**2019 Leaving Cert Physics Solutions (Ordinary Level)**

**2019 Question 1**

1. **How did the student measure the weight of the metre stick?**    
   Newton balance // weighed it and multiplied by g
2. **How did she find the centre of gravity of the metre stick?**    
   suspended from string/thread and moved the string until it balanced
3. **How did she make sure that the metre stick was balanced and level?**  
   balanced: (hung weights until) no movement

level: horizontal / used a spirit level / visually level

1. **Redraw the above diagram in your answerbook and include the weight of the metre stick.**

copy diagram and show given forces plus 2 N shown downwards at 50 cm mark

1. **Using appropriate calculations, show that the first law of equilibrium is verified in this experiment.**Force up = 8 + 4 = 12 6

Force down = 3 + 2 + 7 = 12

1. **In your answerbook, complete the calculations to verify the second law of equilibrium.**

|  |  |  |
| --- | --- | --- |
| Clockwise moments | (3×30) + (2×50) + (7×70) | 680 N cm |
| Anticlockwise moments | **(8×40) + (4×90)** | 680 N cm |

**2019 Question 2**

1. **Draw a labelled diagram of the apparatus used in this experiment.**   
   labelled diagram to show:

calorimeter (with water)

thermometer

ice

(electronic) balance

1. **The ice was crushed before it was added to the water.  Why was the ice crushed?**

helps it to melt faster // reference (to increase in) the surface area

1. **Name (a) one mass measured and (b) one temperature measured.**   
   (a) mass of empty calorimeter / mass of calorimeter and water (and ice) / mass of ice  
   (b) temperature of water initially/finally // temperature of (crushed) ice
2. **Name an instrument used to measure one of the quantities listed in (iii) above.**   
   (electronic) balance // thermometer
3. **State one precaution used in this experiment, other than crushing the ice.**   
   Insulate the calorimeter, use a sensitive/digital thermometer, stir, dry the crushed ice,

use lots of ice, avoid splashing, do quickly etc

**2019 Question 3**

A student carried out an experiment to calculate the refractive index, *n*, of a material. 

1. **Draw a labelled diagram of the apparatus used in this experiment.**   
   labelled diagram to show:

glass/(perspex) plastic block // container of liquid

raybox / laser / (optical) pins //(optical) pins

detail e.g. protractor, sheet of paper, normal, critical angle // mirror, ruler

1. **State the formula used in this experiment to calculate the refractive index, *n*.**
2. **What measurements did the student take during the experiment?   
   What instrument was used to take these measurements?**  
   angles *i* and *r*   
   protractor // metre stick // protractor
3. **Why should the experiment be repeated?**  
   increase accuracy, take an average, to get data for a graph
4. **Other than repeating the experiment, state one precaution that the student took to improve the accuracy of the experiment.**   
   use large angles of incidence // avoid no parallax

**2019 Question 4**

1. **Name the instrument used to measure the length *l* of the wire.**   
   metre stick / ruler
2. **Name the instrument used to measure the resistance *R* of the wire.**  
   ohmmeter / (digital) multimeter
3. **Name the instrument used to measure the diameter *d* of the wire.**micrometer (screw gauge) // digital/ Vernier callipers
4. **Use the data to calculate the average diameter of the wire.**  
   d = ( 0.00024 + 0.00028 + 0.00023) ÷ 3 = 0.00025 m
5. **Calculate the cross‐sectional area *A* of the wire.**   
    = 4.9 × 10-8 m2.
6. **Use the formula to calculate the resistivity of the wire.**

= 1.14 × 10-6 Ω m.

**2019 Question 5**

5.  (a), (b), (c), etc.

1. **State the principle of conservation of momentum.**  
   in a closed system the total momentum before interaction = the total momentum after
2. **A force of 2500 N acts on a car of mass 1000 kg.     Calculate the acceleration of the car.** = 2.5 m3.
3. **Which of the following is the unit of electrical charge?**

coulomb 

1. **State Boyle’s law.**  
   for fixed mass at constant temperature pressure is inversely proportional to volume
2. **Calculate the power output of the crane.**  
    = 1400 W
3. **The boiling point of water is 100 °C.  Convert this temperature to kelvin (K).**  
   100 + 273.15 = 373.15 K
4. **Explain why it is possible to hear around corners but not to see around corners.**  
   The wavelength of sound waves is much larger than the wavelength of light waves.
5. **Name the three primary colours of light.**  
   red, green and blue
6. **What is a semiconductor?**  
   material whose resistivity lies between that of an insulator and a conductor
7. **Name the three forms of nuclear radiation.**   
   Alpha, beta, gamma

**2019 Question 6**

1. **What is the acceleration of the jet?**  
   *v*= *u* + *at* ⟹ 28 = 0 + *a*(7) i.e. *a* = 4 m s‐2
2. **Distinguish between a vector quantity and a scalar quantity.**   
   vector quantities have a direction (scalar quantities don’t)
3. **Explain why an astronaut standing on the moon has a constant speed but a changing velocity.**  
   when the moon orbits it changes its direction of motion so its velocity changes
4. **Armstrong had a mass of 90 kg. Calculate his weight on Earth.**   
   weight = m g = (90)(9.8) = 882 N
5. **What was Armstrong’s mass on the moon?**   
   90 kg
6. **Armstrong’s weight on the moon was only 17% of his weight on Earth. Explain why.**   
   smaller mass of moon // less gravitational force // value for *g* is less
7. **Define pressure.**  
   pressure is the force per unit area
8. **Calculate the pressure Armstrong exerted on the surface of the moon.**   
    = 4998 Pa

**2019 Question 7**

1. **Which of these characteristics can be quantified as a frequency?**  
   pitch
2. **Name the property of a wave that affects its loudness.**  
   amplitude
3. **What is the wavelength of the note?**  
   *v* = *fλ*  = 3.09 m
4. **Describe an experiment to show that sound cannot travel through a vacuum.**  
   apparatus: (bell) jar, sound source / electric bell

vacuum pump

procedure: turn on pump / pump out the air

observation/conclusion: loudness decreases as air is removed /no sound heard

1. **Describe how to demonstrate the Doppler effect in a laboratory.**  
   apparatus: buzzer/sound source with fixed frequency/pitch, string

procedure: turn on sound source and rotate using string

observation/conclusion: frequency /pitch changes (as sound source moves closer/away)

1. **Distinguish between a longitudinal wave and a transverse wave.**

the disturbance is parallel to the direction of motion for longitudinal waves

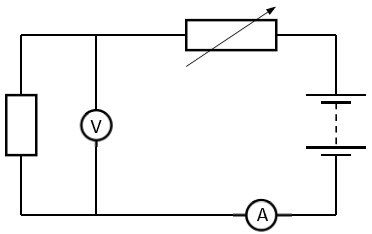
the disturbance is perpendicular to the direction of motion for transverse waves

1. **Which one of these phenomena do sound waves not undergo?**   
   Explain why.  
   polarisation as they are not transverse /e.m. waves // polarisation as they are longitudinal waves

**2019 Question 8**

1. **Is the student’s statement correct?  Explain your answer.**   
   no, (the bath has) more water/mass
2. **What is meant by a thermometric property?**  
   property which changes (continually) with changing temperature
3. **Name another example of a thermometric property.**   
   colour, resistance, pressure, volume, emf, voltage, etc
4. **Define specific heat capacity.**  
   energy required to raise the temperature of 1 kg by 1 K / 1 ⁰C
5. **Why does the material in the bricks need to have a high specific heat capacity?**  
   so that they can store a lot of heat energy without a big change in temperature
6. **Calculate the heat energy gained by the water in the kettle.**  
    = (1.5)(4200)(88‐15) = 4.599 × 105 J
7. **Apart from boiling, name one other change of state that can happen to water.**  
   freezing, condensing, melting
8. **What is meant by latent heat?**latent heat is the heat required to change the state of a substance without a change in temperature

**2019 Question 9**



(a)

1. **What is meter A?**  
   ammeter
2. **What is meter V?**   
   voltmeter
3. **Which of the graphs below shows Ohm’s law being obeyed?   
   Explain your answer.**   
   Graph 1   
   the straight line through the origin

(b)

1. **Calculate the total resistance in the circuit.**
2. **Calculate the current flowing through the circuit.**

(c)

1. **Name the wire labelled A.**   
   earth
2. **Name the wire labelled B.**   
   live
3. **State the function of the fuse.**   
    break the circuit when current too big
4. **Name one of these devices.**   
   circuit breaker/ trip switch, RCD , RCB, MCB, ELCB

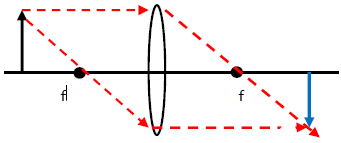
**2019 Question 10**

1. **State two properties of an electron.**

negative charge, small mass, orbits outside nucleus, deflected by electric/magnetic fields

1. **How are the electrons produced in a cathode ray tube?**  
   thermionic emission
2. **How could the beam of electrons be deflected?**  
   by electric / XY plates // magnetic fields
3. **What happens when the beam of electrons strikes the screen?**  
   lose energy, fluorescence, KE converted to light energy
4. **State one use of a cathode ray tube.**   
   CRO, old TV monitors, ECG screens, etc
5. **What are X‐rays?**  
   high energy electromagnetic radiation // electromagnetic radiation of short wavelength
6. **State one way in which an X‐ray tube is designed to take account of this large amount of heat energy.**   
   its large metal target absorbs most of this heat energy // coolant / heat sink
7. **Why might an X‐ray tube be surrounded by lead shielding?**  
   for protection from ( ionising) radiation
8. **State one use of X‐rays.**  
   e.g. check for broken bones, locate cracks in metal pipes
9. **State one hazard associated with X‐rays.**  
   can cause skin burns /cancer/ionise cells, death, etc.

**2019 Question 11**

1. **Name the part of the eye where an image is formed.**  
   retina
2. **What is the function of the pupil?**  
   allows light enter the eye
3. **Describe how the eye changes to allow this to happen.**  
   the lens has a different power for near and far objects // lens changes shape
4. **Name the two most common eye defects. What type of lens corrects short sightedness?**    
   myopia (short sightedness) and hyperopia (long sightedness)
5. **Draw a sketch of this lens.**  
   diverging/ concave lens named and sketche
6. **Copy the diagram below into your answerbook and complete the ray diagram to form a real image.**
7. **Calculate the power of the lens required to correct this defect?   
   What is the focal length of this lens?**  
   P = 38 – 32 = 6 m‐1

m = 0.167 m

1. **What is meant by refraction?**  
   the bending of light when it goes from one medium to another

**2019 Question 12 (a)**

1. **State the principle of conservation of energy.**  
   Energy cannot be created or destroyed but can be converted from one form to another
2. **Calculate the cannonball’s kinetic energy as it is fired.**  
   K.E. = ½ *mv*2 = ½ (7)(50)2 = 8750 J
3. **As the cannonball rises, its kinetic energy is converted into another form of energy. Name this energy.**Potential energy
4. **Calculate the greatest height reached by the cannonball.**  
   KE = 8750 = *mgh* = (7)(9.8) h // *v*2=*u*2+ 2*as* ⟹ 0 = (50)2+2(‐9.8)s   
     
   ⟹ h = 127.55 m // *s* = 127.55 m
5. **Calculate the density of the cannonball.**

= = 7777.8 kg m‐3

**2019 Question 12 (b)**

1. **Define capacitance.**  
   capacitance is the ratio of charge to potential difference
2. **State the unit of capacitance.**  
   Farad / F
3. **Calculate the capacitance.**   
    = 10-4 F
4. **Explain how the circuit is used.**   
   throw the switch to close the bottom circuit and observe

the bulb lights briefly due to the energy from the capacitor.

1. **State another use for a capacitor.**   
   specific use: conducts a.c., (radio) tuning/filtering/smoothing ,timing, etc.

**2019 Question 12 (c)**

1. **State one other property of magnets.**   
   unlike poles attract, magnets attract certain metals, magnets are strongest at the poles, etc.
2. **What is meant by a magnetic field?**  
   region/space (around a magnet) within which a magnetic force is experienced
3. **Describe an experiment to plot the magnetic field of a bar magnet.**  
   apparatus: magnet, plotting compass

procedure: use the apparatus to locate the field lines e.g. (place the compass on the paper and) mark the dots

detail: join the dots/ show field lines / lines go from north to south/ field lines are concentrated at the magnet poles

OR  
magnet , iron filings, sprinkle filings, tap filings

1. **State one other use of magnets.**  
   compass, to keep a fridge door closed, electric bell, electric motor, transformer, electromagnet, electromagnetic induction, moving coil meters, etc.

**2019 Question 12 (d)**

1. **is a uranium atom. How many protons are in this uranium atom?**      
   92 protons
2. **How many neutrons are in this uranium atom?**  
   146 neutrons
3. **is another isotope of uranium. What are isotopes?**  
   atoms with the same atomic number and with different mass numbers
4. **Distinguish between nuclear fission and nuclear fusion.**  
   Fission is the breaking up a nucleus

Fusion is the joining of nuclei into one larger nucleus

1. **State one advantage and one disadvantage of nuclear energy.**  
   Advantage: lots of energy, no carbon emissions, no pollution any one

Disadvantage: danger of leaked radiation, health risk, etc.