S4 Home Economics Practice Paper

S4 | Home Economics | Time: 75 minutes | Total: 100 marks | 24 questions

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Part 1 Nutrients and Energy Calculations (17 marks)

Show your working and answer all questions.

1. A 50 g egg contains 6.3 g protein, 5.0 g fat and 0.4 g carbohydrate. Using the Atwater factors (protein 17 kJ/g, fat 37 kJ/g, carbohydrate 17 kJ/g), calculate the total energy of the egg and convert it to kcal (1 kcal = 4.184 kJ, 1 decimal place).

Answer: Protein 6.3 x 17 = 107.1 kJ; fat 5.0 x 37 = 185.0 kJ; carbohydrate 0.4 x 17 = 6.8 kJ. Total = 298.9 kJ, i.e. 298.9 / 4.184 = 71.4 kcal (about 71 kcal).

2. A person takes in 8400 kJ per day: 15% from protein, 30% from fat and 55% from carbohydrate. Calculate the energy (kJ) supplied by each nutrient and the mass required (1 decimal place).

Answer: Protein 8400 x 15% = 1260 kJ, / 17 = 74.1 g; fat 8400 x 30% = 2520 kJ, / 37 = 68.1 g; carbohydrate 8400 x 55% = 4620 kJ, / 17 = 271.8 g. The three add up to 8400 kJ, matching the intake.

3. An S4 girl of 60 kg has a basal metabolic rate of 4.2 kJ/kg/hour and a physical activity level (PAL) of 1.6. Find her daily total energy expenditure (TDEE). If she eats 10500 kJ per day, find the daily and weekly energy surplus, and estimate the weekly fat gain in kg (2 decimal places), given 32 000 kJ per kg of fat.

Answer: BMR = 60 x 4.2 x 24 = 6048 kJ; TDEE = 6048 x 1.6 = 9676.8 kJ. Daily surplus = 10500 - 9676.8 = 823.2 kJ; weekly surplus = 823.2 x 7 = 5762.4 kJ, i.e. about 5762.4 / 32 000 = 0.18 kg of fat.

4. Dietary fibre: oats contain 10 g fibre per 100 g and apples 2.4 g per 100 g. A student eats 60 g of oats and one 150 g apple. Find the total fibre and the percentage of the 25 g daily recommendation (1 decimal place).

Answer: Oats 60 x 10 / 100 = 6.0 g; apple 150 x 2.4 / 100 = 3.6 g. Total 9.6 g, which is 9.6 / 25 x 100% = 38.4% of the recommendation.

Part 2 Meal Planning and Menu Costing (17 marks)

The questions below concern planning a school lunch menu.

5. A menu provides 8800 kJ in total, split into breakfast 25%, lunch 35%, dinner 30% and snacks 10%. Find the energy of each meal (kJ) and check the total.

Answer: Breakfast 8800 x 25% = 2200 kJ; lunch 8800 x 35% = 3080 kJ; dinner 8800 x 30% = 2640 kJ; snacks 8800 x 10% = 880 kJ. Total 8800 kJ, equal to the given energy.

6. Protein quality: menu A has 8 g rice protein (biological value 70) and 12 g tofu protein (BV 65); menu B has 20 g fish protein (BV 80). Using protein x BV / 100, calculate the usable protein and compare the utilisation percentage of the two menus. Which is better?

Answer: Menu A: 8 x 70 / 100 = 5.6 g and 12 x 65 / 100 = 7.8 g, total 13.4 g out of 20 g, i.e. 67.0%. Menu B: 20 x 80 / 100 = 16.0 g, i.e. 80.0%. Menu B is better because animal protein has a more complete essential amino acid profile.

7. Design lunch for 12 people: 120 g rice each ($12/kg), 1.2 kg chicken breast in total ($68/kg) and 900 g vegetables in total ($16/kg). Find the cost of each ingredient, the total cost and the cost per person (2 decimal places).

Answer: Rice 12 x 0.12 = 1.44 kg, 1.44 x 12 = $17.28; chicken 1.2 x 68 = $81.60; vegetables 0.9 x 16 = $14.40. Total $113.28, i.e. $113.28 / 12 = $9.44 per person.

8. The food pyramid recommends 3 to 4 bowls of grains a day, one bowl being 150 g of cooked rice. A student eats 450 g of cooked rice at lunch. How many bowls is that? Against the minimum of 3 bowls a day, does this meal meet the minimum, and how many more bowls are needed?

Answer: 450 / 150 = 3 bowls. That already uses the whole daily minimum of 3 bowls, leaving nothing for breakfast and dinner, so the day still needs grain portions within the 3 to 4 bowl range, i.e. 450 to 600 g of cooked rice in total.

Part 3 Food Safety and Microbial Growth (17 marks)

The temperature danger zone is 4 C to 60 C.

9. A tray of cooked chicken cools in a 25 C room from 88 C to 30 C over 180 minutes, linearly. Find how long the food stays in the danger zone (4 C to 60 C), to the nearest minute, and explain why cooling at room temperature is risky.

Answer: Cooling rate = (88 - 30) / 180. Reaching 60 C takes (88 - 60) / 58 x 180 = 86.9 minutes, after which the food stays in the danger zone and is still above 4 C at 180 minutes. Danger-zone time = 180 - 86.9 = about 93 minutes. Bacteria multiply fastest between 4 C and 60 C, so holding food there for over two hours is unsafe.

10. A food starts with 10^2 CFU/g and doubles every 30 minutes at 25 C. Find the count after 4 hours, and the time needed to exceed 10^6 CFU/g, the infective dose.

Answer: 4 hours = 240 minutes = 8 doublings, so 10^2 x 2^8 = 25600 CFU/g. Reaching 10^6 needs 2^n >= 10^4, i.e. n = 14 (2^14 = 16 384), which takes 14 x 30 = 420 minutes = 7 hours.

11. Household bleach contains 5.25% sodium hypochlorite. What is the available chlorine concentration in ppm after a 1:99 dilution? Show your working and explain why this dilution, not the neat bleach, is used on kitchen surfaces.

Answer: 5.25% = 52500 ppm. A 1:99 dilution is a 100-fold dilution, so 52500 / 100 = 525 ppm. This kills common bacteria while neat bleach would corrode surfaces and irritate skin and airways, and leave residues that may contaminate food.

12. Raw chicken juice contains 10^5 CFU. A cloth wipes it and transfers 0.1%% of the bacteria onto 500 g of cooked meat. Find the number of bacteria transferred and the count per gram of meat, and name the type of contamination.

Answer: Transferred = 10^5 x 0.001 = 100 CFU; per gram = 100 / 500 = 0.2 CFU/g. This is cross-contamination through cloths, chopping boards or hands. The cooked meat is not reheated, so the bacteria are eaten directly; separate boards and cloths are essential.

Part 4 Food Preservation and Processing (17 marks)

The questions cover chilling, dehydration, canning and curing.

13. 1.5 kg of meat is frozen from 20 C to -18 C. Specific heat of fresh meat is 3.3 kJ/kg/K, latent heat of freezing 250 kJ/kg and specific heat when frozen 1.7 kJ/kg/K. Find the total heat removed (kJ).

Answer: Cooling to 0 C: 1.5 x 3.3 x 20 = 99.0 kJ; freezing: 1.5 x 250 = 375.0 kJ; cooling to -18 C: 1.5 x 1.7 x 18 = 45.9 kJ. Total 519.9 kJ.

14. 1 kg of vegetables contains 90%% water (wet basis). After drying to 10%% water (wet basis), what is the product mass in g, and how much water is removed (1 decimal place)?

Answer: Dry solids stay at 100 g. At 10% moisture the solids are 90% of the product, so mass = 100 / 0.9 = 111.1 g. Water in the raw food was 900 g and in the product 11.1 g, so 888.9 g of water is removed.

15. The pH limit for canning is 4.6. Tomato is pH 4.3, green peas pH 5.8 and lemon juice pH 2.2. Which may be processed in a boiling-water bath (100 C) and which need pressure canning? Explain the link to Clostridium botulinum.

Answer: Tomato (4.3) and lemon juice (2.2) are below 4.6, so they are high-acid foods and a boiling-water bath kills vegetative cells and prevents spore outgrowth. Peas at 5.8 are low-acid and need pressure canning (about 116 to 121 C) to destroy Clostridium botulinum spores, which germinate in anaerobic, low-acid conditions and produce a lethal toxin.

16. For a brine in which salt is 20% of the total solution mass (w/w), how many g of salt must be added to 1000 g of water (nearest integer)?

Answer: Let the salt be x g: x / (x + 1000) = 0.20, so 0.8x = 200 and x = 250 g. The brine weighs 1250 g in total with 20% salt. The high salt level lowers water activity and inhibits microbial growth.

Part 5 Textile Fibres and Fabric Care (16 marks)

The questions cover fibre properties, shrinkage, washing energy and fabric cutting.

17. Cotton has a moisture regain of 8.5% and polyester 0.4%. How many g of water do a 250 g cotton T-shirt and a 250 g polyester T-shirt hold in humid air? Explain the effect on comfort.

Answer: Cotton: 250 x 8.5% = 21.25 g; polyester: 250 x 0.4% = 1.0 g, about 21 times less. Cotton absorbs sweat and releases it slowly, which feels comfortable; polyester absorbs almost nothing, so sweat stays on the skin - hot and sticky, but it dries fast, which suits sportswear.

18. Cotton trousers measure 120 cm before washing and 114 cm after. Find the shrinkage (%). To end up 114 cm long after washing, what length must be cut (1 decimal place)?

Answer: Shrinkage = (120 - 114) / 120 x 100% = 5.0%. Cut length = 114 / (1 - 0.05) = 120.0 cm, i.e. 6.0 cm extra.

19. A wash uses 30 L of water. Compare heating it from 20 C to 60 C against heating to 30 C: what is the difference in kJ and in kWh? (Specific heat of water 4.18 kJ/kg/K, 1 kWh = 3 600 kJ)

Answer: 60 C: 30 x 4.18 x 40 = 5016 kJ; 30 C: 30 x 4.18 x 10 = 1254 kJ. Difference 3762 kJ = 3762 / 3 600 = 1.045 kWh. Cooler washing therefore saves real energy and reduces wear on the fabric.

20. A fabric 150 cm wide is used to cut 40 pieces of 60 cm x 80 cm. Two pieces per row, cut along the length. Find the fabric length needed (m), the fabric area, the area actually used and the utilisation (%).

Answer: Two pieces per row (2 x 60 = 120 cm, leaving 30 cm selvedge waste), so 40 / 2 = 20 rows and length = 20 x 80 cm = 1600 cm = 16 m. Fabric area = 1.5 x 16 = 24.0 m2; used area = 40 x 0.60 x 0.80 = 19.2 m2. Utilisation = 19.2 / 24.0 x 100% = 80%, with 4.8 m2 waste.

Part 6 Family Resources and Consumer Budgeting (16 marks)

The questions cover budgeting, unit price, energy cost and depreciation.

21. A family earns $28000 a month, allocated as housing 35%, food 25%, transport 8%, education 12%, savings 15% and others 5%. Find each amount and check that the total equals the income.

Answer: Housing $9800, food $7000, transport $2240, education $3360, savings $4200, others $1400. Total $28000, equal to the income. Savings of 15% means $4200 a month towards an emergency fund.

22. Detergent A: 2.5 kg for $42.5; detergent B: 1.8 kg for $32.4. Find the price per 100 g of each, and say which is cheaper and by how much per 100 g.

Answer: A: 42.5 / 25 = $1.70 per 100 g; B: 32.4 / 18 = $1.80 per 100 g. A is cheaper by $0.10 per 100 g. Larger packs usually cost less per unit, but consumption and shelf life still matter.

23. A 150 W refrigerator actually runs 8 hours a day and electricity costs $1.2/kWh. Find the daily consumption (kWh), the 30-day consumption and the 30-day cost (2 decimal places).

Answer: Daily = 150 x 8 / 1 000 = 1.2 kWh; 30 days = 1.2 x 30 = 36 kWh; cost = 36 x 1.2 = $43.20.

24. A washing machine costs $4800 and is expected to last 8 years, using straight-line depreciation. Find the annual depreciation, the book value after 3 years, and the accumulated depreciation as a percentage of cost after 3 years.

Answer: Annual depreciation = 4800 / 8 = $600; accumulated over 3 years = 600 x 3 = $1800; book value = 4800 - 1800 = $3000. That is 1800 / 4800 x 100% = 37.5% of cost.