SCOTTISH SCHOOLS SCIENCE

EQUIPMENT RESEARCH

CENTRE

Bulletin No. 82. August, 1975.

Contents

Introduction

In Bulletin 78 we announced that in response to several requests from teachers we were to establish a cost index for consumable items of equipment which appear in every requisition, and which would be revalued regularly. In this way, the principal teacher or other individual in charge of requisitions would have some idea of how much more he would require to allow for consumables since the previous requisition.

The groundwork has now been done; we have a weighted list of 41 items, prepared from information sent us by members of our Development Committee, and by Griffin and George and Philip Harris. What was done was to select every item whose cost formed more than 1% of the total cost of consumables, and to weight its proportion in our index list in accordance with that percentage. The index gives equal weighting to the needs of biology, chemistry and physics, but excludes workshop materials like timber, metal sheet, etc.

In May, 1974 which we are to take as our base line, the total cost of our items was around £193 and this will be given the reference figure of 100. In January, 1975 the index had risen to 117.5. Hereafter we shall revalue the index in May and November, and publish the results in the Bulletin. Any reader wishing the information will be sent the list of items on which the index is based.

Opinion

The Health and Safety at Work etc. Act, 1974 has now been in force for some months, and is causing no small concern and confusion in scientific and scholastic circles. How far this has percolated down to the school lab. bench is hard to judge, but there would seem to be little reason for complacency. Articles on the Act abound in the journals, each preceded by a personal disclaimer that anyone foolish enough to act on the author's interpretation does so on his own responsibility. This article needs none such; the opinion section of the bulletin should by now have established itself as the very personal viewpoint of the writer.

What seems to have happened as a result of the Act is that where previously the buck on safety could conveniently be passed around ad infinitum, now there is a definite chain of responsibility to ensure that the buck stops somewhere. Hence the hedging mentioned in the preceding paragraph; no one wants the buck stopped at his desk. It could be the individual teacher's desk, although it would require a rather unusual set of circumstances to make it so. Pupils are not directly covered by the Act, not being employees, although it does establish that an employer has a duty to all who use or occupy

his premises or who use plant or substances provided by him, to ensure that such premises, plant and substances shall be safe and without risks to health. Towards his employees, the employer has a further duty: to prepare and make known to all his employees a written statement of his general policy with respect to health and safety at work, and the organisation and arrangements for carrying out that policy.

Thus the principal teacher who receives a written directive from his Science Adviser on the storage of chemicals say, and ignores it or fails to make it known to his technician, would be liable should anything happen to the technician. Or an assistant teacher who had seen the general policy statement and who uses unsafe techniques in the laboratory could be liable in the event of injury to a pupil. For it is here that the Act will bite; not through the official channel of the Factory Inspector, who will be used by the Health and Safety Executive to apply the Act, and who will use every power of persuasion and warning before bringing in an Improvement or Prohibition Notice, but through the possibility of a civil action for damages brought by an injured party.

However, the Act does not confine itself to those actually at work, in one capacity or other, in the school. In section 6 it is specified that it is the duty of any person who designs, manufactures, imports or supplies any article to ensure that it is so designed and constructed as to be safe. He has a further duty to carry out or arrange for the carrying out of any testing or examination as may be necessary to ensure safety in use, and to supply adequate information about the article to ensure its safe use. The implications of this could be frightening. Is the supplier of hazardous chemicals required to provide on each bottle sufficient information to ensure its safe use? SSSERC has been one of the prime movers in causing to be prepared a safety manual which would supplement what we felt were the inadequate warnings which of necessity were all that could be printed on bottle labels.

Does the design of articles or the supply of substances, both of which come under the Act, apply also as a description to the writer of text-books or the developer of curricula? Is the writer who describes an unsafe experiment - and we have unravelled a few of these here - to be held liable? Will the editors of all the practical journals which depend largely on free lance authors be allowed to get away with a published disclaimer of responsibility, will they accept responsibility and test every design, or will they risk that their sources of material might dry up if they leave the responsibility with the writer? Will the publisher of a school text-book assume responsibility for the author's experimental descriptions? If the Act stops or reduces the plagiarism that is rife in school science literature by making the author do the experiments himself, it would be no bad thing; if it dries up the supply of text-books altogether, that might be no bad thing either.

Chemistry Abstracts

General.

List of reports produced by SSSERC and CLEAPSE up to May, 1968. (22).

List of SSSERC and CLEAPSE reports to September, 1969. (33).

Addendum to SSSERC list of reports given above. (34).

List of SSSERC physics reports to January, 1971. (44).

List of SSSERC biology and chemistry reports to January, 1971. (45).

List of CLEAPSE reports to July, 1973. (64).

Additions to CLEAPSE reports, May, 1974 (71).

Additions to CLEAPSE reports, August, 1974. (73).

Equipment list for '0' Grade Physics, Part I. (6).

Equipment list for '0' Grade Physics, Part II. (7).

Equipment list for Sixth Year Studies Physics. (19).

Corrections to Circular 490, '0' Grade Physics list. (36).

Equipment list for '0' and 'H' Grade Biology syllabus. (23).

Additions to Circular 512 Chemicals list. (43).

Equipment list of tools for the technician's workshop. (9).

Discussion on some items of apparatus and experiments used in the Integrated Science course. (40).

Assessment of costs and comment on the Integrated Science equipment list. (74).

Discussion on the training of technicians. (1).

CLEAPSE recommendations for standardising laboratory glassware. (37).

Discussion on the uses of chart recorders in schools. (57).

Constructional details of a programmable self-testing machine with a capacity of 10 true/false questions. (27).

Thermo-chemistry and thermodynamics.

Example of an exothermic and partially reversible reaction by stretching rings cut from plastic detergent bottles. (17).

Example of an exothermic reaction - adding Tide detergent to water. (15).

Discussion on heat of neutralisation of acids with sodium hydroxide. (71).

A thermo-chromic liquid recipe. (70).

Chemical Dynamics.

Constructional details of a model illustrating chemical dynamics; exo- and endothermic reactions and the effect of the activation energy barrier can be illustrated. (68).

Details of model for demonstrating modes of vibration of molecules. (57).

Correction to article on molecular vibration above. (59).

Constructional details of a powder and air apparatus to model expansion, evaporation and boiling. (35).

How to use plastic detergent bottles as troughs for showing diffusion. (18).

Electro-chemistry.

Constructional details of tubular glass electrode in which the gas from the electrolysis collects. Can also be used as redox cells. (43).

Constructional details of an electrolysis cell, using 10 mm length of platinium wire for each electrode. (28).

Details of an electrical circuit for a constant current power supply for coulometric titrations. (31).

Constant current power supply for electrolysis and coulometry; current (100 mA) is greater than in the design above. (68).

How to copper plate a carbon electrode to obtain a soldered connection. (12).

Details and recipe for anodising aluminium. (16).

Techniques and solutions for electroplating. (59).

Account of procedure for evaluating pH meters. (36).

Summary of tests on 3 pH meters. (36).

Summary of tests on 3 pH meters. (49).

Summary of tests on 3 pH meters. (51).

A method for storage of pH electrodes is described. (51).

Constructional details of an instrument for checking the functioning of a pH meter. (78).

Modification of a pH meter to allow it to be used with a demonstration size milliammeter or chart recorder. (75).

Discussion on techniques, power supplies and meters required for conductimetric titrations and electrolysis of melts. A list of 15 experiments successfully carried out is given. (10).

Summary of tests on conductivity apparatus. (9).

Suggestions for using nife cells for conductimetric titrations, and for the electrolysis of melts. (4).

Details for using moving coil milliammeter with alternating current in conductimetric titrations. (15).

Warning against impure sodium chloride used in corrosion tests. (13).

Discussion on methods of measuring electrode potentials. (17).

Correction to article on electrode potentials above. (18).

Constructional details of an individual pupil apparatus for measuring electrode potentials. (17).

Colloid Chemistry.

Smoke cell. Constructional details of a glass smoke cell, using a festoon light source and glass rod as a condenser lens. (2).

Smoke cell. Constructional details for a smoke cell from a rubber stopper, using a glass bead as a condenser lens, and a lens-ended light bulb as source. (4).

Modification to smoke cell above, using cork bung in place of rubber stopper. (65).

Account of attempts to show dependence of Brownian motion and temperature. (16).

Constructional details of a two-dimensional model of Brownian motion. (33).

Molecular Weight.

Method for measuring the molecular weight of volatile liquids, using a specific gravity bottle. (20).

Details of measurement of gram molecular weight of gases by syringe injection and direct weighting. (21).

Molecular weight of gas by using a syringe and a gas lighter fuel container. (46).

Modification of the above method for determining molecular weight using Ronson multi-fill lighter fuel container. (79).

Chemical Compounds.

Request for information on frequency of use and necessary purity of chemicals. (12).

Bottle labels from plastic detergent bottles. (17).

Comparison of the costs of producing distilled and de-ionised water. (14).

Availability of suitable minimum quantities of chemicals from suppliers. (40).

Details of water purifier made using a disposable can containing de-ionising chemicals. (55).

Offer of samples of vanadium pentoxide to schools. (59).

Recipe for the preparation of bicarbonate indicator. (61).

A method for recovery of silver from silver halide solutions. (73).

Purity of lead sulphate required for investigating the equilibrium constant of lead sulphate and sodium iodide solution. (78).

Chemical Structure in relation to Properties.

Constructional details for a jig to mark tetrahedral holes in any size of polystyrene sphere. (26).

Account of techniques used to prepare polystyrene spheres for cutting to form orbital models of molecules. (36).

Constructional details of a jig for cutting spheres to form orbital models of molecules. (36).

Making polystyrene cement for joining polystyrene spheres. (41).

Experimental and Preparative Chemistry.

Constructional details of an individual pupil gas generator. (16).

Constructional details of an individual pupil gas generator. (20).

Technique for preparing plastic sulphur from sodium thiosulphate and nitric acid. (8).

How to use a plastic syringe for forced filtration. (20).

Method of sampling gas jar contents to determine when full, using a plastic syringe. (37).

Inverting a test-tube of water in a narrow vessel for collection of a gas sample. (41).

Constructional details of a gas collector which can be connected to gas generator or cylinder. (47).

A controlled supply of dried gas by using polythene bag within an aspirator. (46).

A small scale apparatus for the preparation of producer gas. (63).

A small scale apparatus for the catalytic oxidation of ammonia. (67).

A method of demonstrating the composition of ammonia by electric spark. (70).

Combustion of ammonia by using a suitable ammonia/air proportion. (72).

Reduction of metallic oxide with hydrogen from a heated mixture of zinc powder and calcium hydroxide. (49).

Preparation of sulphur trioxide using vanadium pentoxide as catalyst. (59).

Hazards associated with sulphur trioxide; addendum to article above. (60).

A small scale technique for analysis of exhaled air. (60).

How to use a piezo-electric generator to spark eudiometers. (12).

Constructional details of a spark generator based on a car ingition coil. It is substitute for an induction coil. (49).

Comparison of costs of obtaining a sample of the commoner gases by preparation and from cylinders. (46).

Measurement and Instrumentation.

Constructional details of a pipette filler, using a plastic syringe. (32).

Modification of the pipette filler above. (64).

Constructional details of a constant volume liquid dispenser. (73).

Modification of the liquid dispenser above. (74).

Constructional details of a liquid dispenser which obviates the need to pour from reagent bottles. (29).

Details of a titration apparatus based on two syringes. (78).

Constructional details of an automatic burette filler. (13).

Physical Methods of Analysis.

Detection of halogens in organic and inorganic compounds by flame test. (46).

Account of the action of a mass spectrometer. (19).

Constructional details for a mass spectrometer analogue. (21).

A test procedure for assessment of colorimeters is described. (52).

Summary of tests on 4 colorimeters. (62).

Constructional details for a colorimeter. (25).

Details of a booklet of infra-red spectrographs for Sixth Year Studies. (34).

Account of technique for fitting a mechanical drive to the MLI Vuespec infra-red spectrometer and for recording spectrograms on chart paper. (24).

Account of experiments with results to measure the dielectric constant for organic liquids, to demonstrate polarised molecules. (27).

Construction of a simple polarimeter. (47).

Details of adaptation of a single-pan balance to a Gouy balance for measuring the paramagnetic effect. (37).

Chromatography.

Constructional details for pupil apparatus for ascending paper chromatography. (26).

Paper chromatography using a filter paper spill pushed down through the centre of a filter paper into the eluent to act as a wick. (76).

Constructional details of a gas chromatograph which is designed particularly for identification of component gases of liquified petroleum gas. (69).

Constructional details of a gas chromatography apparatus using as detector low voltage lamp filaments in a katharometer circuit. The apparatus can be heated, but not thermostatically controlled. (39).

A method is described for pressurising town or natural gas to give increased flow rate in a gas chromatography column. (52).

A means of heating the column in a Gallenkamp (now Griffin) junior gas chromatograph is described. (54).

Testing of the natural gas conversion kit to be used on the student gas chromatograph supplied by Griffin and George. (54).

Organic Chemistry.

A semi-quantitative method of testing the ignition temperatures of fractions collected from crude oil distillation. (35).

Summary of techniques used in organic preparations for Higher grade, with specification of the necessary apparatus. (21).

Constructional details of a melting apparatus based on a metal block such as a brass weight. (76).

Correction to description of melting point apparatus above. (77).

Homolytic reaction of methane and chlorine by using photographic flash bulb. (41).

The "oxygen-flask method" for analysis of organic compounds which can replace the sodium fusion and soda ash/zinc powder fusion methods. (71).

Gaseous Fuels.

Percentage composition of natural (North Sea) gas. (37).

Information is given on the types of burners and lighters supplied by Gas Board for use on natural gas. (51).

Testing of bunsen burners designed for use with Liquified Petroleum Gas. (53).

Investigation of the efficiency of natural gas burners. (42).

Assessment of gas lighters of various types. (74).

Testing of blowpipes using natural gas and the need for non-return valves in gas line. (71).

Constructional details of an apparatus for demonstrating the explosion of mixtures of air and petrol, town gas, natural gas, petrol and combustible powder. (65).

Constructional details of an apparatus for exploding a mixture of petrol vapour and oxygen. (22).

Workshop Practice.

Account of the test procedure for evaluating centrifuges. (25).

Summary of tests on 2 centrifuges. (25).

Summary of tests on 5 centrifuges. (33).

Correction to test report summary on centrifuges above. (34).

Summary of tests on 3 centrifuges. (59).

How to identify stainless from other steels. (59).

How to distinguish borosilicate (Pyrex) and soda glass. (59).

How to abrade glass tubing, using wire gquze. (77).

Warning against using silicone grease for lubricating stopcocks on glassware. (13).

Note on burette control using a glass bead in rubber tubing, in place of the normal stopcock. (8).

Two hints for removing glassware stuck in rubber stoppers. (30).

A method of automatic washing of a solid in a filter funnel or Buchner funnel. (76).

Note on the water consumption of filter pumps. (64).

A means of diluting waste liquids for disposal down the drain is described. (73).

Details of an air pump constructed from a plastic detergent bottle and home-made 1-way valve. (62).

Constructional details of a small individual desiccator using a plastic lunch box. (34).

Constructional details of apparatus for polythene dip coating. (48).

Constructional details of test-tube stands from wire mesh. (48).

Modification to test-tube stands above, using different wire mesh. (52).

Safety.

Regulations for registration of teachers using radioactive sources. (14).

Warning against the use of an induction coil with apparatus capable of generating X-rays. (13).

Report on a code of practice on the use of lasers in schools. (37).

Note on disposal arrangements for hazardous chemicals. (40).

List of hazards associated with chemicals used in Sixth Year Studies. (38).

List of hazardous chemicals to be supplied in smaller minimum quantities. (43).

Explosion hazard associated with ethers. (40).

Hazards in burning mixtures of copper powder and sulphur powder. (65).

Hazards associated with heating a mixture of zinc and sulphur. (46).

The danger in demonstrating explosion of mixtures of combustible gases and air. (64).

Failure of wire type test-tube holders if jaws are heated strongly in a flame. (41).

Corrosion of aluminium canisters containing liquid sulphur dioxide. (64).

A technique for oxidation of ethanol in which the air/ethanol mixture is obtained by blowing the air through rocksil soaked with ethanol. Heating is in combustion tube open at one end. (45).

Constructional details of a mobile fume cupboard. (43, 44).

Flame proof cabinets for chemical storage; discussion on relative merits of wood and metal cabinets, and account of fire test on a wood cabinet. (75).

Flame proof cabinets; account of fire test on a metal cabinet, and comparison with wooden cabinet test above. (78).

Description of a technique to demonstrate the presence of mercury vapour at room temperatures. (4).

How to reduce vapour hazard from spilt mercury in floorboards, using zinc dust. (43).

Testing for the presence of mercury vapour, and an assessment of hazards arising from spilt mercury in laboratories. (48).

Accident account involving isopropyl ether. (40).

Details of several accidents which have occurred in schools. (40).

Details of several laboratory accidents. (43).

Details of several laboratory accidents. (62).

Details of accident due to explosion when making a solid rocket propellant with potassium chlorate and sulphur. (70).

Details of several laboratory accidents. (79).

Electrical hazards in the use of aquarium heaters and thermostats. (57).

Discussion on hazards in microbiology. (76).

Discussion on the degree of risk associated with the use of Clinistix test strips. (71).

Discussion on the safe disposal of plastic petri dishes. (74).

Hazards associated with the tasting of phenylthiocarbamide. (54).

Hazards associated with the use of Millon's reagent, and a discussion on possible alternatives. (79).

Bulletin Supplement

Below is a summary of tests carried out on low voltage power supplies. Individual reports on these may be borrowed by writing to the Director. The classifications used are; A - most suitable for school use; B - satisfactory for school use; C - unsatisfactory.

Model No.		P7997/01	P7997/03	EJ176	SPS4
Supplier		Harris	Harris	Irwin-Desman	Adlab
Price		£25.00	£45.50	£45.80	£41.00
Voltage Control		wander plug	switched 2 V step**	variable transformer	variable transformer
Maximum output at zero current	ac dc	12.9 V 16.9 V	26.0 V 23.2 V	27.0 V* 36.0 V	36.0 V* 32.3 V
Maximum current	ac dc	4 A 4 A	6 A 6 A	8 A 8 A	8 A 8 A
Outputs at max. current	ac dc	12.2 V 12.8 V	23.8 V 20.0 V	22.5 V 21.3 V	31.7 V 27.2 V
Overload protection		primary fuse 0.5 A	thermo-magnetic cut-out	two thermal cut-outs	primary fuse, 1 A; two 10 A sec. fuses
Behaviour on continuous load		satisfactory	satisfactory	satisfactory	satisfactory
Smoothing		4.7 mF	none	1 mF	none
R.M.S. ripple at max. load		1.4 V	-	7.8 V	-
Stacking ability		good	good	adequate	good
Assessment		B	B	B	B

Notes: * These models are fitted with output voltmeter and ac/dc switch (EJ176), and with separate a.c. and d.c. output voltmeters (SPS4).

** Also carries a '+1 V' switch, adding 1 V to the output.

S.S.S.E.R.C., 103 Broughton Street, Edinburgh, EH1 3RZ.
Tel. 031 556 2184.

Adlab Ltd., P.O. Box 1, Farnworth, Bolton, Lancs., BL4 7SN.

Griffin and George Ltd., Braeview Place, Nerston, East Kilbride,
Glasgow G74 3XJ.

Philip Harris Ltd., 30 Carron Place, Kelvin Industrial Estate,
East Kilbride, Glasgow G75 0TL.

Irwin-Desman Ltd., 294 Purley Way, Croydon, CR9 4QL.