Q1. A pediatrics journal published a randomized study of the use of honey as a remedy for coughing compared to two other remedies. Cough improvement scores (measured on a scale of 0 to 100) for the patients treated by over-the-counter cough medicine (M), honey (H), or water (W) were recorded.

The data were analyzed as a completely randomized design, and gave rise to the following ANOVA table. Some elements are omitted and replaced with roman numerals (i) to (v).

SOURCE	DF	SS	MS	F
REMEDY	(i)	(iii)	159.255	(v)
ERROR	103	927.719	(iv)	
TOTAL	(ii)	1246.229		

(a) Identify the numerical values replaced by (i) – (v). 5 MARKS

(b) Report the conclusion of an ANOVA F-test at the $\alpha = 0.05$ level. State the value of the test statistic and identify the null distribution. 5 MARKS

(c) The remedy group sample sizes for the study are not equal. Does the lack of balanced replication compromise the ANOVA conclusions ? Justify your answer. 2 MARKS

(d) Report the estimate of the residual error variance, σ^2, derived from these data. 4 MARKS

(e) Levene's test was carried out for these data, and yielded a p-value of 0.96. Explain what this test is used for, what conclusion should be drawn, and identify one further check that should be made to support the conclusions made by the ANOVA analysis. 4 MARKS

Q2. In an agricultural experiment, two factors were investigated to assess their impact on the yield of a crop.

- Factor A: Fertilizer type
- Factor B: Fertilizer delivery method

A balanced complete factorial design was used. The following ANOVA table was produced:

SOURCE	DF	SS	MS	F	p
A	3	222.731	74.244	16.878	0.0000
B	4	393.427	98.357	22.360	0.0000
INTERACTION	12	54.354	4.530	1.030	0.4281
ERROR	100	439.882	4.399		
TOTAL	119	1110.394			

(a) Report the conclusions that can be drawn from this ANOVA table. Justify your answers. 6 MARKS

(b) Report the conclusions that would be drawn if the data were re-analyzed but the interaction was omitted from the model. Justify your answer. Use the significance level of $\alpha = 0.05$ for the tests you carry out. 6 MARKS

(c) Explain what the absence of an interaction between Factor A and Factor B would imply about the effect of the factors on the response variable. 3 MARKS

(d) Compute the overall sample variance based on all the data collected in the study. 3 MARKS

(e) In light of the ANOVA conclusions above, it is desired to carry out two-sample tests to assess whether there are any mean differences between the treatment groups defined by each of the factor level combinations. What significance level should be used for each test if the Familywise Type 1 error rate of $\alpha_F = 0.05$ is required ? Briefly justify your answer. 2 MARKS

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