ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Home Economics 5561/6561

HEC7 – Textiles Science and Technology

Mark Scheme

2006 examination – June series

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Textiles Science and Technology HEC7

Question 1

(a) **why is indigo blue**?

The visible spectrum is composed of a mixture of light of different wavelengths. This is often remembered by the term ROYGBIV. Colour results from a change in the light which is absorbed and reflected from the surface of a coloured fabric. *(2 marks)*

The dyes present absorb some of the colours (wavelengths) present in visible light and reflect those remaining. Blue indigo is coloured blue because all the other wavelengths apart from blue are absorbed by the dye and only the blue light is reflected. *(2 marks)*

(b) **colourfastness**
Colourfastness is the ability of a dyed fabric to maintain its original colour when it is exposed to those environments which may adversely affect the colour of the dye present.
(2 marks)
Usually no dye/fabric combination is perfectly colourfast to all environments. During wear and washing coloured fabrics are exposed to rubbing, washing, UV light chlorine water etc. and these conditions may adversely affect the colour of the dyed fabric.
(3 marks)

(c) **twill weave fabric**
Twill weave fabrics have a series of diagonal lines on one side of the fabric due to the interlacing of the yarns. *(2 marks)*
If the diagonal lines run from lower left to upper right the fabric is a right-hand twill and from lower right to upper left it is a left-hand twill. Traditional cotton twills are LH and twill wools are RH.
(2 marks)

(c) **colour of indigo-dyed denim fabric**
Denim is a twill weave fabric with blue (indigo-dyed) yarns on the face and white yarns on the back.
(2 marks)
The blue yarns are dyed so that only the cotton fibres near the surface of the yarns are dyed blue; fibres towards the centre are white. As the denim is worn and washed the blue dye on the surface fibres is gradually lost and more of the white fibres appear. The fading of the indigo in the denim fabric during wear and washing produces a bright blue effect which is highly prized by the fashion conscious.
(2 marks)

(d) **use of indigo to dye cotton**
Indigo dye is insoluble in water so to dye cotton the indigo has to be made into a water-soluble form. The blue indigo is treated with a reducing agent which makes the dye colourless and water-soluble.
(2 marks)
The yarns are now immersed in the soluble indigo (leuco-form) and the dye penetrates into the cotton fibres especially in the surface of the yarns. *(2 marks)*
The yarns are now treated with an oxidising agent which restores the blue colour and makes the dye insoluble. *(2 marks)*
The insoluble dye is now trapped inside the cotton fibres and it is reasonably colourfast. The white fibres and yarns present in the fabric are not affected by the indigo and remain white in the denim contributing significantly to the attractive colour of the fabric. *(2 marks)*

Question 2

(a) **standard moisture regain value for 80%cotton and 20% polyester fabric**

The Standard Moisture Regain of a fibre or fabric is the percentage of moisture present when the bone-dry material is allowed to come into contact with air at 21°C and 65% relative humidity. *(2 marks)*
Calculation: (80 x 8.5/100) + (20 x 0.5/100) = 7% *(3 marks)*

(b) **heat setting**

Fabric (held at its full width) is briefly exposed to a temperature of about 30° – 40°C higher than any temperature that the fabric will be exposed to during its useful life. For most fabrics which require ironing a temperature of 220° – 230°C is the usual setting temperature. (*3 marks)*

Heat setting removes all the stresses and strains introduced into the fabric during production and finishing. It produces very stable fabrics which do not shrink by more than 5% during washing. If 100% polyester was not heat-set the fabric would crease and wrinkle during washing and drying.
(2 marks)

(c) use of **DMDHEU**

Garments made from 100% cotton are very prone to shrinkage. Shirts and blouses may shrink by up to 10% after a few washings and this could result in collars going down by 2 sizes.
(2 marks)
DMDHEU is the finishing agent which is used to reduce these shrinkage problems. It is a colourless, water-soluble compound which, when added to 100% cotton in appropriate amounts and the fabric is subsequently heated, forms cross-links between the cellulose polymer chains in the cotton fibres. These chemical cross-links prevent the cellulose molecules moving within the fibres and shrinkage does not occur. *(2 marks)*
(better candidates may draw a representation of the **DMDHEU** molecule) *(1 mark)*

(d) **Zerostat** in 100% polyester fabric

Because of the low moisture regain value (0.5%) of polyester, static electrical charges are easily generated when dry textiles containing polyester fibres are rubbed together with other dry textiles. These static electrical charges can cause skirts to ride up, sparks may be produced and cause discomfort.
(2 marks)

If a thin film of water can be generated on the surfaces of the fibres, static electrical charges do not accumulate because the water conducts away the charge. *(1 mark)*

Zerostat is a typical anti-static finishing agent which has detergent-like characteristics. It accumulates on the surfaces of fibres with the ionic (positively charged) 'heads' of the molecules being held close to negatively charged groups on the polyester. *(1 mark)*

Between the charged groups water accumulates and it acts as an electrical conductor so that static does not build up. *(1 mark)*

(e) Most garments can be dry-cleaned without any problems arising. If there is any chance of shrinkage occurring during normal laundering, dry-cleaning is strongly recommended. *(2 marks)*

However fine acetate fabrics can be damaged if powerful chlorinated solvents are used in the dry-cleaning process. *(1 mark)*

Acetate groups tend to be soluble in organic solvents so fine fabrics containing these groups may slightly dissolve in powerful dry-cleaning solvents. *(1 mark)*

The acetate fabrics do not totally dissolve in the solvent but fabric damage may occur because of the weakening effects caused by the surface of the fibres being affected by the solvent. *(1 mark)*

Question 3

(a) use of **hollow polyester filaments** in duvets.

There are two important features of hollow polyester filaments which enable them to be successfully used in the filling of duvets and pillows. Because of the low SMR value of polyester (0.5%) the filaments tend not to become damp and uncomfortable during sleeping.

(2 marks)

Hollow filaments have a very large surface area and consequently they are excellent insulators. Large volumes of still air are present in the hollow filaments and because air is an excellent insulator these filaments retain heat. *(2 marks)*

The combination of low moisture absorbency and highly insulating fibres ensures that when in bed consumers are comfortable and warm. *(1 mark)*

(b) heat transfer printing/ best results with **thermoplastic fibres**

This is the most recently developed form of printing when the design on paper is transferred on to cloth by the application of heat. *(1 mark)*

The best results with transfer printing are obtained by using disperse dyes on polyester or blends of polyester containing a substantial proportion of this fibre. *(1 mark)*

Light pressure is required for between 15 – 30 seconds and a temperature of about 200^{o}C is used. Under these conditions disperse dyes on the paper sublime on to the fabric when the colours are readily absorbed by synthetic fibres. *(2 marks)*

Heat transfer printing on 100% cotton is now very widely used when special dyes and chemical carriers ensure that the print (in fine detail) is transferred on to cotton and that the image is reasonably fast to washing. *(1 mark)*

(c) **fatty stains** are difficult to remove from **polyester** fabrics

Because fatty substances and polyester fibres have some similar characteristics, when one comes into contact with the other they can be difficult to separate *(2 marks)*

Hydrophobic polyester fibres and water-hating fatty stains readily combine and the fatty stain will be held deep within the polyester fibres. Because both fibre and stain are very water-repellent, removing stains of this type from polyester garments is a problem. *(1 mark)*

Generally detergent powders or liquids are very effective in cleaning hydrophilic fibres such as cotton, viscose and wool because the warm detergent solution easily penetrates the fibre surfaces and consequently removes the stains. *(1 mark)*

Modern polyester garments may have a chemical finish applied, Permalose is typical, when the surface of the fibres is modified so that the fibre repels stains during wear and enhances cleaning when the garment is being washed. *(1 mark)*

(d) **wool fibres** are never used in towels

Even though wool has a very high moisture regain (16%) and is able to hold significant amounts of water, wool is never used as a fibre in towels. *(2 marks)*

Wool is very elastic and consequently tends to stretch when pulling forces are applied to it. A consequence of this is that when a wet body is rubbed with a towel made from wool, the fibres simply stretch and do not really make good contact with the skin or remove the water present. The situation with cotton is very much the opposite and, being inelastic, the cotton remains in close contact with the skin and

the water is removed. *(2 marks)*

Wool also is much more expensive than cotton and will shrink terribly as a result of frequent washing. *(1 mark)*

(e) blends of **silk and microfibre polyester** are ideal for underwear

Although silk is not really classified as a microfibre, its fineness is quite compatible with microfibres and blending it with microfibre can be used to produce good quality fabric. *(2 marks)*

Both silk and polyester have similar physical properties; silk, a filament natural fibre, has properties rather similar to those of polyester. Before the advent of microfibres, it was not possible to successfully blend silk with conventional polyester. Fibre dimensions, especially very different fibre fineness, made it virtually impossible to produce quality fabric. *(2 marks)*

Underwear fabrics need to be fine but firm and these blends have the properties which make them particularly suitable for underwear. *(1 mark)*

Question 4

(a) Polyamides have (i) high strength and durability (toughness) and (ii) excellent elastic properties including a very good elastic recovery. *(4 marks)*

(b) (i) chemical formulae nylon 6 $-NH(CH_2)_5CO-$

nylon 6.6 $-NH(CH_2)_6NHCO(CH_2)_5CO-$ *(2 marks)*

(ii) being synthetic fibres, polyamides have quite low moisture regain values (~4.5%) because there are very few sites on the polyamide polymer molecules for water molecules to bond to. A consequence of this is that textiles and clothing containing these fibres dry very quickly after washing. *(3 marks)*

(c) **multifilament yarns** are produced by twisting together many fine continuous filaments. The twist increases the friction between the filaments so that the yarns have strength and elasticity. *(2 marks)*

(d) (i) **linear density** is the mass in grammes of a unit length of fibre or filament. Units used include tex (mass in g of 1000 m), decitex (mass in g of 10000m) and denier (mass in g of 9000m). *(2 marks)*

(ii) **Yarn A** has 46 filaments, each filament having a linear density of 0.9 decitex. Each filament is classified as a microfilament because each filament has a linear density of less than 1 decitex (dpf). *(4 marks)*

(iii) **Yarn B** contains much thicker filaments. Only 13 are required to make an overall yarn linear density of 44 decitex. *(2 marks)*

(e) **polyester filaments** are rarely used in tights because the elastic recovery of nylon is very much better than that of polyester. If nylon is given an 8% stretch it recovers by 100% once the load is removed; polyester, however, if given the same stretch only recovers by 80%. If tights were made of polyester they would remain 'baggy' at the knees and bottom, a situation which does not occur with nylon. *(4 marks)*