**2015 Leaving Cert Physics Solutions (Ordinary Level)**

**2015 no.1**

1. **Draw a labelled diagram of the apparatus used in the experiment.**

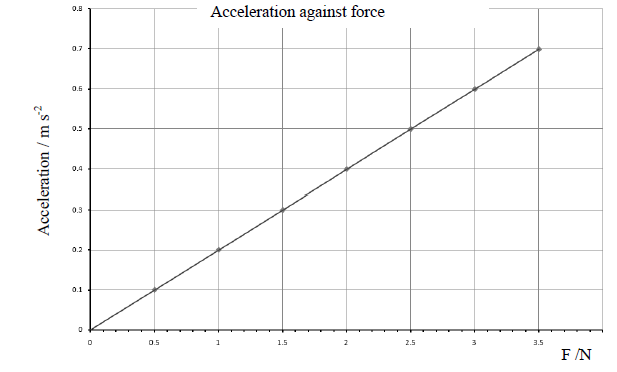
Diagram to show: trolley and runway // air track and rider

means of applying force correctly

timer e.g. ticker timer / photogate(s) / motion sensor

1. **State what measurements were taken during the experiment.**force /

distance / velocity / acceleration / time

1. **How were the effects of friction reduced in this experiment?**Slant/clean the runway / oil (the trolley) wheels / frictionless wheels
2. **Plot a graph, on graph paper, of the acceleration against the force.**labelled axes   
   three points plotted correctly  
   three more points plotted correctly   
   straight line with good fit
3. **What does your graph tell you about the relationship**They are proportional

**2015 no.2**

1. **Draw a labelled diagram of the apparatus used in the experiment.**Water in calorimeter, means of adding steam, thermometer, mass balance, insulation, steam trap
2. **How was the steam dried?**By using a steam trap
3. **What other measurements should be taken during this experiment?**Mass of calorimeter, initial temperature, final temperature, mass of steam, mass of water any two
4. **Calculate the mass of steam used.**Mass = (92.3 – 90.7) = 1.6 g
5. **Calculate the latent heat released when the steam condensed.**Q **=** (0.0016) × (2.3 × 106)   
   = 3680 J.
6. **State one safety precaution required for this experiment.**gloves / tongs / safety glasses / etc.

**2015 no.3**

1. **Draw a labelled diagram showing the arrangement of the apparatus used.**Labelled diagram to show object, concave mirror, screen
2. **How was the position of the image located?**Move screen over and back until the sharpest image formed on the screen
3. **Show the distances *u* and *v* on your diagram.**distance from the object/crosswire to the mirror shown = *u*  
   distance from the image/screen to the mirror shown = *v*
4. **Calculate the value of *f*, the focal length of the mirror.**

average value for *f* = 15 ± 0.1 cm

1. **Why did the student repeat the experiment?**to get an average / greater accuracy / more reliable result / minimise errors

**2015 no.4**

1. **Describe how the student found the resistance of the wire.**Ohmmeter / digital multimeter set to read resistance
2. **What instrument did the student use to measure the diameter of the wire?**Digital callipers
3. **Use the data to calculate the cross-sectional area of the wire.**average *d* = 0.23 mm / *r* = 0.115 mm

*A* = πr2   
*A* = π(0.115)2  
*A* = 0.042 ± 0.001 mm2

1. **Find the resistivity of the material in the wire.**

Ω m

1. **State two precautions which should be taken in order to obtain an accurate result.**Make sure that the wire is taut, measure length from inside of clips, measure diameter in number of places / get average diameter, etc.

**2015 no.5**

1. **State Newton’s law of universal gravitation.**  
   Newton’s Law of Gravitationstates that any two point masses in the universe attract each other with a force that is directly proportional to the product of their masses, and inversely proportional to the square of the distance between them.
2. **Calculate the height it has reached after two seconds.**  
   *s* = *ut* + ½ *at*2

*s* = *(20)(2)* - ½ *(9.8)(2)*2

*s* = 20.4 m

1. From the list below, identify (*i*) the scientist associated with the law of refraction of light and (*ii*) the scientist associated with the laws of electromagnetic induction.

**Faraday Snell Joule Archimedes**

(i) Snell (ii) Faraday

1. **Calculate the refractive index of the glass used in the block.**

n = 1.49 ± 0.05

1. **Calculate the effective resistance of the resistors shown in this circuit diagram.**

RT = 4 Ω

1. **State Boyle’s law.**For a fixed mass of gas kept at a constant temperature the pressure is inversely proportional to the volume.
2. **State one use of the device shown on the right.**Investigating static electricity // create high voltage // stores charge
3. **Name an electronic component that has a p-n junction.**Diode // transistor // LED etc.
4. **What is the purpose of a transformer in a mobile phone charger?**Changes the voltage
5. **What is meant by the *half-life* of a radioactive substance?**Time taken for the radioactivity to reduce by half

**2015 no.6**

1. **Define potential energy**

Potential Energy is the energy an object has due to its position in a force field.

1. **Define kinetic energy**Kinetic Energy is energy an object has due to its motion.
2. **State the principle of conservation of energy.**  
   states that energy cannot be created or destroyed but can only be converted from one form to another.
3. **Explain how the principle applies to a roller-coaster.**   
   Potential energy at top of roller-coaster is converted into kinetic energy as speed increases / height decreases
4. **Calculate the difference in height between point A and point B.**  
   75 m
5. **Calculate the change in the potential energy of the car between A and B.**   
   Change in potential energy = potential energy at A – potential energy at B  
   mg(100) – mg(25)  
   624750 J
6. **Write down the kinetic energy of the car at point B, assuming there is no friction and no air resistance.**   
   Due to conservation of energy, the potential energy lost between A and B must equal the kinetic energy gained.

The car lost 624750 J of potential energy so gained the same amount of kinetic energy, and given that it had no kinetic energy to begin with, its potential energy at B must also be 624750 J.

1. **Calculate its velocity at point B.**

½ mv2 = 624750 J

v = 38.3 m s-1

v2 = 1470

1. **Calculate the deceleration of the car between B and C.**

*v*2 = *u*2 +2*as*

0 = 1470 + 2a(95)  
deceleration = 7.7 m s-2

1. **Calculate the average force required to bring the car to a stop.**

F= ma

F = (80)(7.7)  
F = 6576 N

**2015 no.7**

1. **Explain the term *resonance*.**

Resonance is the transfer of energy so that an object vibrates at its natural frequency

1. **Describe a laboratory experiment to demonstrate resonance.**

* Use two ***identical*** tuning forks (same frequency) and a sound-board.
* Start one fork vibrating, place it on the sound-board and notice the sound.
* Place the second tuning fork on the sound-board and then stop the first tuning fork from vibrating.
* The second fork can now be heard.

Explanation:

The vibrations were passed from the first tuning fork via the sound-board to the second tuning fork.

1. **What is length A called?**

wavelength

1. **What is length B called?**

amplitude

1. **What is meant by the frequency of a wave?**

number (of waves) per second

1. **List three characteristics of a musical note.**

loudness, quality, pitch

1. **What is meant by the term *natural frequency of an object*?**

frequency at which it tends to vibrate (if free to do so)

1. **Calculate the wavelength of the sound wave produced.**

λ = 340/250

λ = 1.36 m

**2015 no.8**

1. **Define capacitance. Name the unit of capacitance**.   
   The capacitance of a conductor is the ratio of the charge on the conductor to its potential.

The farad (F)

1. **What is observed when the switch is closed?**

The bulb lights

1. **What would be observed if a 12 V d.c. supply were used instead of the a.c. supply?**

The bulb would not light

1. **What do these observations tell us about capacitors?**

capacitors allow a.c. to flow but not d.c.

1. **The capacitor has a charge of 0.8 C when connected to the 12 V d.c. supply.**

Calculate its capacitance.

C = Q/V

C = 0.8/12

C = 0.07 F

1. **Describe an experiment to show that energy is stored in a charged capacitor.**Apparatus: charged capacitor, bulb

Procedure: connect the capacitor to the bulb

Observation/conclusion: bulb flashes

1. **Name the property used in each case.**

radio: tuning / smoothing   
camera flash: storage of energy

**2015 no.9**

1. **Distinguish between heat and temperature.**

Heat is a form of energy and temperature is a measure of hotness

1. **Find the energy required to raise the temperature of the water to 100 °C.**

*mcΔθ*5×4180×80   
167 200 J

1. **What is the energy supplied by the element per second?**0.8 kW = 800 Watts which corresponds to 800 Joules per second.
2. **How long will it take the kettle to heat the water to 100 °C?**   
   167 200 J are required to heat the water, and energy is supplied at a rate of 800 Joules per second  
   So time taken is 167200/800  
   = 209 s
3. **Why are handles of kettles often made of plastic?**plastic is a good insulator of heat
4. **How is the heat transferred throughout the liquid in the kettle?**   
   Convection
5. **Why is the heating element of a kettle made of metal?**   
   Metals are good conductors (of heat / electricity)
6. **The heat source for a kettle is placed at the bottom. Suggest why this is the case.**   
   Hot water rises (because it is less dense than cold water) / convection

**2015 no.10**

1. **What are X-rays?**   
   Electromagnetic rays/waves of high frequency
2. **State two properties of X-rays.**High energy, high frequency/ low wavelength, no mass, travel at speed of light, no charge
3. **What process occurs at the cathode?**   
   Thermionic emission // emission of electrons
4. **Name a substance commonly used as the target.**   
   Tungsten
5. **State the function of the part marked A.**Shielding / protection
6. **State one use of X-rays.**   
   Check for broken bones, breaks in metal pipes etc.
7. **Draw a sketch of a cathode ray tube suitable for use in an oscilloscope.**   
   anode, cathode, electric deflecting plates, fluorescent screen, (heated) filament, vacuum tube
8. **Why is a vacuum needed in both the X-ray tube and the cathode ray tube?**   
   So the electrons do not hit gas particles / electrons are not stopped
9. **State one use of a cathode ray oscilloscope.**  
   (early) TV screens, ECG, checking for voltage/signal etc.

**2015 no.11**

1. **What are alpha-particles?**Positively charged helium ions // two protons and two neutrons
2. **Name a source of alpha-particles.**Radium bromide, uranium, thorium, actinium, radium, etc.
3. **What material was used as the target in the experiment?**

Gold

1. **How did Geiger and Marsden detect the alpha-particles?**Flashes of light / scintillations
2. **What was the surprising result they observed?**Some alpha-particles were bouncing back
3. **What force caused the deflection of the alpha-particles?**Electric // magnetic
4. **Outline what the Geiger-Marsden experiment revealed about the structure of the atom.**Central nucleus much smaller than atom, positive charge, with orbiting electrons etc.
5. **For what invention is Hans Geiger most famous?**

Geiger-Muller tube /G-M tube /Geiger counter

**2015 no.12**

*a*)

1. **What is meant by the term *lever*?**A rigid body which is free to rotate
2. **What is the name given to the turning effect of a force?**Moment//torque
3. **What is the name given to a pair of equal but opposite forces?**   
   A couple
4. **Calculate the turning effect of the force.**

*M* = force × distance  
= 0.4 × 20

*M* = 8 N m

*b)*

1. **What is meant by dispersion of light?**   
   Separation of light into different colours/frequencies/wavelengths
2. **What does dispersion of light indicate about the nature of white light?**It is made of different colours/frequencies/wavelengths
3. **Name two laboratory techniques that can be used to cause dispersion of light.**   
   Refraction / using a (transparent/glass/perspex) prism  
   diffraction / using a (diffraction) grating/CD disc
4. **Describe one example of dispersion of light occurring in nature.**   
   A rainbow, diamond reflection, reflection off of oil film, etc.
5. **Explain why this is so.**

All other coloured lights can be made from combinations of these lights // these are the three primary colours

*c*)

1. **Define resistance.**   
   The resistance of a **conductor** is the ratio of the potential difference across it to the current flowing through it.
2. **What is the unit of resistance?**

The Ohm

1. **Describe an experiment to demonstrate the heating effect of an electric current.***apparatus*: battery, resistance wire // toaster /(electric) heater/ hairdryer

*procedure*: complete the circuit / close the switch

*observation/conclusion*: (wire) gets hot

1. State the charge carriers that are responsible for conduction in each of the following.

* **gases** ions
* **semiconductors** electrons and holes
* **metals** electrons
* **solutions** ions



*d*)

1. **Diagram**
2. **Explain the term *electromagnetic induction*.**

voltage/emf/current induced due to changing magnetic flux/field

1. **Describe, with the aid of a diagram, how this can be done.***apparatus*: magnet, (galvano)meter, solenoid   
   *procedure:* magnet moves relative to solenoid   
   *observation/conclusio*n:the (galvano)meter/needle deflects