S6 Technology and Living Practice Paper (Set 2): Nutrition Labels, Protein Requirement and Amino Acid Score, Glycaemic Load, Food Additives and Bacterial Growth, Functional Foods, Fabric Shrinkage and Regain, Pattern Grading and Costing, Food Safety and HACCP (100 marks)

Level: S6 | Subject: Technology and Living | 75 minutes | 100 marks | 24 questions | answer key

Part 1 Food Science and Nutrients (16 marks)

Show all formulae, substitutions and calculation steps; express energy in kcal.

#	Question	Answer	Marks
1	A breakfast cereal contains, per 100 g, 62 g carbohydrate, 9 g protein, 8 g fat, 6 g dietary fibre and 420 mg sodium. (a) Using the Atwater factors (4 kcal/g for carbohydrate and protein, 9 kcal/g for fat), calculate the energy per 100 g; (b) the energy in a 40 g serving; (c) the percentage of total energy supplied by fat (1 d.p.).	(a) Energy = 62x4 + 9x4 + 8x9 = 356 kcal per 100 g. (b) A 40 g serving gives 356 x 40 / 100 = 142.4 kcal. (c) Fat supplies 72 kcal, i.e. 72 / 356 x 100 = 20.2% of the total, which is below 30% and therefore acceptable. Fibre and sodium contribute no energy.	4
2	A 15-year-old boy weighs 60 kg and the protein recommendation is 0.9 g per kg body weight per day. (a) Calculate his daily protein requirement; (b) his lunch provides 22 g of protein, so calculate the percentage of the daily requirement (1 d.p.); (c) name two foods that supply complete protein.	(a) Requirement = 60 x 0.9 = 54.0 g per day. (b) Percentage = 22 / 54.0 x 100 = 40.7%. (c) Eggs, milk, fish or soya bean (any two); they supply all the essential amino acids in proportions close to human needs.	4
3	Cooked white rice has a glycaemic index of 83 and a bowl contains 52 g of available carbohydrate; wholemeal pasta has a GI of 45 and a portion contains 40 g of available carbohydrate. (a) Calculate the glycaemic load of each (GL = GI x available carbohydrate / 100); (b) classify them (10 or less low, 11-19 medium, 20 or more high); (c) explain why GL assesses the real glycaemic effect better than GI alone.	(a) Rice GL = 83 x 52 / 100 = 43.2; pasta GL = 45 x 40 / 100 = 18.0. (b) Rice is high GL (20 or more) while wholemeal pasta is medium GL (11-19). (c) GI only describes the speed per unit of carbohydrate, whereas GL also includes the amount actually eaten, so it reflects the true glycaemic burden of a meal.	4
4	Millet protein contains 2.4 g of lysine per 100 g of protein while the reference pattern is 5.8 g per 100 g of protein. (a) Calculate the amino acid score; (b) identify the limiting amino acid of millet; (c) suggest one food to eat in the same meal to improve protein quality and explain why.	(a) AAS = 2.4 / 5.8 x 100 = 41.4 (about 0.41). (b) Lysine is the limiting amino acid, present at only 41.4% of the reference pattern. (c) Serve it with soya bean, tofu or milk, which are rich in lysine; the two complement each other so the overall essential amino acid pattern comes closer to requirements and protein utilisation improves.	4

Part 2 Food Additives, Preservation and Food Microbiology (16 marks)

Show all formulae, substitutions and calculation steps, with units clearly stated.

#	Question	Answer	Marks

5	A preserved fruit sample of mass 250 g contains 0.36 g of benzoic acid; the legal limit is 2000 mg/kg. (a) Calculate the concentration in the sample (mg/kg); (b) the percentage of the legal limit; (c) decide whether the sample complies.	(a) Concentration = 0.36 g x 1000 / 0.25 kg = 1440 mg/kg. (b) Percentage of the limit = 1440 / 2000 x 100 = 72.0%. (c) Since 1440 mg/kg is below 2000 mg/kg the sample complies, but it already reaches 72.0% of the limit, so the amount added should be controlled.	4
6	Fresh chicken initially carries 10^3 cfu/g and the bacteria double every 20 minutes at 25 C. (a) Calculate the number of generations in 2 hours; (b) express the bacterial count after 2 hours in scientific notation; (c) state what should be done to keep the count at or below 10^4 cfu/g within those 2 hours, and why.	(a) Generations = 120 / 20 = 6. (b) Count = 10^3 x 2^6 = 6.4e+04 cfu/g, i.e. 6.4 x 10^4. (c) Chill at once to 4 C or below: the low temperature greatly lengthens the doubling time, so the bacteria stay behind the logarithmic phase and the count does not exceed 10^4 cfu/g within 2 hours.	4
7	A spoilage bacterium has a Q10 of 2. (a) Calculate the factor by which its growth rate rises when the temperature goes from 4 C to 25 C, using 2^(dT/10), to 2 d.p.; (b) hence explain the effect of refrigeration on shelf life; (c) explain why food left at room temperature is clearly more risky.	(a) dT = 25 - 4 = 21 C, so the factor = 2^(21/10) = 2^2.1 = 4.29. (b) Under refrigeration the growth rate is only 1/4.29 (about 23%) of that at 25 C, so spoilage is much slower and shelf life can be several times longer. (c) 25 C lies in the middle of the danger zone (4-60 C) where bacteria multiply fast and may form heat-stable toxins that reheating cannot destroy.	4
8	A bacterium has a D value of 2.5 minutes at 121 C. (a) Explain what the D value means; (b) calculate the time needed to achieve a 12 D reduction; (c) explain why the canning industry uses the 12 D standard.	(a) The D value is the time at a stated temperature needed to reduce the number of viable cells (or spores) by 90%, i.e. to one tenth. (b) 12 D time = 12 x 2.5 = 30.0 minutes. (c) A 12 D process lowers the spore count by a factor of 10^12, so the chance of a surviving spore in a can is extremely small; this gives commercial sterility and makes ambient storage safe.	4

Part 3 Functional Foods and Dietary Fibre (17 marks)

Show all formulae, substitutions and calculation steps, stating any reference values used.

#	Question	Answer	Marks
9	The daily fibre recommendation for adults is 25 g. A person takes 6.5 g at breakfast, 8.2 g at lunch and 7.4 g at dinner. (a) Calculate the daily total; (b) the shortfall from the recommendation; (c) the percentage of the recommendation met (1 d.p.).	(a) Total = 6.5 + 8.2 + 7.4 = 22.1 g. (b) Shortfall = 25 - 22.1 = 2.9 g. (c) Percentage met = 22.1 / 25 x 100 = 88.4%; a portion of fruit or a wholegrain breakfast would close the 2.9 g gap.	4
10	Research shows that 3 g of beta-glucan a day helps lower LDL cholesterol. A cereal provides 0.8 g of beta-glucan per serving. (a) Calculate the minimum number of servings per day (whole number); (b) the amount actually supplied by that number of servings; (c) state which class of dietary fibre beta-glucan belongs to and its common food sources.	(a) 3 / 0.8 = 3.75, so at least 4 servings are needed. (b) They supply 4 x 0.8 = 3.2 g, slightly above the 3 g target. (c) Beta-glucan is a soluble fibre found in oats, barley and mushrooms; it forms a gel in the gut that reduces cholesterol absorption.	4
11	A prebiotic product contains 12 g of fructo-oligosaccharide per 100 g. (a) How many grams does a 30 g daily portion supply; (b) distinguish prebiotics from probiotics; (c) state the digestive effects of excessive intake.	(a) Intake = 30 x 12 / 100 = 3.6 g. (b) Prebiotics are non-digestible food components such as fructo-oligosaccharide and inulin that selectively stimulate beneficial gut bacteria, whereas probiotics are the live micro-organisms themselves, such as	4

		lactobacilli and bifidobacteria. (c) Excess causes bloating, wind and diarrhoea because gut bacteria ferment them and produce gas.	
12	A drink claims to be sugar free and contains 0.4 g of sugar per 100 mL in a 330 mL bottle. (a) Calculate the sugar in the whole bottle; (b) decide whether the claim holds under the definition of not more than 0.5 g per 100 mL; (c) name two other sugar-type ingredients found on such labels, and explain why a diabetic still has to count the carbohydrate in this drink.	(a) Sugar per bottle = 0.4 x 330 / 100 = 1.32 g. (b) Since 0.4 g per 100 mL is not more than 0.5 g per 100 mL the claim is valid, but the bottle still contains 1.32 g of sugar. (c) Concentrated fruit juice, glucose-fructose syrup or maltodextrin are also sugar or rapidly digested carbohydrate; a diabetic must still count the carbohydrate of the whole bottle because it raises blood glucose.	5

Part 4 Textile Fibres and Functional Fabrics (17 marks)

Show all formulae, substitutions and calculation steps; give percentages to 1 d.p.

#	Question	Answer	Marks
13	A cotton fabric is 120 cm long before washing and 115.2 cm long after washing as directed by the care label. (a) Calculate the shrinkage in length (%); (b) explain how shrinkage affects pattern dimensions; (c) state one industrial treatment that reduces shrinkage.	(a) Shrinkage = (120 - 115.2) / 120 x 100 = 4.0%. (b) The pattern must allow for it, e.g. dimensions enlarged by 1 / (1 - 0.04), otherwise the garment falls short of size after washing and the shape distorts. (c) Use a sanforising pre-shrink process or a resin shrink-resistant finish so that built-in fibre stresses are released in advance.	4
14	A jacket needs 1.35 m of fabric, three jackets are cut, the fabric costs 68 dollars per metre and cutting waste is 8%. (a) Calculate the net fabric used; (b) the actual fabric including waste; (c) the total fabric cost to 2 d.p.	(a) Net fabric = 1.35 x 3 = 4.05 m. (b) Actual fabric = 4.05 x 1.08 = 4.374, i.e. 4.37 m. (c) Fabric cost = 4.374 x 68 = 297.43 dollars.	4
15	A fibre sample weighs 200 g when dry and 216 g after conditioning in the standard atmosphere. (a) Calculate the moisture regain (%); (b) compare the regain of cotton and polyester and explain the effect on comfort; (c) explain why regain matters for the official mass of a fabric consignment.	(a) Regain = (216 - 200) / 200 x 100 = 8.0%. (b) Cotton has a regain near 8.5% while polyester is only about 0.4%, so cotton absorbs moisture, breathes and feels comfortable but dries slowly, whereas polyester dries fast yet feels stuffy and builds static. (c) Fibre mass varies with humidity, so trade uses an official regain to compute the official mass; otherwise the same consignment would be priced differently in different weather.	4
16	Two summer jackets are labelled UPF 50 (A) and UPF 25 (B). (a) Calculate the percentage of ultraviolet radiation each blocks; (b) compare the ultraviolet transmitted, as a multiple; (c) give three design or use measures that raise the sun-protective performance of a fabric.	(a) A blocks (1 - 1/50) x 100 = 98.0% and B blocks (1 - 1/25) x 100 = 96.0%. (b) A transmits 2% and B transmits 4%, so B lets through twice as much. (c) Use a tight weave or fine high-density yarn, choose dark dyes, and apply a UV-blocking finish such as a titanium dioxide coating; in use, avoid repeated washing and stretching that open the structure, since UPF falls after washing.	5

Part 5 Pattern Making and Production Costing (17 marks)

Show all formulae, substitutions and calculation steps; give money values in dollars to 2 d.p.

#	Question	Answer	Marks

17	A womens top comes in five sizes (XS to XL) with bust measurements from 84 cm to 100 cm, graded at equal steps. (a) Calculate the step between sizes; (b) the bust of size M (the third size); (c) explain why the armhole and neckline are graded by smaller steps than the bust.	(a) Step = (100 - 84) / (5 - 1) = 4.0 cm. (b) Size M = 84 + 2 x 4.0 = 92.0 cm. (c) Body parts grow at different rates, and the real increase in armhole and neckline is much smaller than at the bust; using the same step would leave an oversized armhole and a loose neckline, distorting the shoulder line and the fit, so each part is graded in proportion.	4
18	A T-shirt uses 42 dollars of fabric, 8 dollars of trims, 35 dollars of labour and 3 dollars of packing, and the target gross margin is 45%. (a) Calculate the unit cost; (b) the selling price, where margin = (price - cost) / price; (c) the gross profit per unit to 2 d.p.	(a) Unit cost = 42 + 8 + 35 + 3 = 88.00 dollars. (b) Price = 88.00 / (1 - 0.45) = 160.00 dollars. (c) Gross profit = 160.00 - 88.00 = 72.00 dollars, i.e. 45% of the price.	4
19	A workshop completes 30 garments in 240 minutes. (a) Calculate the average time per garment; (b) how many garments an 8-hour production day yields; (c) the daily output if efficiency rises by 15% (whole number).	(a) Time per garment = 240 / 30 = 8.0 minutes. (b) Daily output = 8 x 60 / 8.0 = 60 garments. (c) After the improvement = 60 x 1.15 = 69 garments.	4
20	A brand has fixed costs of 24000 dollars a month and a contribution of 60 dollars per unit. (a) Calculate the monthly break-even quantity; (b) if a 10 dollar price cut lowers the contribution to 50 dollars, find the new break-even quantity; (c) calculate the percentage increase in break-even quantity.	(a) Break-even = 24000 / 60 = 400 units. (b) New break-even = 24000 / 50 = 480 units. (c) Increase = (480 - 400) / 400 x 100 = 20.0%, i.e. 80 more units must be sold to offset the price cut.	5

Part 6 Food Safety, HACCP and Consumer Protection (17 marks)

Show all formulae, substitutions and calculation steps, and briefly justify each answer.

#	Question	Answer	Marks
21	The Centre for Food Safety states that 4 C to 60 C is the danger zone. (a) State whether 32 C is inside it; (b) cooked food has stood at 32 C for 3 hours, so state what the 2-hour rule requires; (c) give two correct practices that shorten the time food spends in the danger zone.	(a) 32 C lies between 4 C and 60 C, so it is inside the danger zone. (b) It has stood for 3 hours, 1 hour (50.0%) beyond the 2-hour limit, so under the 2-hour rule it must not be eaten or kept for later and should be discarded. (c) Cool it quickly, using shallow trays or an ice bath, and hold hot food above 60 C or cold food below 4 C.	4
22	Household bleach contains 5.25% sodium hypochlorite, i.e. 52500 ppm, and is diluted 1:99 for use. (a) Calculate the available chlorine concentration after dilution (ppm); (b) state what this concentration is used for; (c) give two safety precautions.	(a) A 1:99 dilution is a hundredfold dilution, so the concentration = 52,500 / 100 = 525 ppm. (b) This strength is used to disinfect utensils, kitchen worktops and general surfaces, with an action time of about 10 minutes. (c) Wear gloves and keep the room ventilated; never mix it with acidic cleaners, which release toxic chlorine gas, and prepare only enough for the day.	4

23	A packaged food is produced on 1 March 2026 with a shelf life of 9 months. (a) Calculate the best-before date; (b) distinguish best before from use by; (c) explain how a rise in storage temperature after opening affects the real shelf life.	(a) 1 March 2026 plus 9 months gives 1 December 2026. (b) Best before concerns quality such as flavour, texture and nutrients, so the food may still be safe afterwards, while use by concerns safety and the food must be discarded once past it, as for highly perishable items. (c) Once opened the food meets oxygen, moisture and micro-organisms; a higher temperature speeds microbial growth and fat oxidation, so the real shelf life is much shorter than the printed date and the food should be chilled and eaten soon.	4
24	A food factory sold 1250 units this month and received 25 complaints. (a) Calculate the complaint rate (%); (b) list four of the seven HACCP principles; (c) explain why HACCP stresses prevention rather than relying on end-product testing.	(a) Complaint rate = 25 / 1,250 x 100 = 2.0%. (b) Any four of: conduct a hazard analysis; determine the critical control points; establish critical limits; monitor each CCP; establish corrective actions; establish verification procedures; establish record keeping. (c) Sampling tests only a tiny fraction of output and cannot guarantee every unit, and problems are found only after production; HACCP controls hazards in the process itself, so it prevents failures in advance at lower cost and with wider coverage.	5