…
    a. matter.
    b. solids.
    c. a vacuum.
    d. a gas.

11. A reflected sound wave is known as …
    a. a repeat.
    b. an echo.
    c. a return.
    d. a reverberation.

12. The frequency range of human hearing is…
    a. 200 – 20,000 Hz
    b. 20 – 2,000,000 Hz
    c. 200 – 200, 000 Hz
    d. 20 – 20,000 Hz

13. Dolphins can use sonar to detect objects in the sea. How far away is the object from the dolphin if the sonar takes 1 sec to be returned? Sound travels at 1484 m/s in sea water.
    a. 742 m
    b. 1484 m
    c. 2968 m
    d. 371 m

14. Ultrasound waves are used for medical scans because they are partly reflected at a boundary between…
    a. air and body tissue.
    b. body tissue and bone only.

c. body tissues of the same type.
d. two different types of body tissue.

15. Which ONE of the following is NOT an advantage of using ultrasound?
    a. Ultrasound is non-ionising.
    b. Ultrasound can be used to scan organs.
    c. Ultrasound can be used to scan soft tissues.
    d. Ultrasound can detect chemical changes within the body's tissues.

16. Ultrasound waves are sound waves of a frequency…
    a. above 2 kHz.
    b. above 20 kHz.
    c. above 20 MHz.
    d. above 200 kHz.

17. Which ONE of the following statements about seismic waves is correct?
    a. Primary seismic waves and secondary seismic waves are longitudinal waves.
    b. Primary seismic waves and secondary seismic waves are transverse waves.
    c. Primary seismic waves are longitudinal waves and secondary seismic waves are transverse waves.
    d. Primary seismic waves are transverse waves and secondary seismic waves are longitudinal waves.

18. Earthquakes are recorded by detectors on the surface of the Earth called…
    a. accelerometers.
    b. seismometers.
    c. Quake-alarms.
    d. motion detector.

19. Seismic P waves are useful for investigating the inner structure of the Earth because they…
    a. travel slower than S waves.
    b. are reflected by solid rock.
    c. are refracted by different densities of rock.
    d. cannot travel through liquids.

20. The frequency of a sound wave is 440 oscillations every second. Calculate the time period of the tuning fork.
    a. 2.5×10^{-3} s
    b. 440 s
    c. 4.4×10^{-3} s
    d. 2.5 s

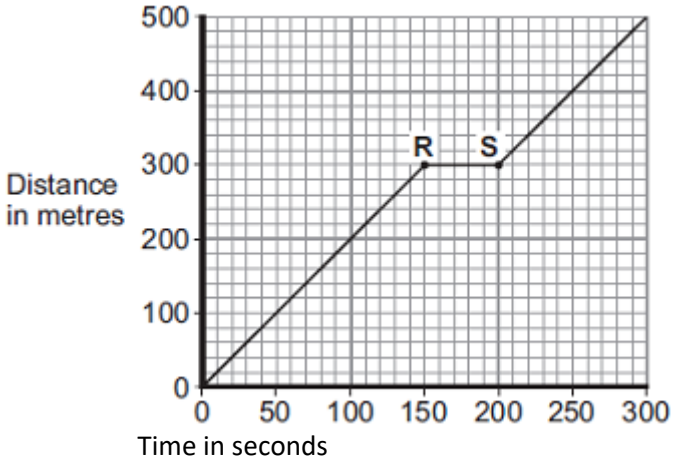
Appendix B: Learning Checklist for Mechanics

	What do I need to know…?	☹	😐	☺
Essential	State examples of contact and non-contact forces			
	Calculate weight using the equation weight = mass x gravitational field strength			
	Calculate work done using work done = force × distance			
	Define power			
	Define velocity and acceleration and state their units.			
	State Newton's 3 Laws of Motion			
	Define terminal velocity			

Challenge	Use free body diagrams to describe the resultant force on an object and calculate the resultant of two forces that act in a straight line.			
	Understand that non-zero resultant forces will lead to accelerations			
	Use Newton's 2nd Law to calculate accelerations and forces			
	Apply Newton's 3rd Law in static situations			
	State Hooke's law for an elastic object (e.g. a spring) and use the equation Force = spring constant × extension			
	Use equations for velocity and acceleration			
	Calculate the average acceleration of an object and apply the equation uniform acceleration $v^2 - u^2 = 2as$			
	Describe how the resultant force on a falling object changes until terminal velocity is reached			
	Use equations for kinetic energy, gravitational potential energy, elastic energy and thermal energy.			
	Apply Conservation of Energy to different situations and understand that the work done is the amount of energy transferred.			
	Be able to calculate momentum			
	Apply the Principal of Conservation of Momentum to describe the outcomes of collisions and explosions			
	Apply the equation force = change in momentum / time taken to describe a range of safety features and stuff like bungee jumping and wotnot			
Extend	Explain the difference between mass and weight.			
	Describe what is meant by "inertia," and be able to calculate inertial mass			
	Be able to use scale diagrams to determine whether a body is in equilibrium			
	Draw scale diagrams to calculate resultant displacement			
	Use the tangent of a distance–time graph to calculate the speed of an object.			
	Use a velocity time graph to determine acceleration and displacement.			
	Apply the Principal of Conservation of Momentum to calculate the velocities of objects in a range of collisions and explosions			
	Apply the equation force = change in momentum / time taken to analyse a range of situations			

Appendix C: GCSE Mechanics Questions

Q1. (a) **Figure 1** shows the distance–time graph for a person walking to a bus stop.



(i) Which **one** of the following statements describes the motion of the person between points **R** and **S** on the graph?

Tick (✓) **one** box.

Not moving ☐

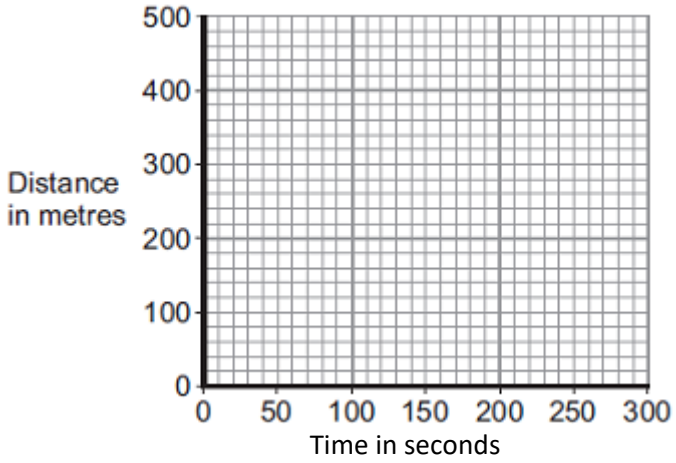
Moving at constant speed ☐

Moving with increasing speed ☐

(1)

(ii) Another person, walking at constant speed, travels the same distance to the bus stop in 200 seconds.

Complete **Figure 2** to show a distance–time graph for this person.



(1)

(b) A bus accelerates away from the bus stop at 2.5 m/s^2.

The total mass of the bus and passengers is 14 000 kg.

Calculate the resultant force needed to accelerate the bus and passengers.

.....

.....

.....

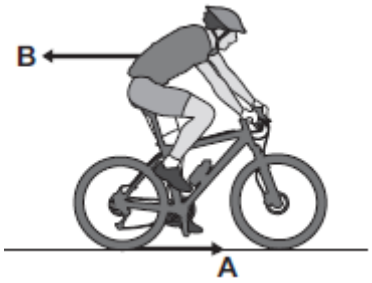
Resultant force = ... N

(2)

(Total 4 marks)

Q2. (a) **Figure 1** shows the horizontal forces acting on a moving bicycle and cyclist.

Figure 1



(i) What causes force **A**?

Draw a ring around the correct answer.

friction **gravity** **weight**

(1)

(ii) What causes force **B**?

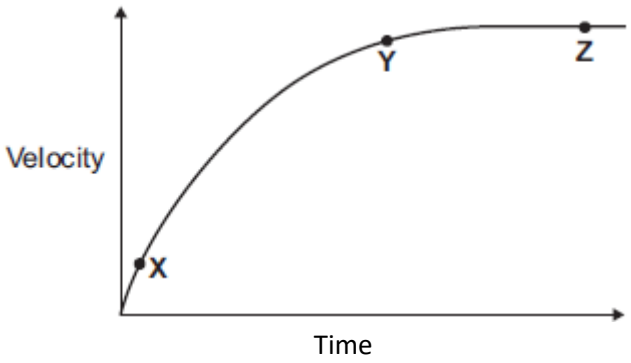
.....

(1)

(iii) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Figure 2 shows how the velocity of the cyclist changes during the first part of a journey along a straight and level road. During this part of the journey the force applied by the cyclist to the bicycle pedals is constant.

Figure 2



Describe how **and** explain, in terms of the forces **A** and **B**, why the velocity of the cyclist changes:

- between the points **X** and **Y**
- and between the points **Y** and **Z**, marked on the graph in **Figure 2**.

.....

.....

.....

.....

.....

.....

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.....

.....

(6)

(b) (i) The cyclist used the brakes to slow down and stop the bicycle.

A constant braking force of 140 N stopped the bicycle in a distance of 24 m.

Calculate the work done by the braking force to stop the bicycle. Give the unit.

.....

.....

Work done = ...

(3)

(ii) Complete the following sentences.

When the brakes are used, the bicycle slows down. The kinetic energy of the

bicycle ..... .

At the same time, the ..... of the brakes increases.

(2)

(Total 13 marks)

Q3. The figure below shows a skateboarder jumping forwards off his skateboard.

The skateboard is stationary at the moment the skateboarder jumps.

(a) The skateboard moves backwards as the skateboarder jumps forwards.

Explain, using the idea of momentum, why the skateboard moves backwards.

.....

.....

.....

.....

.....

(3)

(b) The mass of the skateboard is 1.8 kg and the mass of the skateboarder is 42 kg.

Calculate the velocity at which the skateboard moves backwards if the skateboarder jumps forwards at a velocity of 0.3 m / s.

.....

.....

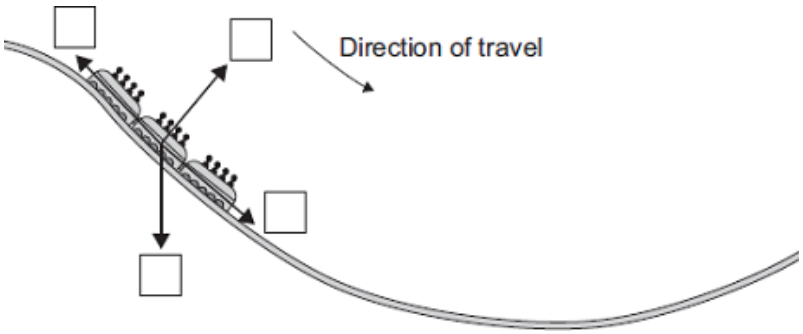
Velocity of skateboard = ... m / s

(3)

(Total 6 marks)

Q4. The diagram shows the passenger train on part of a rollercoaster ride.

(a) Which arrow shows the direction of the resultant force acting on the passenger train?
Put a tick (✓) in the box next to your choice.



(1)

(b) For part of the ride, the maximum gravitational field strength acting on the passengers seems 3 times bigger than normal.

Normal gravitational field strength = 10 N/kg

(i) Calculate the maximum gravitational field strength that seems to act on the passengers during the ride.

.....

.....

Maximum gravitational field strength = ... N/kg

(1)

(ii) One of the passengers has a mass of 75 kg.

Calculate the maximum weight this passenger seems to have during the ride.

.....

.....

Maximum weight = ... N

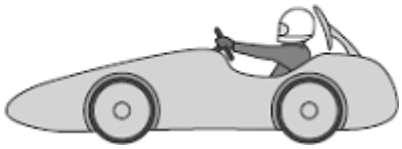
(2)

(Total 4 marks)

Q5. (a) Some students have designed and built an electric-powered go-kart. After testing, the students decided to make changes to the design of their go-kart.

First design **X**

Final design **Y**



The go-kart always had the same mass and used the same motor.

The change in shape from the first design (**X**) to the final design (**Y**) will affect the top speed of the go-kart.

Explain why.

.....

.....

.....

.....

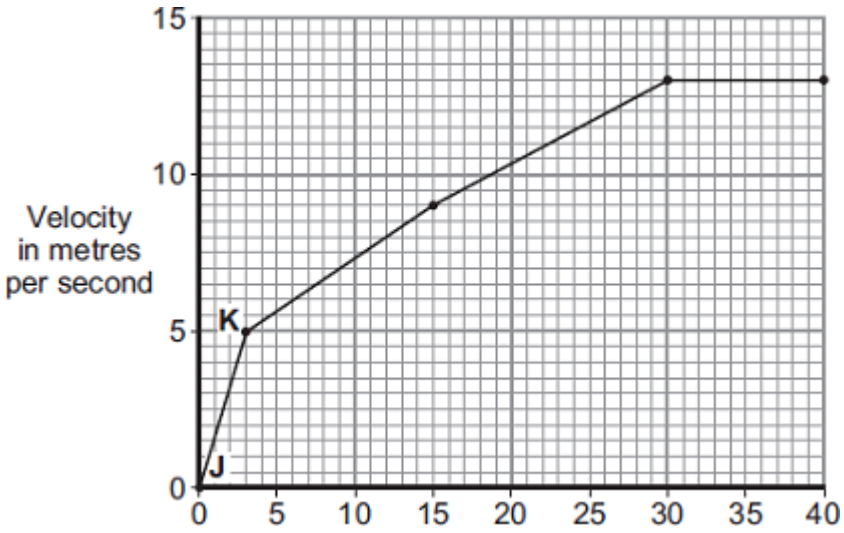
.....

.....

(3)

(b) The final design go-kart, **Y**, is entered into a race.

The graph shows how the velocity of the go-kart changes during the first 40 seconds of the race.


15
10
5
0
Velocity in metres per second
K
J
0
5
10
15
20
25
30
35
40
Time in seconds

(i) Use the graph to calculate the acceleration of the go-kart between points **J** and **K**.

Give your answer to **two** significant figures.

.....

.....

.....

Acceleration = ... m/s^2

(2)

(ii) Use the graph to calculate the distance the go-kart travels between points **J** and **K**.

.....

.....

.....

Distance = ... m

(2)

(iii) What causes most of the resistive forces acting on the go-kart?

.....

(1)

(Total 8 marks)

Appendix D: Data Handling Skills

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 10^{y}. E.g. for an answer of 1200kg we would write 1.2 x 10^{3}kg. For more information visit: 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.

Symbols and Prefixes

At A level, unlike GCSE, you need to remember all symbols, units and prefixes.

Prefix	Symbol	Power of ten
Nano	n	x 10^{-9}
Micro	µ	x 10^{-6}
Milli	m	x 10^{-3}
Centi	c	x 10^{-2}
Kilo	k	x 10^{3}
Mega	M	x 10^{6}
Giga	G	x 10^{9}

Below is a list of quantities you may have already come across and will be using during your A level course

Quantity	Symbol	Unit
Velocity	v	ms^{-1}
Acceleration	a	ms^{-2}
Time	t	S
Force	F	N
Resistance	R	Ω
Potential difference	V	V
Current	I	A
Energy	E or W	J
Pressure	P	Pa
Momentum	p	$kgms^{-1}$
Power	P	W
Density	ρ	kgm^{-3}
Charge	Q	C

Solve the following:

1. How many metres in 2.4 km?
2. How many joules in 8.1 MJ?
3. Convert 326 GW into W.
4. Convert 54 600 mm into m.
5. How many grams in 240 kg?
6. Convert 0.18 nm into m.
7. Convert 632 nm into m. Express in standard form.
8. Convert 1002 mV into V. Express in standard form.
9. How many eV in 0.511 MeV? Express in standard form.
10. How many m in 11 km? Express in standard form.

Rearranging formulae

This is something you will have done at GCSE and it is crucial you master it for success at A level. For a recap of GCSE watch the following links:

www.khanacademy.org/math/algebra/one-variable-linear-equations/old-school-equations/v/solving-for-a-variable

www.youtube.com/watch?v=_WWgc3ABSj4

Rearrange the following:

1. E=m x g x h to find h
2. Q= I x t to find I
3. E = ½ m v^2 to find m
4. E = ½ m v^2 to find v
5. v = u + at to find u
6. v = u + at to find a
7. $v^2 = u^2 + 2as$ to find s
8. $v^2 = u^2 + 2as$ to find u

Significant figures

At A level you will be expected to use an appropriate number of significant figures in your answers. The number of significant figures you should use is the same as the number of significant figures in the data you are given. You can never be more precise than the data you are given so if that is given to 3 significant your answer should be too. E.g. Distance = 8.24m, time = 1.23s therefore speed = 6.75m/s

The website below summarises the rules and how to round correctly.

http://www.purplemath.com/modules/rounding2.htm

Give the following to 3 significant figures:

1. 3.4527
2. 40.691
3. 0.838991
4. 1.0247
5. 59.972

Calculate the following to a suitable number of significant figures:

6. 63.2/78.1

7. 39+78+120

8. (3.4+3.7+3.2)/3

9. 0.0256 x 0.129

10.592.3/0.1772

Recording Data

Whilst carrying out a practical activity you need to write all your raw results into a table.

Tables should have column heading and units in this format quantity/unit e.g. length /mm

All results in a column should have the same precision and if you have repeated the experiment you should calculate a mean to the same precision as the data.

Below are link to practical handbooks so you can familiarise yourself with expectations.

http://filestore.aqa.org.uk/resources/physics/AQA-7407-7408-PHBK.PDF

http://www.ocr.org.uk/Images/295483-practical-skills-handbook.pdf

http://www.ocr.org.uk/Images/295483-practical-skills-handbook.pdf

Below is a table of results from an experiment where a ball was rolled down a ramp of different lengths. A ruler and stop clock were used.

1) Identify the errors the student has made.

	Time			
Length/cm	**Trial 1**	**Trial 2**	**Trial 3**	**Mean**
10	1.45	1.48	1.46	1.463
22	2.78	2.72	2.74	2.747
30	4.05	4.01	4.03	4.03
41	5.46	5.47	5.46	5.463
51	7.02	6.96	6.98	6.98
65	8.24	9.68	8.24	8.72
70	9.01	9.02	9.0	9.01

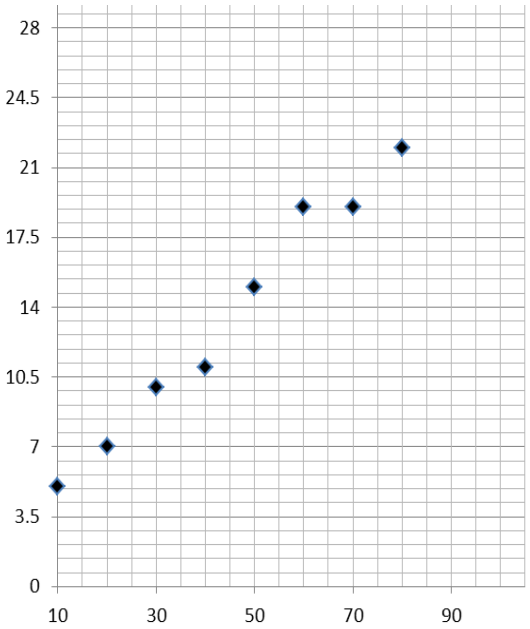
Graphs

After a practical activity the next step is to draw a graph that will be useful to you. Drawing a graph is a skill you should be familiar with already but you need to be extremely vigilant at A level. Before you draw your graph to need to identify a suitable scale to draw taking the following into consideration:

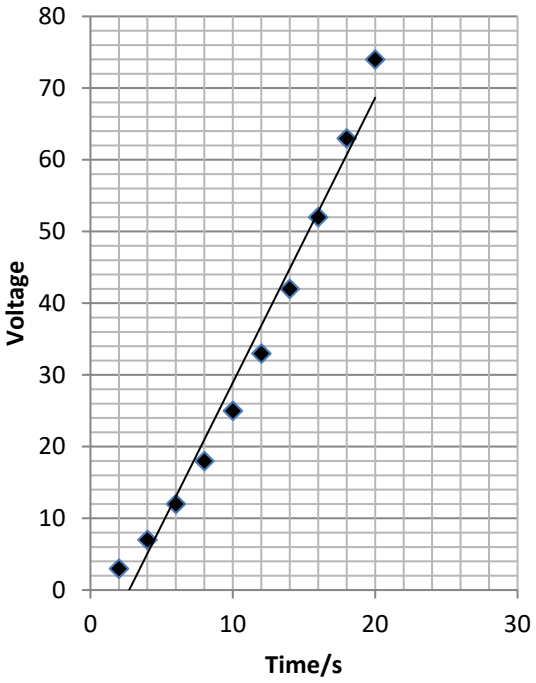
- the maximum and minimum values of each variable
- whether 0.0 should be included as a data point; graphs don't need to show the origin, a false origin can be used if your data doesn't start near zero.
- the plots should cover at least half of the grid supplied for the graph.
- the axes should use a sensible scale e.g. multiples of 1,2, 5 etc.)

Identify how the following graphs could be improved

Graph 1



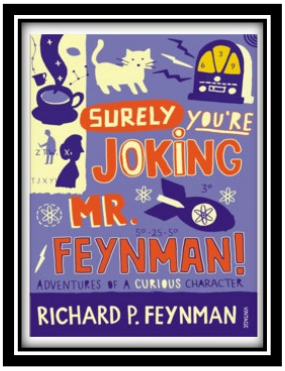
Grip



Appendix E: Further Study

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.

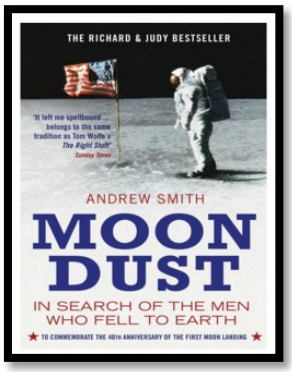


1. **Surely You're Joking Mr Feynman: Adventures of a Curious Character**

ISBN - 009917331X - 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.

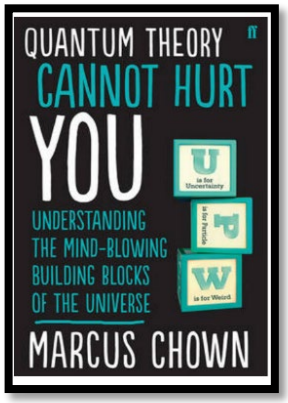
(Also available on Audio book).
https://www.waterstones.com/books/search/term/surely+youre+joking+mr+feynman++adventures+of+a+curious+character

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



ISBN – 1408802384 - 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.

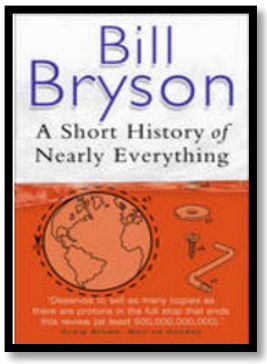
https://www.waterstones.com/books/search/term/moondust++in+search+of+the+men+who+fell+to+earth



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

ISBN - 057131502X - 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.waterstones.com/book/quantum-theory-cannot-hurt-you/marcus-chown/9780571315024



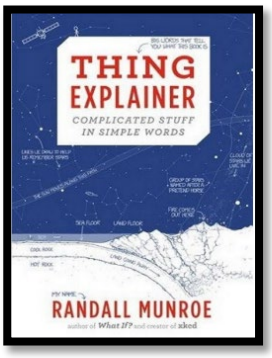
4. **A Short History of Nearly Everything**

ISBN – 0552997048 - 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.waterstones.com/books/search/term/a+short+history+of+nearly+everything

5.

6. **Thing Explainer: Complicated Stuff in Simple Words**



ISBN – 1408802384 - This final 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.waterstones.com/book/thing-explainer/randall-munroe/9781473620919

Movie / Video Clip Recommendations

Science Fictions Films

1. **Moon (2009)**
2. **Gravity (2013)**
3. **Interstellar (2014)**
4. **The Imitation Game (2015)**
5. **The Prestige (2006)**

Online Clips / Series

1. **Minute Physics –** Variety of Physics questions explained simply (in felt tip) in a couple of minutes. Addictive viewing that will have you watching clip after clip – a particular favourite of mine is "Why is the Sky Dark at Night?"

   https://www.youtube.com/user/minutephysics
2. **Wonders of the Universe / Wonders of the Solar System –** Both available of Netflix as of 17/4/16 – Brian Cox explains the Cosmos using some excellent analogies and wonderful imagery.

3. **Shock and Awe, The Story of Electricity –** A 3 part BBC documentary that is essential viewing if you want to see how our lives have been transformed by the ideas of a few great scientists a little over 100 years ago. The link below takes you to a stream of all three parts joined

together but it is best watched in hourly instalments. Don't forget to boo when you see Edison. (alternatively watch any Horizon documentary – loads of choice on Netflix and the I-Player)

https://www.youtube.com/watch?v=Gtp51eZkwoI

4. **NASA TV –** Online coverage of launches, missions, testing and the ISS. Plenty of clips and links to explore to find out more about applications of Physics in Space technology.

   http://www.nasa.gov/multimedia/nasatv/

5. **The Fantastic Mr. Feynman –** I recommended the book earlier, I also cannot recommend this 1 hour documentary highly enough. See the life's work of the "great explainer", a fantastic mind that created mischief in all areas of modern Physics.

   https://www.youtube.com/watch?v=LyqleIxXTpw