| Country: _____ | Student Code: _____ |
|---|---|

# 23rd INTERNATIONAL BIOLOGY OLYMPIAD

8th – 15th July, 2012

SINGAPORE

IBO 2012 SINGAPORE

## PRACTICAL TEST 3

## PLANT DIVERSITY, ANATOMY & PHYSIOLOGY

## *ANSWER KEY*

Total points: **100**

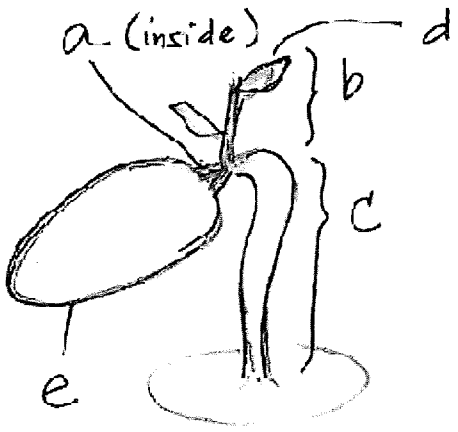
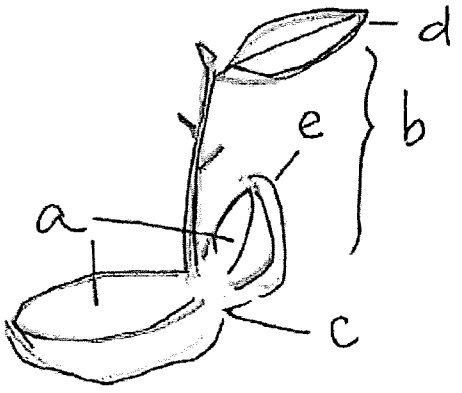
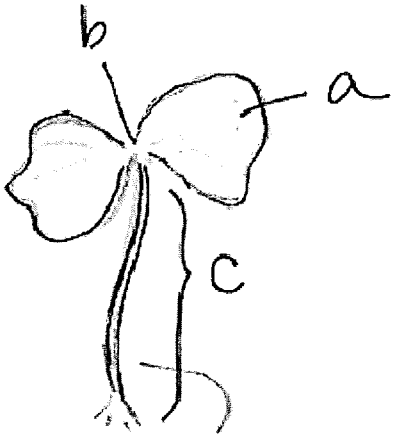
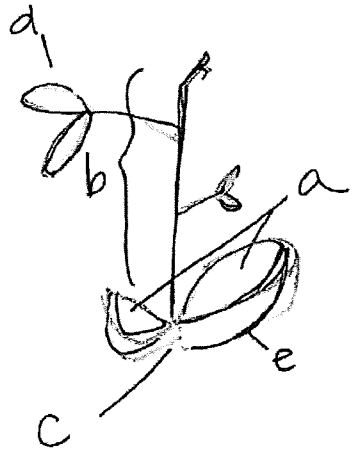
Duration: **90 minutes**

# Task I (60 points)

## Plant diversity and anatomy

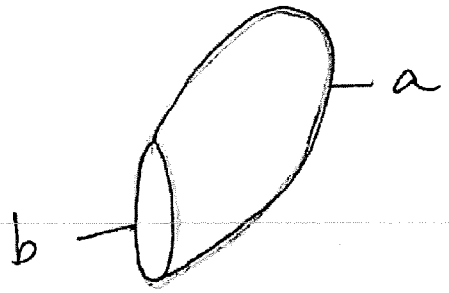
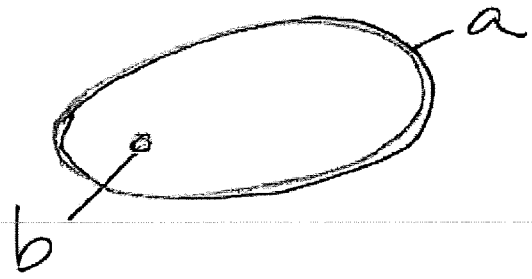
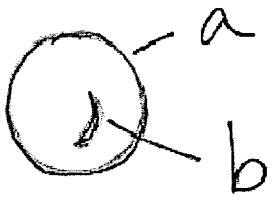
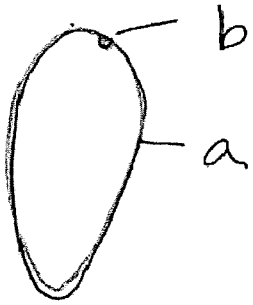
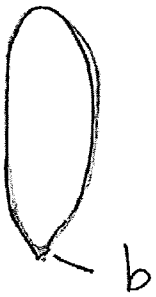
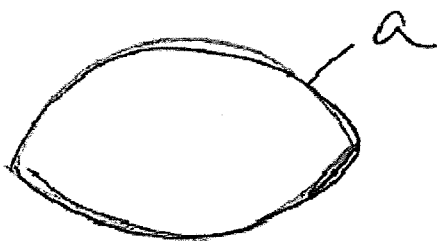
Part A. Morphology of seedlings (14.25 points)

**Q1.1 (0.5 points × 20 = 10 points; 2 points for quality of drawings; 2.25 points for not damaging specimens)**

| A | B |
|---|---|
|  |  |
| Absent: **b, d for some samples** | Absent: **(c)** |
| **C** | **D** |
|  |  |
| Absent: **d, e** | Absent: **(c)** |

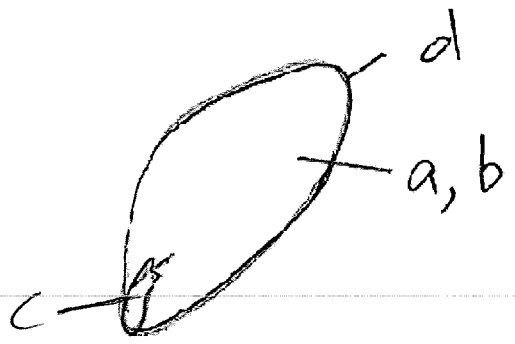
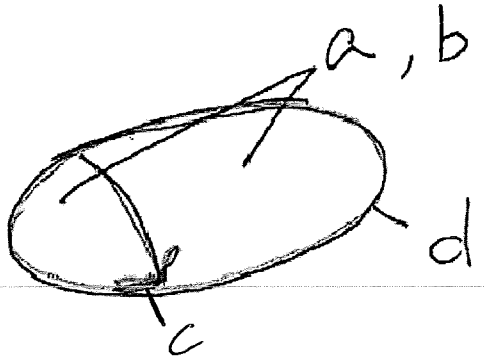
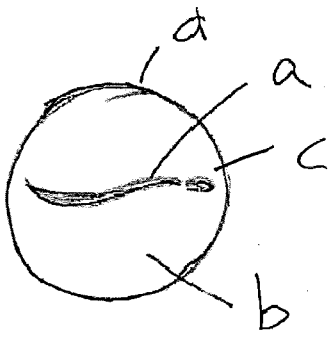
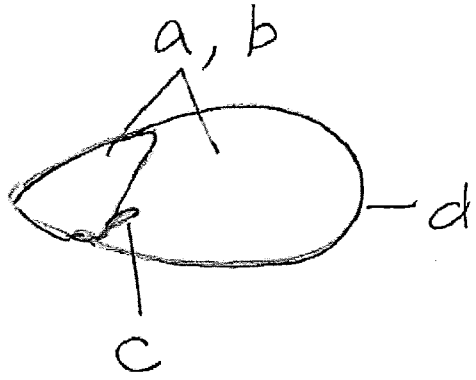
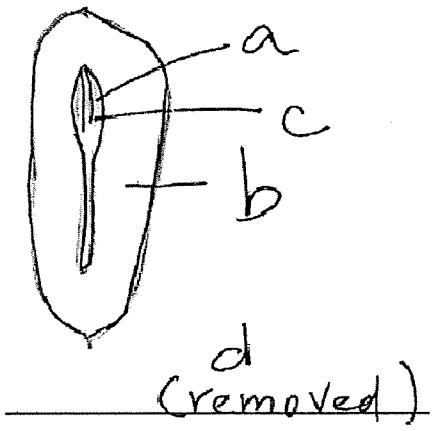
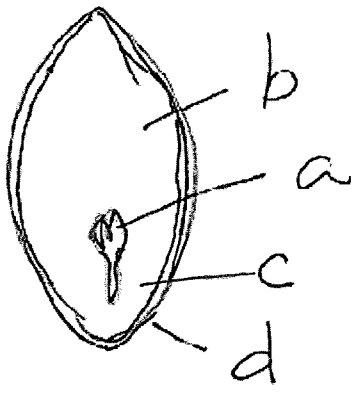
Part B. Seed morphology and anatomy (27.25 points)

**Q1.2 (0.25 points × 11 = 2.75 points)**

| 1 | 2 |
|---|---|
|  Absent: _____ |  Absent: _____ |
| **3** | **4** |
|  Absent: _____ |  Absent: _____ |
| **5** | **6** |
|  Absent: a |  Absent: b |

不算分

**Q1.3 (0.5 points × 24 = 12 points; 1 point for quality of drawings)**

| 1 | 2 |
|---|---|
|   |   |
| **3** | **4** |
|   |   |
| **5** | **6** |
|   |   |

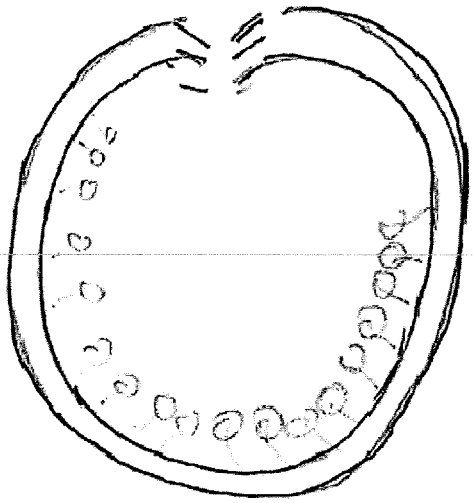
**Q1.4 (0.5 points × 23 = 11.5 points)**

| Seed | a | b | c | d |
|---|---|---|---|---|
| 1 | 2N | 2N | 2N | 2N |
| 2 | 2N | 2N | 2N | 2N |
| 3 | 2N | 3N | 2N | 2N |
| 4 | 2N | 2N | 2N | 2N |
| 5 | 2N | 1N | 2N | --- |
| 6 | 2N | 1N | 2N | 2N |

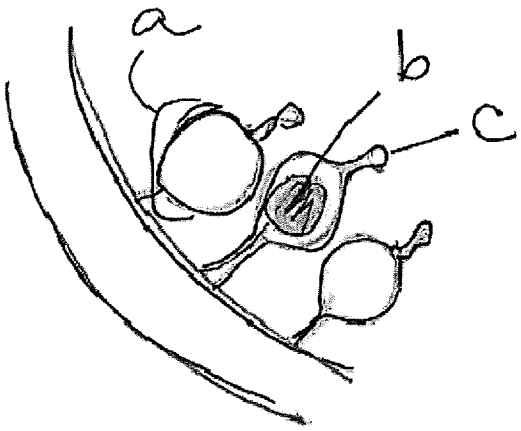
Part C. *Ficus* propagule (5 points)

**Q1.5 (1+1+3 points)**

E



Enlarged section



Part D. Functional, ecological and phylogenetic aspects of seeds and seedlings (13.5 points)

**Q1.6 (0.5 points × 9 = 4.5 points)**

**Table 1**

| Seeds | Family | Primary function of cotyledon* | Seed dry weight as % fresh weight | Probable germination pattern+ | Climate of original habitat |
|---|---|---|---|---|---|
| 1 | Malvaceae | S | 60% | R | Tropical / wet |
| 2 | Moraceae | S | 45% | R | Tropical / wet |
| 3 | Malvaceae | P | 80% | O | Tropical-Subtropical / dry |
| 4 | Sapindaceae | S | 65% | R | Tropical / wet |
| 5 | Pinaceae | P | 80% | O | Temperate / subtropical |
| 6 | Ginkgoaceae | *** | 55% | R | Tropical / wet |
| E | Moraceae | P | 85% | O | Tropical / wet |

****Ginkgo* cotyledons remain embedded in the seed during germination

**Q1.7 (1 point × 5 = 5 points)**

| a | b | c | d | e |
|---|---|---|---|---|
| × | × | × | ✓ | ✓ |

**Q1.8 (1 point × 4 = 4 points)**

| a | b | c | d |
|---|---|---|---|
| ✓ | -- | -- | × |

# Task II (40 points)

## Plant anatomy and physiology

Part A. Anatomy of a plant stem (13 points)

**Q2.1 – Q2.3** **(1 point × 3 = 3 points)**

| **Q2.1** (M or D) | **Q2.2** (✓ or ×) | **Q2.3** (C or P) |
|---|---|---|
| D | ✓ | P |

**Q2.4** **(0.5 points × 3 = 1.5 points)**

| Shrub | Tree | Herb |
|---|---|---|
| × | × | ✓ |

**Q2.5** **(0.5 points)**

| a | b | c | d | e |
|---|---|---|---|---|
| | | | | ✓ |

**Q2.6 (8 points)**

| Quality of stem section (*for examiner's use only*) | |
|---|---|

| CRITERIA | SCORE |
|---|---|
| Completeness of stem section<br>Complete: 10 points; Incomplete: 5 points | /10 |
| Staining of stem section<br>Yes: 10 points<br>No: O point | /10 |
| Thickness of stem section<br>Single layer (throughout): 40 points<br>Single layer in (some areas): 30 points<br>2-3 layers of cells: 20 points<br>>3 layers of cells: 10 points<br>5 bonus points if more than half the section meets criteria | /40 |
| % intact cells in stem section<br>100% of cells: 20 points<br>80% of cells: 15 points<br>50% of cells: 10 points<br><5% of cells: 5 points | /20 |
| % air bubbles in stem section<br>0 bubbles: 20 points<br><10 small bubbles: 15 points<br>>10 small bubbles and some large bubbles: 10 points<br>Numerous large bubbles, section obscured: 0 point | /20 |
| TOTAL | 100 |

Part B. Study of leaf epidermis and physiology (15 points)

(i) Lower epidermis

**Q2.7 (2 points)**

Answer: ✓ .

**Q2.8 (1.5 points × 2 = 3 points)**

| | 1 | 2 | 3 | 4 | 5 | Mean |
|---|---|---|---|---|---|---|
| Length (μm) | 120 | 100 | 100 | 150 | 150 | 124 |
| Width (μm) | 100 | 80 | 110 | 70 | 80 | 88 |

Acceptable Answers:

Length: 120–225 μm; Width: 80–130 μm

(Length: 125–225 μm; Width: 80–125 μm, Chimpan & Sipos; 2009)

(ii) Upper epidermis

**Q2.9 (2 points)**

Answer: ✗ .

**Q2.10 (1.5 points × 2 = 3 points)**

| | 1 | 2 | 3 | 4 | 5 | Mean |
|---|---|---|---|---|---|---|
| Length (μm) | 180 | 220 | 240 | 210 | 200 | 210 |
| Width (μm) | 180 | 240 | 210 | 210 | 160 | 200 |

Acceptable Answers:

Length: 220 – 270 μm; Width: 160 – 230 μm

(Length: 225 – 250 μm; Width: 175 – 225 μm, Chimpan & Sipos; 2009)

**Q2.11 (0.5 point × 3 = 1.5 points)**

| a | b | c |
|---|---|---|
| ✓ | × | ✓ |

**Q2.12 (1 point)**

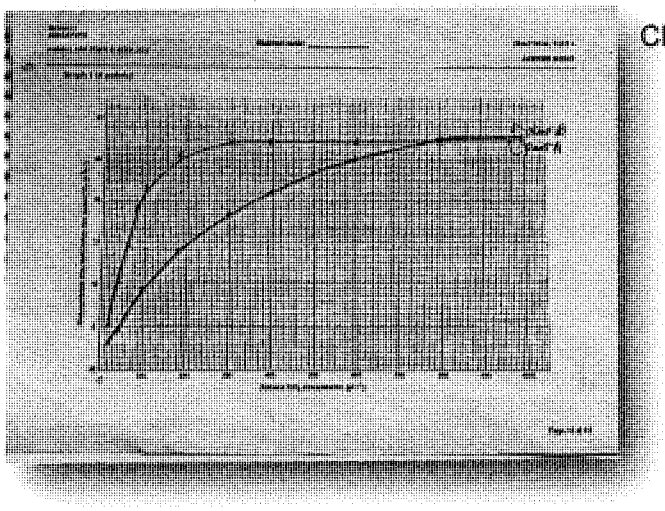
| a | b | c |
|---|---|---|
| | ✓ | |

**Q2.13 (0.5 points × 5 = 2.5 points)**

| a | b | c | d | e |
|---|---|---|---|---|
| ✓ | ✓ | ✓ | × | ✓ |

Part C. Interpretation of photosynthetic data from plants measured at different $CO_2$ concentrations (12 points)

**Q2.14 (4 points)** Graph 1



CRITERIA:

1. Plot
   a. Accuracy (1 mark) – one point off, - 0.5 mark , two points off, -1 point
   b. Differentiation of curves by different symbols or labels ( 1 point)
2. Smoothness of curves: 2 points, 1 point for each curve

**Q2.15 (0.5 points × 2 = 1 point)**

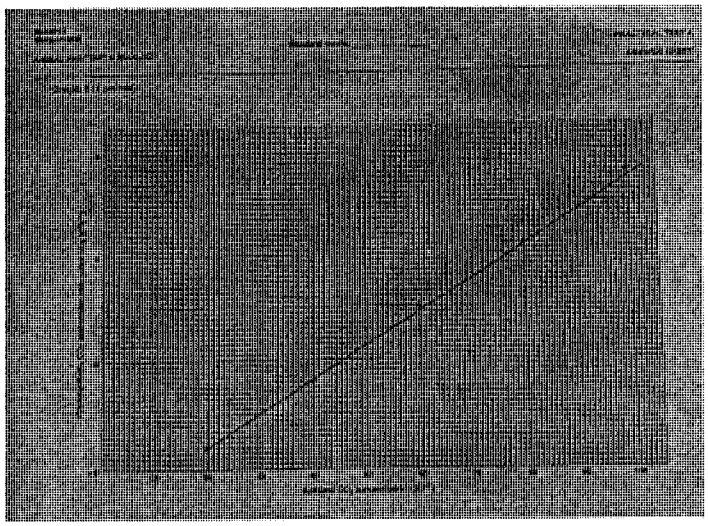
| | C3 | C4 |
|---|---|---|
| A | | ✓ |
| B | ✓ | |

**Q2.16 (2 points)**

| | A | B |
|---|---|---|
| Net photosynthetic $CO_2$ assimilation rate | $42 \pm 1.0$ μmol $CO_2$ $m^{-2}$ $s^{-1}$ | $20 \pm 1.0$ μmol $CO_2$ $m^{-2}$ $s^{-1}$ |

(Note: without a unit, 0.5 points will be deducted)

**Q2.17 (2 points)** Graph 2



CRITERIA:

1. Plot
   Accuracy (1 point)
   – one point off, – 0.5 point,
   – two points off, –1 point

2. Straight line (1 point)

**Q2.18 (1 point)**

**Answer:** $46 \pm 1$ μmol $CO_2$ $m^{-2}$ $s^{-1}$

(Note: without a unit, 0.5 marks will be deducted.)

**Q2.19 (1 point)**

| increase | decrease | remain unchanged |
|---|---|---|
| ✓ | | |

**Q2.10 (1 point)**

| increase | decrease | remain unchanged |
|---|---|---|
| | ✓ | |