3. Scoring of the Examination

3.1 Marking guide

GUIDELINES FOR CORRECTING QUESTIONS

The marking scale for correcting the answers to the questions of the examination is presented below, along with explanations of the terms used in the scale.

It is **IMPORTANT** that the teacher read this information carefully before correcting the examination.

Questions usually consist of two parts: the **procedure** used to solve the problem and the **answer**. Thus, a question should be corrected in two steps.

Step 1

Analyze the work to understand the procedure used by the student, and then decide if the procedure is appropriate or not.

A **procedure** is **appropriate** if the steps presented could lead to the correct answer.

A **procedure** is **partially appropriate** if the steps presented do not lead to the correct answer, but include at least one step that is relevant and correct.

A **procedure** is **inappropriate** if none of the steps presented are relevant or if the student has not shown any work.

Step 2

If the procedure is deemed appropriate, then evaluate the answer. If the answer is incorrect, identify the type of error made.

The **error** is considered **minor** if it is an error in calculation or transcription, if the unit of measurement is incorrect or missing, or if the student has rounded off a number incorrectly.

The **error** is considered **major** if a law, rule, or formula has been applied incorrectly.

No marks are allotted for a correct answer when the procedure used is inappropriate.

The application of significant figures should be considered during the correction of this examination.

Do not mark each question for significant figures, unless indicated in the marking scale.

Two marks will be allocated for the appropriate use of significant figures for the entire examination, not for the individual question, unless indicated in the marking scale.

3.2 Examples of appropriate procedures

Question 1

Example of an appropriate procedure:

Given information: $\Delta d = 45.0\ \text{m}$

$\Delta t = 24.0\ \text{s}$

1. Average speed of moving sidewalk in m/s:

$$V_{av} = \frac{\Delta d}{\Delta t}$$
$$= \frac{45.0\ \text{m}}{24.0\ \text{s}}$$
$$= 1.875\ \text{m/s}$$

2. Average speed in km/h:

$$\frac{1.875\ \text{m}}{1\ \text{s}} \times \frac{3600\ \text{s}}{1\ \text{hr}} \times \frac{1\ \text{km}}{1000\ \text{m}}$$
$$= 6.75\ \text{km/h}$$

Answer: The average speed of the moving sidewalk is **6.75 km/h.**

* Accept a range of 6.73 km/h to 6.77 km/h due to rounding off of significant figures during calculations.

Marking Scale	
3 marks	Appropriate procedure and correct answer.
2 marks	Appropriate procedure but incorrect answer because of a minor mistake such as a calculation error, transcription error, or an incorrect or missing unit of measurement.
1 mark	Appropriate procedure with a major error (e.g. calculates speed in m/s only).
0 marks	Inappropriate procedure or did not show the procedure, the final answer is either missing, incorrect, or was derived by chance.

Question 2

Example of an appropriate procedure

Answer: Part A The spring deformation is 7.25 ± 0.05 cm.

Part B Given:

$$x = 7.25\ \text{cm} = 0.0725\ \text{m}$$

$$K = 4.6 \times 10^3\ \text{N/m}$$

$$F = kx$$

$$= (4.6 \times 10^3\ \text{N/m}) \times (0.0725\ \text{m})$$

$$= 333.96\ \text{N}$$

$$F = mg$$

$$334\ \text{N} = m \times 9.8\ \text{m/s}^2$$

$$m = 34\ \text{kg}$$

Answer: Part B Alex's luggage **does exceed** the maximum weight permitted per passenger because the mass of Alex's luggage is 34 kg.

Note: *Accept an answer in newtons (334 N).*

Part A

Marking Scale

2 marks	Appropriate procedure and correct answer.
1 mark	Partially appropriate and correct procedure (e.g. error in significant figures or recording of uncertainty.)
0 marks	Inappropriate procedure or did not show the procedure, the final answer is either missing, incorrect, or was derived by chance.

Part B

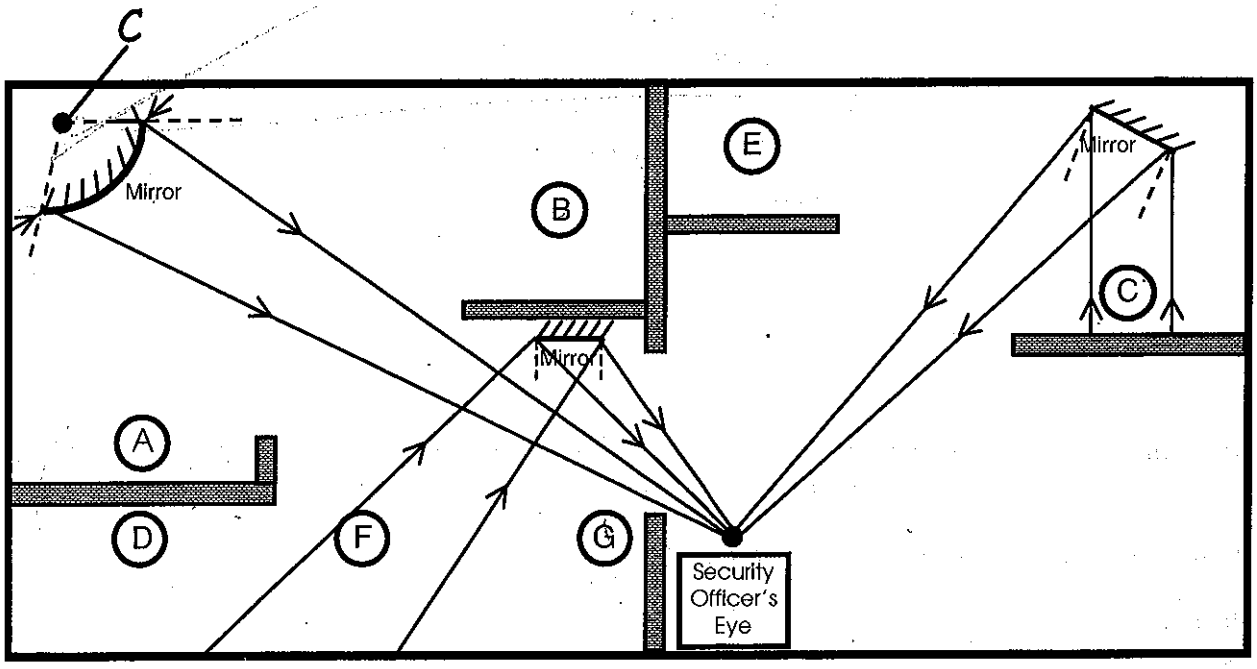
Marking Scale

4 marks	Appropriate procedure and correct answer.
3 marks	Appropriate procedure but incorrect answer because of a minor mistake such as a calculation error, transcription error, or an incorrect or missing unit of measurement.
2 marks	Appropriate procedure with a major error (e.g. did not convert cm to m).
1 mark	Partially appropriate and correct procedure.
0 marks	Inappropriate procedure or did not show the procedure, the final answer is either missing, incorrect, or was derived by chance.

Question 3

Example of an appropriate procedure

Answer: The students who are **NOT** visible in the security officer's field of vision are: **D and E.**

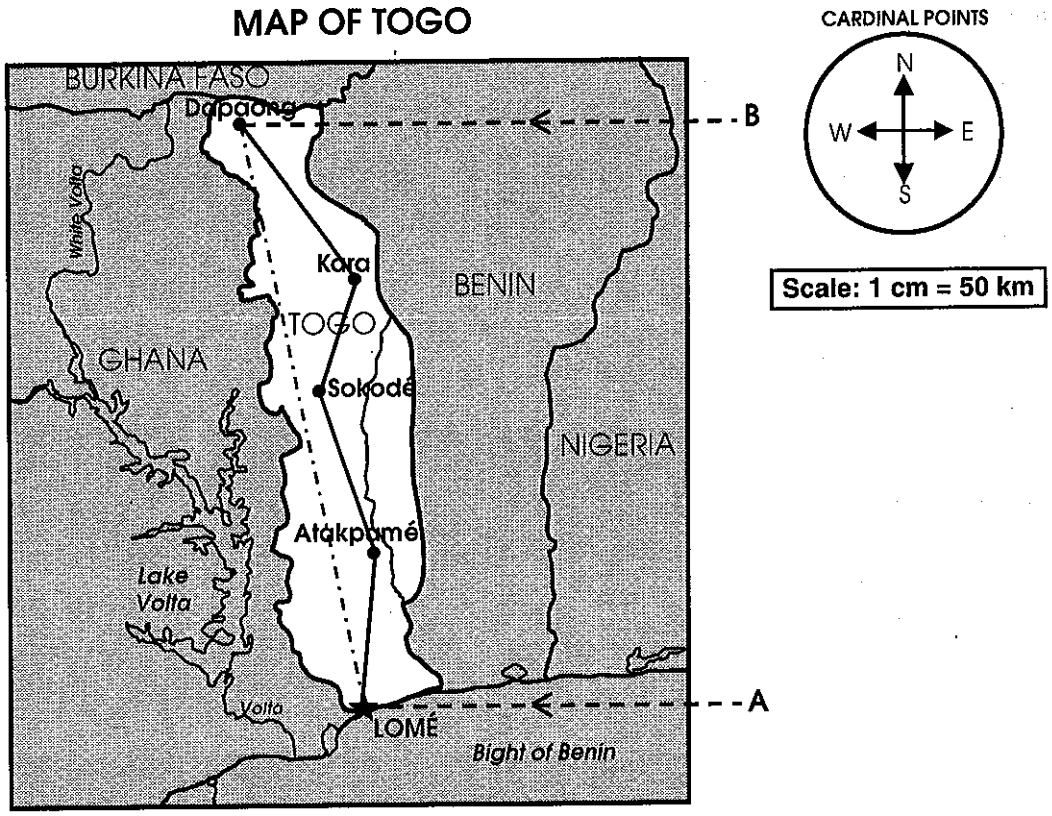


Marking Scale

4 marks	Appropriate procedure and correct answer.
3 marks	Appropriate procedure but incorrect answer because of a minor mistake such as direction of rays missing or incorrectly labelled.
2 marks	Appropriate procedure with a major error.
1 mark	Partially appropriate and correct procedure (e.g. one students correctly identified).
0 marks	Inappropriate procedure or did not show the procedure, the final answer is either missing, incorrect, or was derived by chance.

Question 4

Example of an appropriate procedure



Answer:

405-425 ⇒ outside (3)

a) The total distance travelled by the bus is: 415 km ±10 km.

b) The displacement from Lomé to Dapaong is: 400 km ±10 km [N11°W] or [W79°N] ± 5°.

Note: *Significant figures do not apply.*

Note: *Allow for slight variations in the answer, due to the size of the dots.*

Marking Scale

4 marks	Appropriate procedure and correct answer.
3 marks	Appropriate procedure but incorrect answer because of a minor mistake such as a calculation or transcription error.
2 marks	Appropriate procedure but incorrect answer because of a major mistake (e.g. did not record the direction of the displacement).
1 mark	Partially appropriate and correct procedure
0 marks	Inappropriate procedure or did not show the procedure, the final answer is either missing, incorrect, or was derived by chance.

Question 5

Example of an appropriate procedure

1. Calculate the work done for one complete push.

   Find the area under the curve of the Force versus Distance graph.

$$(0.3\text{ m} \times 200\text{ N}) + (0.3\text{ m} \times \frac{50\text{ N}}{2}) + (0.3\text{ m} \times 200\text{ N}) + (0.15\text{ m} \times \frac{200\text{ N}}{2}) =$$

$$60\text{ Nm} + 7.5\text{ Nm} + 60\text{ Nm} + 15\text{ Nm} = 142.5\text{ Nm}$$

   Work = **142.5 Nm or J**

2. Calculate the work done for 15 complete pushes.

   142.5 J × 15 = **2137.5 J**

3. Calculate the power.

$$\text{Power} = \frac{\text{Work (J)}}{\text{Time (s)}}$$

$$\text{Power} = \frac{2137.5\text{ J}}{30\text{ s}}$$

Power = 71 J/s or W

Answer: The power needed to raise the mini bus is **71 W.**

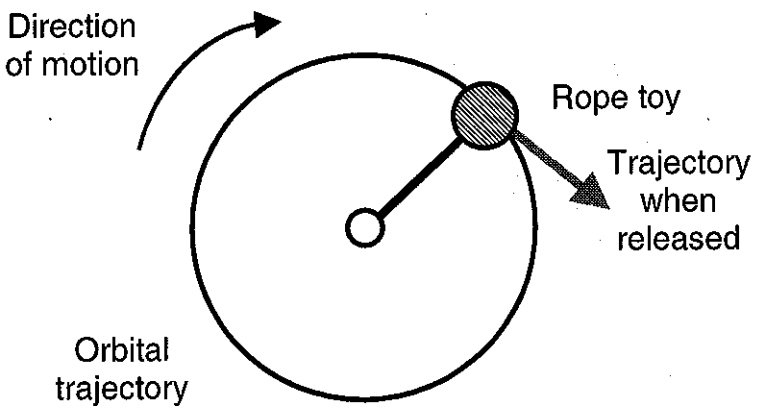
Marking Scale

4 marks	Appropriate procedure and correct answer.
3 marks	Appropriate procedure but incorrect answer because of a minor mistake such as a calculation error, transcription error, or an incorrect or missing unit of measurement, an error in significant figures, an inappropriate rounding off.
2 marks	Appropriate procedure with a major error (e.g. calculated for one push of the lever).
1 mark	Partially appropriate and correct procedure.
0 marks	Inappropriate procedure or did not show the procedure, the final answer is either missing, incorrect, or was derived by chance.

Question 6

Example of an appropriate procedure

a) The rope toy will have a straight trajectory tangent to the orbit at that position.
OR
The rope toy will have a trajectory that is perpendicular to the rope.



b) The centripetal force will be 4 times greater. Given that the centripetal force is represented by $F = \frac{mv^2}{r}$, if the speed is doubled the centripetal force will be represented by (2^2=4) therefore 4 times greater.

Marking Scale

4 marks	Appropriate procedure and correct answer.
3 marks	Appropriate procedure but incorrect answer because of a minor mistake in the word description of the motion (drawing is correct).
2 marks	Appropriate procedure but incorrect answer because of a major mistake. The student only correctly answered A or B.
1 mark	Partially appropriate and correct procedure. The student only drew the trajectory correctly, everything else is incorrect or missing.
0 marks	Inappropriate procedure or did not show the procedure, regardless of the final answer. The student does not provide explanations for A and B.

Question 7

Example of an appropriate procedure

$$n_{air} = 1.00$$
$$n_{water} = 1.33$$
$$\theta_{air} = 43.0°$$
$$\theta_{substance} = 25.0°$$

1. Determine the angle of refraction of water

$$n_{air} \sin\theta_{air} = n_{water} \sin\theta_{water}$$
$$\theta_{water} = \sin^{-1}\left(\frac{n_{air} \sin\theta_{air}}{n_{water}}\right)$$
$$= \sin^{-1}\left(\frac{(1.00)(\sin 43.0)}{1.33}\right)$$
$$= 30.8492...$$
$$\theta_{water} = 30.85°$$

2. Determine the index of refraction of substance

$$n_{water} \sin\theta_{water} = n_{substance} \sin\theta_{substance}$$
$$n_{substance} = \frac{n_{water} \sin\theta_{water}}{\sin\theta_{substance}}$$
$$n_{substance} = \frac{(1.33)(\sin 30.85)}{\sin 25.0}$$
$$= 1.61378$$
$$n_{substance} = 1.61$$

Answer: The unknown transparent solid is: **flint glass**.

Marking Scale

4 marks	Appropriate procedure and correct answer.
3 marks	Appropriate procedure but incorrect answer because of a minor mistake such as a calculation error, transcription error.
2 marks	Appropriate procedure with a major error (e.g. incorrect uses of equation).
1 mark	Partially appropriate and correct procedure (e.g. student calculated only the angle of refraction in the water).
0 marks	Inappropriate procedure or did not show the procedure, the final answer is either missing, incorrect, or was derived by chance.

Question 8

Example of an appropriate procedure

1. Applying the magnification equation and isolating d_i

$$M = \frac{h_i}{h_o} = \frac{-d_i}{d_o}$$

$$5 = \frac{-d_i}{d_o}$$

$$d_i = -5\, d_o$$

2. Substituting d_i in the lens equation

$$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$$

$$\frac{1}{d_o} + \frac{1}{-5d_o} = \frac{1}{4.0\text{ cm}}$$

$$\frac{-5}{-5d_o} + \frac{1}{-5d_o} = \frac{1}{4.0\text{ cm}}$$

$$\frac{-4}{-5d_o} = \frac{1}{4.0\text{ cm}}$$

$$d_o = 3.2\text{ cm}$$

Answer: A distance of **3.2 cm** separates the algae sample from the lens of the magnifying glass.

Marking Scale

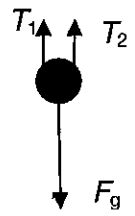
4 marks:	Appropriate procedure and correct answer.
3 marks:	Appropriate procedure but incorrect answer because of a minor mistake such as a calculation error, transcription error, or an incorrect or missing unit of measurement.
2 marks:	Appropriate procedure with a major error (e.g. not applying the magnification equation to isolate Di).
1 mark:	Partially appropriate and correct procedure.
0 marks	Inappropriate procedure or did not show the procedure, the final answer is either missing, incorrect, or was derived by chance.

Question 9

Example of an appropriate procedure

$m = 2.9$ kg
$g = 9.8$ m/s^2

Answer: **Part A** Free Body Diagram



Part B Solve for tension in each rope

$$T_1 = T_2 = T$$
$$F_{net} = F_1 + F_2 + F_3 + \ldots$$
$$F_{net} = T_1 + T_2 - F_g$$
$$0 = T + T - mg$$
$$2T = mg$$
$$T = \frac{mg}{2}$$
$$T = \frac{2.9\text{ kg}\left(9.8\text{ m/s}^2\right)}{2}$$
$$= 14.21$$
$$T = 14\text{ N}$$

Answer: **Part B** The tension in each rope is **14 N**.

Part A Free Body Diagram

Marking Scale	
1 mark	Appropriate procedure and correct answer.
0 marks	Inappropriate procedure or did not show the procedure, the final answer is either missing, incorrect, or was derived by chance.

Part B Rope tension

Marking Scale	
3 marks	Appropriate procedure and correct answer.
2 marks	Appropriate procedure but incorrect answer because of a minor mistake such as a calculation error, transcription error, or an incorrect or missing unit of measurement.
1 mark	Partially appropriate and correct procedure (e.g. calculated weight of sign).
0 marks	Inappropriate procedure or did not show the procedure, the final answer is either missing, incorrect, or was derived by chance.

Question 10

Example of an appropriate procedure

1. Potential energy at top of hill
   $E_p = mgh$
   $= 15\,\text{kg}\,(9.8\,\text{N/kg})\,(2.5\,\text{m})$
   $= 367.5\,\text{J}$

2. Work done by friction (Energy lost on path)
   $W = F\Delta d$
   $= 11.0\,\text{N}\,(8.0\,\text{m})$
   $= 88\,\text{J}$

3. Energy required at bottom
   $= 367.5\,\text{J} + 88\,\text{J}$
   $= 455.5\,\text{J}$

4. Force applied on cart
   $W = F_a \Delta d$
   $455.5\,\text{J} = F_a\,(5\,\text{m})$
   $F_a = 91.1\,\text{N}$

92 with SeF 0

Answer: The minimum force required in the starting area, to get the cart to the top of the hill is: **91 N** of force on the cart.

Marking Scale

4 marks	Appropriate procedure and correct answer.
3 marks	Appropriate procedure but incorrect answer because of a minor mistake such as a calculation error, transcription error, or an incorrect or missing unit of measurement.
2 marks	Appropriate and correct procedure with a major error (such as forgetting to account for friction on the slope).
1 mark	Partially appropriate procedure (such as calculating only potential energy).
0 marks	Inappropriate procedure or did not show the procedure, the final answer is either missing, incorrect, or was derived by chance.

Question 11

Example of an appropriate procedure

$\ell = \Delta d = 1.5\ \mathbf{m}$

$\theta = 35°$

$m = 275\ \mathbf{g}$

$\Delta t = 1.25\ \mathbf{s}$

$a = ?$

1. Find acceleration of the toy car

$$v_1 = 0$$

$$\Delta d = v_1 \Delta t + \frac{1}{2} a \Delta t^2$$

$$a = \frac{2\Delta d}{\Delta t^2}$$

$$= \frac{2(1.5\ \text{m})}{1.25^2\ \text{s}}$$

$$= 1.92\ \text{m/s}^2$$

$$a = 1.9\ \text{m/s}^2$$

2. Find force of friction

$$F_{net} = F_{along} - F_f$$

$$ma = mg\sin\theta - F_f$$

$$F_f = mg\sin\theta - ma$$

$$= (0.275)(9.8)\sin 35° - (0.275)(1.92)$$

$$= 1.01777...$$

$$F_f = 1.0\ \text{N}$$

Answer: The force of friction between the toy car and the ramp is: **1.0 N**.

Marking Scale

4 marks	Appropriate procedure and correct answer.
3 marks	Appropriate procedure but incorrect answer because of a minor mistake such as a calculation error, transcription error, or an incorrect or missing unit of measurement.
2 marks	Appropriate and correct procedure with a major error (such as miscalculating the force of friction).
1 mark	Partially appropriate procedure (such as calculating only acceleration).
0 marks	Inappropriate procedure or did not show the procedure, the final answer is either missing, incorrect, or was derived by chance.

Question 12

Example of an appropriate procedure

1. Time projectile is in air

$$\Delta d = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$-1.5\text{ m} = 0 + \frac{1}{2}\left(-9.8\text{ m/s}^2\right)\Delta t^2$$

$$\Delta t = 0.553\text{ s}$$

2. Horizontal range of disk

$$\Delta d_h = v_h \Delta t$$
$$= 8.0\text{ m/s}\ \ (0.553\text{ s})$$
$$= 4.4\text{ m}$$

Answer: You will score **7 points**, because your disk landed 4.4 m from the base of the platform.

Marking Scale

4 marks	Appropriate procedure and correct answer.
3 marks	Appropriate procedure but incorrect answer because of a minor mistake such as a calculation error, transcription error, or an incorrect or missing unit of measurement.
2 marks	Appropriate procedure with a major error (e.g. did not calculate score points).
1 mark	Partially appropriate procedure.
0 marks	Inappropriate procedure or did not show the procedure, the final answer is either missing, incorrect, or was derived by chance.

Question 13

Example of an appropriate procedure

1. Deceleration of the bus is equal to the slope of the graph.

$$a = \frac{v_2 - v_1}{t_2 - t_1}$$
$$= \frac{0 - 25}{5 - 0}$$
$$= -5\ \text{m/s}^2$$

2. Time to stop the bus

$$v_2 = v_1 + a\Delta t$$
$$0 = 25 - 5(\Delta t)$$
$$\Delta t = 5\ \text{s}$$

3. Distance travelled by bus in the 5 s

$$\Delta d = v_1 \Delta t + \frac{1}{2} a \Delta t^2$$
$$= 25\ \text{m/s}\ (5\ \text{s}) + \frac{1}{2}(-5\ \text{m/s})(5\ \text{s})^2$$
$$= 62.5\ \text{s}$$

[Or find area under the line: $A = \frac{bh}{2}$, $A = \frac{(5)(25)}{2} = 62.5\ \text{m}$]

4. Distance travelled before bus must decelerate

$$\Delta d = 90\ \text{m} - 62.5\ \text{m}$$
$$= 27.5\ \text{m}$$

5. Time before driver must begin deceleration while travelling at 25 m/s

$$v = \frac{\Delta d}{\Delta t}$$
$$\Delta t = \frac{27.5\ \text{m}}{25\ \text{m/s}}$$
$$= 1.1\ \text{s}$$

Answer: The maximum amount of time the driver can delay before applying the brakes to avoid hitting the fallen boulder is **1.1 s.**

Marking Scale

4 marks	Appropriate procedure and correct answer.
3 marks	Appropriate procedure but incorrect answer because of a minor mistake such as a calculation error, transcription error, or an incorrect or missing unit of measurement.
2 marks	Appropriate procedure with a major error (e.g. calculating the distance travelled during the stopping time only).
1 mark	Partially appropriate and correct procedure (e.g. student calculated only the bus's deceleration).
0 marks	Inappropriate procedure or did not show the procedure, the final answer is either missing, incorrect, or was derived by chance.