NSW INDEPENDENT TRIAL EXAMS -2003

PHYSICS 2 UNIT HSC TRIAL

PART A

1 C	2 C	3 B	4 D	5 D	6 A	7 B	8 A	9 B	10 D
11 C	12 A	13 C	14 A	15 B					

PART B

16. a) 24 hours.
    b) 3 marks for correct answer 6.6 x 10^7 metres (note that radius of Earth needs to be subtracted from answer from formula).
    2 marks for correct answer for distance from centre of earth (1mk for subtracting Earth radius)
    1 mark for correct use of formula without arriving at correct answer
    c) They have the same period (24 hours) and are at the same altitude (approx 36 000 km). Geostationary is above the equator and always above the same point on the Earth's surface while geosynchronous traces a figure of eight pattern across the surface.
17. (a) Galileo combined his knowledge from falling bodies (direct drop and inclined planes) with constant horizontal velocity to deduce a $y \propto x^2$ relationship, and therefore parabolic path.
    (b) 2 marks: student uses v_x = const, and $v_y = \frac{1}{2}at^2$ and successfully shows that the tabulated figures can be arrived at by processing at least 2 sets of data, and concludes that this supports Galileo.
    eg $v = \sqrt{v_x^2 + v_y^2} = \sqrt{20^2 + \frac{1}{2}\times 1.2 \times 10^2} = 23.3\, ms^{-1}$ for t = 10 s; this analysis relies on the parabolic nature of the path and agrees with the measured values, thus supporting Galileo's concepts.
    1 mark: student shows an understanding of the characteristics of projectile motion and makes an unsuccessful attempt to analyse the data in support of this or student analyses data correctly or fails to link their analysis to the characteristics of projectile motion.
18. (a) Events are simultaneous if light from them reaches the midpoint of the interval joining them at the same time.
    (b) Th shooter on the train the laser pulses hit the targets 1 and 2 at the same time. However, to the observer off the train the laser pulse to the left strikes target 1 before the laser pulse to the right strikes target 2.
    (c) $L_v = L_o\sqrt{1 - \frac{v^2}{c^2}} = 100\sqrt{1 - \frac{(0.995c)^2}{c^2}} = 10$ metres
19. 5 marks: answer describes suitable experiment, analysis of results and repetition to ensure reliability.
    2-4 marks: answer lacks detail and/or fails to show analysis of data clearly and/or does not mention reliability
    1 mark: student shows an elementary understanding of a suitable experiment.
20. 1 mark: Identifies correct equation as F = n.B.I.L, and makes correct substitutions
    1 mark: Calculates I = 0.25 A
    1 mark: Identifies current direction as clockwise
21. (a) Anticlockwise (b) The commutator is a device that reverses the direction of current flowing through an electric circuit (c)(i) $\tau = BIAn\cos\theta = 0.5 \times 5 \times 0.05^2 \times 100 \times \cos 0^o = 0.63$ Nm (ii) zero Nm
22. (a) Alternating Current
    (b) The alternating current in the induction coil induces a magnetic field and consequently a current in the saucepan. The natural resistance of the saucepan generates heat that is transferred to the ingredients in the saucepan. This is a more efficient heat transfer than heating by gas or electricity as much of the heat is lost to the air between the source of heat and the saucepan.
    Induction is safer than gas or electric surfaces since there is no open flame, red-hot coil or other radiant heat source to ignite fumes or flammable materials that cause fires.
    (c) Induction cooktops produce eddy currents in cast iron, stainless steel, or enameled iron types of cookware, not aluminium. The eddy currents heat the metal and hence the contents.

23. 1 mark each component: names a structural feature
    1 mark each feature: Explains how feature enables efficient performance of intended task

23. Sample answer

Transmission Component	Structural Feature	How it enables efficient functioning
Generators	Rotor and stator Slip rings	Relative motion induces current Produces AC electricity – easier to step-up
Transformers	Primary and secondary coils with different number of turns Laminated iron core	Magnetic induction enables stepping-up or stepping-down of output current. Reduces energy losses due to eddy currents
Transmission lines	Aluminium alloy conductors Strands with relatively large diameter	Low resistivity reduces line losses Large cross-sectional area means reduced resistance
Supporting poles & pylons	Glass/ceramic insulators Lightning protecting upper wire & conducting path to ground.	Prevents current leaking to support structure Helps prevent disruption to power supply.

24. (a) $\frac{V_p}{V_s} = \frac{n_p}{n_s} \Rightarrow \frac{240}{V_s} = \frac{800}{200} \Rightarrow V_s = \frac{200}{800} \times 240 = 60$ V (b) alternating current source
25. a) 2 marks for correctly indicating that the threshold frequency refers to the minimum frequency of light which has energy equivalent to the work function of the substance. This is the energy needed to break the electrons away from the surface atoms of the substance.
    1 mark for indicating one or other of the above.
    b) 1 mark for selecting the blue beam and the second for indicating that because it has a shorter wavelength, it will have a higher frequency and therefore more energy than the orange beam.
    c) 3 marks for two correct calculations to show that the energy of the blue beam is greater than 2.2 eV and that the energy for the orange beam is less than 2.2 eV.
    2 marks for correctly calculating the energy of one of the beams and indicating that this beam either has more or less energy than the work function of the substance.
    1 mark for attempting to calculate the energy of one of the beams using the correct formula but perhaps using wavelength instead of frequency, or not converting nm to m, or not converting Joules to eV correctly.
26. (a) Hertz used interference between a split radio wave, part directly to receiver and part reflected by a metal plate and travelling a greater distance to the receiver. Interference determined the extra distance travelled by the reflected wave; consecutive fringes allowed calculation of the wavelength and since the frequency was that of the high voltage source, speed was calculated ($v = f\lambda$) and was that of light.
    OR His experiments related radio waves to light waves by showing they had the same properties of reflection, refraction, diffraction and polarisation.
    (b) Produce radio waves from an induction coil or creating any spark. Tuning a radio receiver between stations and observing extra static when a spark is generated.
27. Thermionic devices are evacuated tubes in which a heated cathode produces a flow of electrons. Current flow is unidirectional and so the tube acts like a valve. Solid state devices are made from doped semiconductors. Thermionic devices are large and require high voltages; fragile; consume excess power since the cathode has to be heated; unreliable as the cathode coating does not last; has separate component and so needs to be connected with insulated wires to other components; are expensive to produce. BUT may produce better tone in hifi equipment and must be used for high currents that solid state devices cannot sustain.
    Microchips (integrated circuits) are tiny electronic circuits etched on a single silicon chip and can have millions of transistors. They are used in arithmetic, logic and control circuits that make up a microprocessor. Society today relies on many appliances using integrated circuits for communication (radio, TV, phones, mobiles, faxes. Internet), for entertainment (videos, computer games, internet), for business (computers, internet, banking), travel (control systems in most modes of transport), and defence (smart bombs, satellite surveillance). Therefore the impact of microchips has changed society greatly in many aspects of daily life, improving the quality of our lives.

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agree with the prediction. (Students could make a case for yes or no.)

Q31 From Quanta to Quarks

(a) (i) Transmutation occurs when one element becomes another element by the emission of an alpha or beta particle from the nucleus.

(ii) An alpha source results in shooting "lines" radiating out from the source. The "lines" consist of whitish specks which form progressively and disappear slowly. The beta source results in fainter "lines" in various places and the "lines" disappear quickly.

(iii) The alpha particles ionises the molecules of air in their path. The felt ring is soaked in alcohol and the chamber contains supersaturated alcohol vapour because it is cooled by the dry ice below. The vapour molecules surround the ions and condense to form visible droplets,

(b) (i) $\lambda = h/mv = 6.626 \times 10^{-34} \div 9.109 \times 10^{-31} \times 1.5 \times 10^{8} = 4.9 \times 10^{-12}$ m

(ii) Diffraction is the spreading out or bending of waves as they passthrough slits or around barriers, The pattern of maxima and minima is produced when diffracted waves interfere, in some placesconstructively producing maxima and in other places destructively,producing minima.

(iii) Pauli applied the new quantum approach developed by Heisenberg to explaining the hydrogen atom. In doing so, he revised the work of Bohr that had been based on a mixture of classical and quantum physics. This meant that the theory explaining the electron energy levels of the hydrogen atom was consistent with the new quantum ideas and was therefore an important step forward, approved of by Bohr. Pauli went further than Bohr as he saw the need to add a fourth quantum number to the characteristics of electrons, associated with their spin. He stated that every electron in an atom must have 4different quantum numbers, referred to as the Pauli Exclusion Principle. This was a valuable contribution to atomic theory as the manner of filling electron subshells was now explained.

(c) (i) The hydrogen source emits a bright, deep pink glow. Through a spectroscope, several lines of different colour are observed against a black background. There is a very bright reddish line as well as a fainter green

line and 2 faint blue/mauve lines. The lines are not equally spaced, becoming progressively closer at the blue end.

(ii) The Rutherford model of the atom consisted of a very dense, positive nucleus with negative electrons moving around it. The dense positive nucleus explained the large angles at which some alpha particles were scattered when penetrating thin gold foil.

The problem with the model was that it did not explain the line spectra emitted by excited atoms. The electron moving around the nucleus under the attractive Coulomb force was moving in a circular path of some kind. that is, it was accelerated. Accelerated charges were known to emit electromagnetic radiation and therefore the electron should lose energy and spiral into the nucleus, producing radiation of gradually changing wavelength. Such continuous spectra were not observed and the electrons were able to remain in motion around the nucleus.

(d) Fission is the splitting of a uranium nucleus or other large nucleus when penetrated by a neutron, releasing large amounts of energy. The first large-scale use of nuclear energy occurred in the United States during World War II when the government there in 1940, assembled a group of physicists, including some from Europe, to produce an atomic bomb. This was called the Manhattan project. Fermi was responsible for the development of the first nuclear reactor in which controlled fission reactions produced the raw materials needed for the bombs. The dropping of two atomic bombs in Japan killed a great number of people and caused much suffering for others. It has been argued that the ending of the War as a result of the bombs saved many lives which would have been lost if the fighting had continued. One consequence of this event and of the bomb tests which followed, was the radioactive fallout, carried by winds to many parts of the globe. Many radioactive substances have long half-lives and enter the food chain, resulting in both genetic and somatic effects. A further consequence of the development of this weapon has been the many bombs accumulated world wide and the dangerous tensions between nations causing much stress for people everywhere.

The other major use of fission has been in electrical energy production. The increasing need for electrical energy is an important aspect of modern life and although there are still large supplies of fossil fuel in some countries, the need for alternative energy sources is clear. Fission reactors supply large amounts of energy, are cheaper to run after an initial installation cost and do not discharge gases that damage the environment. Society does have to cope with the dangers of nuclear accidents and the problem of storing wastes that

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