

**FURTHER STUDIES MATHEMATICS (EXTENDED): PAPER II
MODULE IV**

MARKING GUIDELINES

Time: 1 hour

100 marks

These marking guidelines are prepared for use by examiners and sub-examiners, all of whom are required to attend a standardisation meeting to ensure that the guidelines are consistently interpreted and applied in the marking of candidates' scripts.

The IEB will not enter into any discussions or correspondence about any marking guidelines. It is acknowledged that there may be different views about some matters of emphasis or detail in the guidelines. It is also recognised that, without the benefit of attendance at a standardisation meeting, there may be different interpretations of the application of the marking guidelines.

MATRICES AND GRAPH THEORY

QUESTION 1

$$1.1 \quad A^{-1} = -\frac{1}{7} \checkmark \checkmark \begin{pmatrix} -1 & -4 \\ -3 & -5 \end{pmatrix} \checkmark \checkmark = \frac{1}{7} \begin{pmatrix} 1 & 4 \\ 3 & 5 \end{pmatrix} \quad (4)$$

$$1.2 \quad \begin{array}{ll} 3 - 3z = 12 \checkmark & z = -3 \checkmark \\ y - 3 = 0 \checkmark & y = 3 \checkmark \\ 1 - 3(1) = x \checkmark & x = -2 \checkmark \end{array} \quad (6)$$

$$1.3 \quad (a) \quad k \checkmark \checkmark \quad (b) \quad -k \checkmark \checkmark \quad (c) \quad -3k \checkmark \checkmark \quad (d) \quad k \checkmark \checkmark \quad (8)$$

[18]

QUESTION 2

$$2.1 \quad (a) \quad \text{translation } 2 \checkmark \text{ units right } \checkmark \quad (2)$$

$$(b) \quad \text{factor} = -3 \checkmark \checkmark \quad (2)$$

$$2.2 \quad \begin{pmatrix} \cos 2A & \sin 2A \\ \sin 2A & -\cos 2A \end{pmatrix} \checkmark \begin{pmatrix} 3 \\ -2 \end{pmatrix} \checkmark = \begin{pmatrix} 3,232 \\ -1,598 \end{pmatrix} \checkmark$$

$$3\cos 2A - 2\sin 2A = 3,232 \checkmark \checkmark \quad \text{and} \quad 3\sin 2A + 2\cos 2A = -1,598 \checkmark \checkmark$$

$$\cos 2A = 0,5 \checkmark \quad \text{and} \quad \sin 2A = -0,866 \checkmark$$

$$2A = 360^\circ - 60^\circ \checkmark \checkmark$$

$$\mathbf{A = 150^\circ} \checkmark \quad (12)$$

$$2.3 \quad (a) \quad \begin{pmatrix} 1 & k \\ 0 & 1 \end{pmatrix} \checkmark \checkmark \checkmark \begin{pmatrix} t & t \\ v & r \end{pmatrix} \checkmark = \begin{pmatrix} t + kv & t + kr \\ v & r \end{pmatrix} \checkmark \checkmark \quad (6)$$

$$(b) \quad m = \frac{v - r}{(t + kv) - (t + kr)} \checkmark \checkmark = \frac{v - r}{k(v - r)} \checkmark = \frac{1}{k} \checkmark \quad (4)$$

[26]

QUESTION 3

3.1 More zeroes, ✓ hence easier multiplications. ✓ (2)

$$3.2 \quad \det = -(-1) \cdot \begin{vmatrix} 2 & 1 & 0 \\ 9 & 3 & 1 \\ -1 & 5 & 7 \end{vmatrix} \checkmark + 0 - 3 \cdot \begin{vmatrix} 2 & 2 & 0 \\ 4 & 9 & 1 \\ 0 & -1 & 7 \end{vmatrix} \checkmark + 0$$

$$= (-32) \checkmark - 3(72) \checkmark = -248 \quad (6)$$

$$3.3 \quad \frac{1}{-248} \checkmark \checkmark \begin{pmatrix} -192 & 32 & 42 & -6 \\ 100 & 4 & -49 & 7 \\ -64 & -72 & 14 & -2 \\ 60 & 52 & -17 & -33 \end{pmatrix} \quad \text{cofactors } \checkmark \checkmark \text{ transpose } \checkmark \checkmark \quad (6)$$

[14]

QUESTION 4

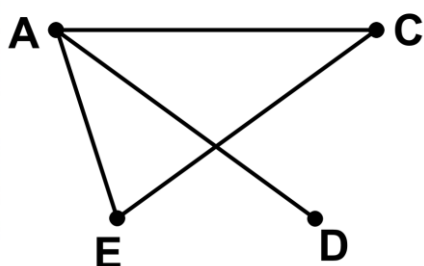
4.1 (a) $n - 1$ ✓✓ (2)

(b) $n/2(n - 1)$ ✓✓ (2)

(c) $n(n - 1)$ ✓✓ (2)

4.2 (a) A, B, C, D, E, B, D or its reverse or many other options
Start at A or D, ✓ end at D or A, ✓ use all edges ✓✓ (4)

(b) **B**
•



5 vertices ✓
4 edges ✓
Connectivity ✓✓

(4)
[14]

QUESTION 5

- 5.1 all vertices do not have the same degrees ✓✓ (2)
- 5.2 no graphs have HCs ✓✓ (2)
- 5.3 A, C, D
For any first pair ✓✓
For any second pair ✓✓ (4)
- [8]**

QUESTION 6

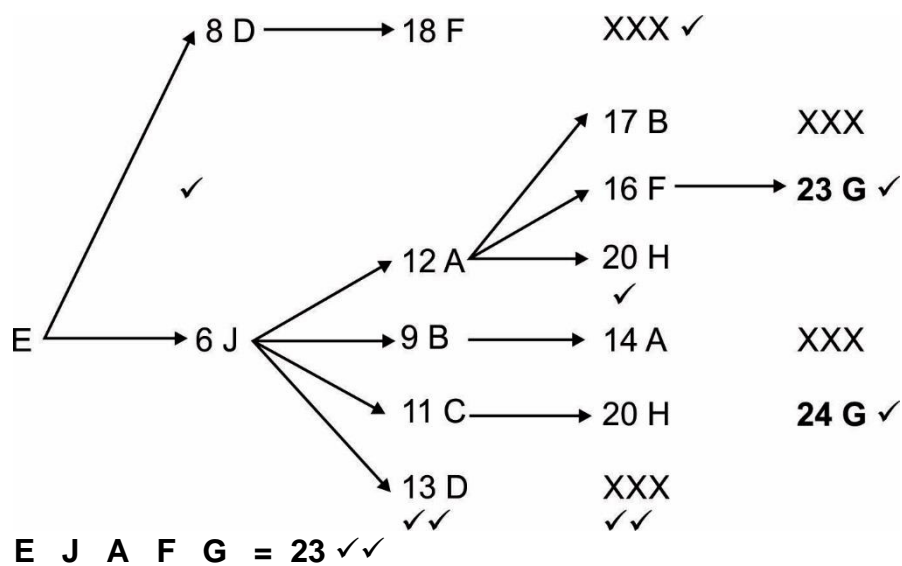
- 6.1
- | | | |
|--------|------|----------------------------------|
| DF | 10 ✓ | |
| HC | 9 ✓ | |
| HA, DE | 8 ✓✓ | |
| JD, GF | 7 ✓✓ | |
| AJ | 6 ✓ | |
| AB | 5 ✓ | max spanning tree = 60 ✓✓ |
- (10)

6.2

	A	B	C	D	E	F	G	H	J	
E				8E					6E	✓
J	12J	9J	11J							✓
D						18D				✓
B	14B									✓
C	20C									✓
A						16A		20A		✓
F							23F			✓
H							24F			✓

E J A F G = 23 ✓✓

OR



(10)
[20]

Total: 100 marks