**2011 Leaving Cert Physics Solutions (Ordinary Level)**

**2011 [Ordinary Level] Question 1**

The following is an extract from a student’s report of an experiment to verify the principle of conservation of momentum.

“I arranged the apparatus. I then measured the mass of each trolley. During the experiment I took further measurements to determine the velocities of the trolleys. I used my measurements to verify the principle of conservation of momentum.”

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

Diagram to include

2 trolleys / 2 riders

runway / air-track

timer: photo- gates (and timer)// tickertape (and timer) /other valid variation

detail e.g. means of measuring mass/ distance

means of measuring velocity e.g. motion sensor / data logger

valid alternatives e.g. data logging methods, which fit the scheme

1. **How did the student measure the mass of a trolley?**

Weighed them using an electronic balance / weighing scales.

1. **How did the student determine the velocity of a moving trolley?**

Measure distance, time

Velocity = distance/time

1. **How was the momentum of a trolley determined?**

Momentum = mass × velocity

1. **How did the student verify the principle of conservation of momentum?**

Upon repeating the experiment a number of times) the value for momentum before and after was always the same (within the limits of the experimental error)

**2011 [Ordinary Level] 2.**

During an experiment to measure the specific latent heat of vaporisation of water, cold water was placed in an insulated copper calorimeter. Dry steam was passed into the water causing a rise in temperature of the water and the calorimeter. The following data were recorded.

Mass of calorimeter = 73.40 g

Mass of cold water = 67.50 g

Initial temperature of water + calorimeter = 10 0C

Temperature of steam = 100 0C

Mass of steam added = 1.03 g

Final temperature of water + calorimeter = 19 0C

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

See diagram

1. **What was the rise in temperature of the water in the experiment?**

19 – 10 = 90 C

1. **Describe how the mass of the cold water was found.**

(mass of calorimeter and cold water) - (mass of calorimeter)

1. **How was the steam dried?**

Using a steam trap or having the delivery tube sloping upward.

1. Calculate:
2. **the heat gained by the water and the calorimeter**

mwcwΔθw+ mcccΔθc

(0.0675)(4180)(9) + (0.0734)(390)(9)

= 2539.4 + 257.6

= 2797 J

1. **the heat lost by the condensed steam**

mcscwΔθcs = (0.00103)(4180)(81) = 348.7 J

1. **the latent heat of vaporisation of water**

(1.03×10-3)( *lv)* = 2797 - 348.7

(1.03×10-3)( *lv)* = 2448

*l*v = 2.37 × 106 J kg-1

**2011 [Ordinary Level] 3.**

You carried out an experiment to measure the speed of sound in air by measuring the frequency and wavelength of a sound wave.

1. **Draw a labelled diagram of the apparatus that you used.**

labelled diagram to show:

frequency source e.g. tuning fork / signal generator

tube, resonance, interference

detail e.g. means of altering length

1. **How did you find the frequency of the sound wave?**

Read it from the tuning fork / signal generator // used tuning forks of known frequency

1. **How was the wavelength of the sound wave measured?**

Equation λ= 4(*l* + (0.3*d*))

Measure length (of vibrating air at resonance) and diameter //

1. **How did you use the measurements to calculate the speed of the sound wave?**

Substituted frequency and wavelength into the formula *c*=*f λ // c* = 4*f* (*l*+(0.3*d*))

1. **Why should you repeat the experiment?**

get an average to ensure greater accuracy

**2011 [Ordinary Level] 4.**

The diagram shows a circuit used to investigate the variation of current with potential difference for a filament lamp.



1. **Name the instrument X. What does it measure?**

voltmeter/multimeter measures voltage 4

1. **Name the component Y. What does it do?**

Rheostat / (variable) resistor / potential divider / potentiometer

Change in one of: resistance, voltage, potential, current, power

The table shows the values recorded for the current and the potential difference during the investigation.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Potential difference/ V | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Current/A | 0.9 | 1.6 | 2.1 | 2.5 | 2.8 | 3.0 | 3.1 |

1. **Draw a graph, on graph paper, of the current against the potential difference.**



1. **What does your graph tell you about the variation of current with potential difference for a filament lamp?**

The relationship between current and potential difference for a filament lamp is non linear / not proportional

1. **Using your graph, calculate the resistance of the lamp when the potential difference across the lamp is 5.5 V.**

 *R* = 5.5 ÷ 2.9 = 1.9 ± 0.2 Ω

**2011 [Ordinary Level] 5.**

1. **What is friction?**
2. **What is the relationship between *G*, the gravitational constant and *g*, the acceleration due to gravity?**
3. **A crowbar is an example of a lever. Give another example of a lever.**
door handle, scissors, wheelbarrow, tongs etc
4. Which of the following terms is associated with a wave motion?

**half-life interference induction doping**Answer: Interference

1. **Name the three ways by which heat can travel from one place to another**conduction, convection, radiation
2. **Give two uses of a concave mirror**
headlights, makeup, shaving mirrors, etc
3. **What is the colour of the earth cable in a standard 3-pin plug?**yellow & green
4. **How does a miniature circuit breaker (MCB) improve safety in a domestic circuit?**

prevent too high current flowing // turns off current

1. **Give a use for an electroscope.**
test for charge, identify charge, measure potential
2. **Give a disadvantage of a named renewable source of energy.**biomass/ tide /sun / wind is not always there

**2011 [Ordinary Level] 6.**

1. **State Newton’s first law of motion.**

A body will remain at rest or moving at a constant velocity unless acted on by an (external) force,

1. **Draw a diagram of the forces acting on the car before it hit the tree.**



1. Calculate the acceleration of the car during the collision.

v = u + at

$$a=\frac{v-u}{t}$$

$$a=\frac{0-15}{0.4}$$

a = 37.5 m s-2

1. **Calculate the net force acting on the car during the collision.**

*F*= ma *F* =1400 × 37.5 = 52500 N

1. **Calculate the kinetic energy of the moving car before it struck the tree.**

(*E* = ½ mv2 E = ½ (1400)(15)2 = 157500 J

1. **What happened to the kinetic energy of the moving car?**

It got converted to heat and sound and also deformed the tree

1. **Explain, with reference to Newton’s laws of motion, how this could occur.**

Even though the car comes to a stop the back-seat passenger will continue to move forward (from Newton’s first law of motion) and so could collide with someone in the front.

1. **How is this risk of injury minimised?**

By wearing a seat belt.

**2011 [Ordinary Level] 7**

1. **Explain the underlined terms.**

Reflection is the bouncing of a wave off an obstacle

Refraction is the bending of a wave when it travels from one medium to another.

1. **Give a practical application of the reflection of light.**

Mirrors / optic fibres / binoculars, etc

1. **State the laws of reflection of light.**

Angle of incidence is equal to the angle of reflection.

Incident ray, the normal, and the reflected ray all lie on the same plane.

1. **Explain, with the aid of a diagram, how total internal reflection can occur.**



1. **What is meant by the ‘critical angle’ in total internal reflection?**

The angle of incidence above which total internal reflection occurs /

the angle of incidence where the angle of refraction is 90º

1. **Draw a diagram to show how light waves travel along an optical fibre.**



1. **Give two advantages of using optical fibres instead of copper wires when transmitting data.**

Cheaper, can carry more signals, faster, less power consumption, etc

1. **Optical fibres are also used in medicine. Give an example of their use in medicine.**

endoscope / to look inside body /( keyhole) surgery , etc

**2011 [Ordinary Level] 8 (a)**

1. **What is meant by a thermometric property?**

A property that changes measurably with temperature

1. **Name two different thermometric properties.**

Length of mercury column, colour, *E*, *V*, *R* , etc.

1. **Name two different thermometers.**

Mercury, alcohol, thermocouple/thermopile, pyrometer, resistance, constant volume gas, digital thermometer, etc

1. **Describe how to calibrate a thermometer.**

*apparatus*: container of water, heat source, un-calibrated thermometer, calibrated thermometer, marker

*procedure*: place the thermometers in water, heat to different temperatures and mark /

plot calibration curve

1. **Why is there a need for a standard thermometer?**

Because different thermometric properties give different results at the same temperature.

**2011 [Ordinary Level] 8 (b)**

An electric kettle is filled with 500 g of water and is initially at a temperature of 15 0C.

The kettle has a power rating of 2 kW.

1. **Calculate the energy required to raise the temperature of the water to 100 0C.**

Q = mc△θ = (0.5)(4180)(85) = 1.78 × 105 J

1. **How much energy is supplied by the kettle every second?**

2 kW = 2000 W = 2000 Joules per second

1. How long will it take the kettle to heat the water to 100 0C?

1.78 × 105 J are required and the kettle supplies 2000 Joules per second, so total number of seconds =

1.78 × 105 ÷ 2000 = 89 seconds

1. **Name a suitable material for the handle of the kettle. Justify your answer.**

Plastic or wood; they are good insulators so will not burn your hand.

**2011 [Ordinary Level] 9 (a)**

1. **State Faraday’s law of electromagnetic induction.**

Induced emf is directly proportional to rate of change of magnetic flux

1. **What is observed on the meter when the magnet is moved towards the coil?**

Needle deflected / moves

1. **What is observed on the meter when the magnet is stationary in the coil?**

No movement of needle

1. **Explain these observations.**

emf only occurs when the magnetic flux changes.

When the magnet is stationary there is no change in magnetic flux therefore no induced emf therefore no movement of the needle.

1. **How would changing the speed of the magnet affect the observations?**

More deflection if faster / less deflection if slower

**2011 [Ordinary Level] 9 (b)**

1. **What is meant by a.c.?**

Alternating current / electric current that reverses/changes its direction (at regular intervals)

1. **Draw a labelled diagram showing the structure of a transformer.**



1. **The input coil of a transformer has 200 turns of wire and is connected to a 230 V a.c. supply.**

**What is the voltage across the output coil, when it has 600 turns?**

$\frac{V\_{s}}{V\_{p}}= \frac{N\_{s}}{N\_{p}}$

$$\frac{V\_{s}}{230}= \frac{600}{200}$$

Vs = 690 V

**2011 [Ordinary Level] 10**

1. **What is radioactivity?**

Radioactivity is the breakup of the nucleus of an atom with the emission of one or more types of radiation

1. **Name the other two types of radiation emitted by radioactive sources.**

Beta and gamma

1. **Describe an experiment to distinguish between the three types of radiation.**
* We placed different materials between the source and the detector.
* We found that a few sheets of paper would stop one type of radiation, a thin sheet of aluminium would be required to block another, while lead is necessary to block the third type.
* The source which could be blocked by paper was alpha, the source which was blocked by aluminium was beta and the source which was blocked by lead was gamma.
1. **List three properties of one of these radiations.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **nature** | **charge** | **ionising** | **range** | **mass** |
| Alpha | He nucleus | (+) 2 | Very good | Few cm in air | 4 amu |
| Beta | electron | (-) 1 | good | Few mm in Al | 1/2000 amu |
| gamma | em radiation | 0 | poor | Many cm in Pb | 0 |

1. **What are isotopes?**

Isotopes are atoms which have the same atomic number (same number of protons) but with different mass numbers (different number of neutrons)

1. **Why is it important to prevent radon gas entering your home?**

Because it can cause lung cancer

1. **If no more radon gas entered your home, how long would it be until one eight of the radon gas was left?**

The half-life is 4 days, so after 4 days ½ would remain, after 2 half-lives (8 days) ¼ would remain, and after 3 half-lives (12 days) 1/8 would remain.

1. **Give two uses of radioisotopes.**

Medical, industrial, agriculture, smoke detectors, energy source, etc

**2011 [Ordinary Level] 11**

* 1. **Who discovered the photoelectric effect?**

Hertz

* 1. **Who explained the photoelectric effect?**

Einstein

* 1. **What happens when light shines on certain metals?**

It transfers its energy to metal/ electrons // electrons are emitted

* 1. **Why is a metal a good conductor of electricity?**

Electrons are only loosely bound

* 1. **Why does your skin feel warm when light shines on it?**

Energy transferred from the light/radiation

* 1. **In the photoelectric effect, what happens when the intensity of the light is increased?**

Number of electrons released increases

* 1. **How can the speed of electrons emitted in the photoelectric effect be controlled?**

Change the frequency of the radiation

* 1. **Give one application of the photoelectric effect.**

Photocell, alarms, photocopiers, light meters, photodiodes, etc

**2011 [Ordinary Level] 12 (a)**

1. **State Boyle’s law.**

(for a fixed mass of gas kept at a constant temperature) the pressure is inversely proportional to the volume // *PV* = *k* (when *T* and *m* are fixed)

1. **Describe an experiment to demonstrate that the atmosphere exerts a pressure.**

*apparatus*: can (containing water) // can (of air) // glass of water

*procedure*: boil water in can // pump // cardboard / lid

seal / invert in cold water // air out // invert

*observation/conclusion*: can crushes / collapses // lid supported

1. **What volume of gas will be available at the top of Mount Everest, when the gas is released from the tank?**

P1V1 = P2V2

(4.2 × 106)(5) = (3.0 × 104)(V2)

*V*= 700 litres

**2011 [Ordinary Level] 12 (b)**

1. **Name the physical property of a sound wave on which each characteristic depends.**

Loudness depends on amplitude / frequency

Pitch depends on frequency

Quality depends on overtones / harmonics

1. **What is meant by the frequency limits of audibility**

These are the lowest and highest frequencies which humans can hear

1. **What name is given to a sound whose frequency is greater than our upper frequency limit of audibility?**

Ultrasonic

1. **Calculate the distance of the bat from the wall.**

Velocity = distance ÷ time. distance = velocity × time. distance = 340 × .01

Distance = 3.4 m

**2011 [Ordinary Level] 12 (c)**

1. **What is an electric current, and give its unit of measurement?**

It is a flow of charge. The unit is the amp.

1. **State the three effects of an electric current.**

Magnetic, heating, chemical

1. **How would you demonstrate one of the effects?**

*apparatus*; e.g. filament bulb, battery, leads 3

*procedure*; e.g. connect up circuit and pass current through the bulb 3

*observation / conclusion*; e.g. the bulb lights / gets hot

1. **Calculate the current supplied by the battery when the screwdriver is turned on.**

*P* = *IV*

120= (*I)(*24)

I = 5 A

**2011 [Ordinary Level] 12 (d)**

1. **What are alpha-particles?**

Consist of two protons and two neutrons // helium (nucleus)

1. **What happened to the alpha-particles in the experiment?**

Some deflected, some un-deviated, some reflected

1. **What did the experiment reveal about the structure of the atom?**

Mainly empty space with a positive nucleus at centre

1. **Name the scientist who designed the experiment.**

Rutherford

1. **Name a suitable detector of alpha-particles.**

GM tube, solid state detector, cloud chamber, ionisation tube, ZnS screen, gold leaf electroscope, photographic film, etc.