CARIBBEAN EXAMINATIONS COUNCIL

CAPE® PHYSICS UNIT 1

Subject Report with Exemplars

May/June 2023

CARIBBEAN EXAMINATIONS COUNCIL

REPORT ON CANDIDATES' WORK IN THE

CARIBBEAN ADVANCED PROFICIENCY EXAMINATION®

MAY/JUNE 2023

PHYSICS
UNIT 1

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INTRODUCTION

This guide has been compiled using candidates' responses from the 2023 May/June CAPE Physics examination. In May/June 2023, there were 2755 entries for Unit 1, compared with 2920 in 2022. Approximately 97.8 per cent of candidates achieved Grades I–V, compared with 96.5 per cent in 2022.

The examination comprised the following papers.
- Paper 01 — Multiple Choice
- Paper 02— Structured Essay Questions
- Paper 031 — School-Based Assessment (SBA)
- Paper 032 — Alternative to School- Based Assessment (Private Candidates)

Performance improved in Module 1 (Mechanics) and Module 3 (Thermal and Mechanical Properties of Matter) but declined in Module 2 (Oscillations and Waves) when compared with 2022.

PAPER 01 — MULTIPLE CHOICE

This paper comprises 45 multiple choice items, 15 items based on each module of the syllabus. The mean mark was 60.94 out of 90 (67.71 per cent) and the standard deviation 13.65. The highest mark obtained was 86 out of 90.

PAPER 02 — STRUCTURED ESSAY QUESTIONS

This paper comprises three compulsory questions (one on each module). The maximum score obtained by any candidate was 81.60 out of 90 marks and the mean score was 33.92. Overall, the performance of candidates was poor.

This paper contributes 40 per cent to candidates' overall examination grade.

_____

Question 1
_____

This question tested the candidates' ability to

- differentiate between precision and accuracy
- analyse a table of results and comment on the accuracy and the precision of the data, stating reasons
- write an expression for the fractional error in the physical quantity expressed a formula
- state the conditions that must be satisfied for a body to be moving in uniform circular motion
- show that the relationship between T, r, m and M is given by $T = 2\pi\sqrt{\left(\frac{mr}{Mg}\right)}$ for a described experiment
- complete the last two columns in the table of results of the experiment
- plot a graph and draw the line best fit through the points
- write an equation in the form y = mx + c showing the gradient to be given by $\frac{4\pi^2 mr}{g}$
- use the gradient calculated from a graph to determine an experimental value for the gradient
- use the experimental value for the gradient to determine the experimental value for "g"
- state Newton's law of Universal Gravitation
- explain, with a sketch, why the formula $E_p = mgh$, g = 9,81 ms^{-2} cannot be used to calculate the potential energy of an orbiting Earth satellite.

Approximately 40 per cent of candidates gained at least 15 of the 30 available marks. The performance of candidates was strongest in Parts (a) and (b). Approximately 75 per cent of them achieved full marks. In contrast, candidates' performance was the weakest on Part (g). More than 70 per cent of candidates scored zero.

Candidate's Response to Part (a)

1. (a) Differentiate between 'precision' and 'accuracy'.

'Precision' refers to the closeness of a set of data values to each other whereas 'accuracy' refers to the closeness of the data values to the true value.

Examiner's Comments

Part (a) was generally well done. However, some candidates could not differentiation between precision and accuracy; therefore, they gave incorrect answers.

Candidate's Response to Part (b) (i)

(i) Comment on the accuracy of the results in Table 1. Justify your response.

The results are relatively accurate, since in all trials none of the values obtained are close to the true value of 3.25 g/mL

Examiner's Comments

Part (b) (i) was generally well done. However, in some cases, candidates provided responses that were too vague. Candidates who provided such responses did not receive full marks. Candidates were expected to provide more definitive responses and to comment on accuracy in terms of deviation and true value.

Candidate's Response to Part (b) (ii)

(ii) Comment on the precision of the results in Table 1. Justify your response.

The values are very precise since the values obtained for each trial are very close to one another.

Candidate's Response to Part (c)

(c)   The following formula is used to calculate the centripetal force for an object undergoing circular motion

$$F = \frac{mv^2}{r}$$

Write an expression to determine the fractional error in F, given the fractional error in m, v and r.

$$\frac{\delta F}{F} = \frac{\delta m}{m} + 2\left(\frac{\delta v}{v}\right) + \frac{\delta r}{r}$$ ✔

Candidate's Response to Part (d) (i)

(i) State the TWO conditions that must be satisfied if a body is moving with uniform circular motion.

The body must be traveling with a constant
directed at a tangent to the circular path
speed ~~velocity~~, and the body must experience an
~~constant~~ unbalanced force and therefore an
acceleration directed perpendicular to their
velocity (toward the centre of the circle) **[2 marks]**
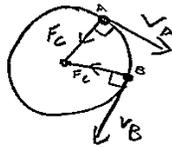
Candidate's Response to Part (d) (ii)

(ii): Show that the relationship between the period, T, the radius, r, and the masses, m and M, is given by the equation $T = 2\pi\sqrt{\dfrac{mr}{Mg}}$.

The centripetal force for the circular motion is provided by the weight of the mass, M.

$$\therefore F_c = W$$

$$m\omega^2 r = Mg \quad \checkmark$$

$$\omega^2 = \frac{Mg}{mr}$$

$$\left(\frac{2\pi}{T}\right)^2 = \frac{Mg}{mr} \quad \checkmark$$

$$\frac{4\pi^2}{T^2} = \frac{Mg}{mr} \quad \checkmark$$

$$T^2 = \frac{4\pi^2 mr}{Mg} \quad \checkmark$$

$$T = 2\pi\sqrt{\frac{mr}{Mg}} \qquad QED.$$

Examiner's Comments

This response was well developed and it included a clear and accurate sequential derivation. While 30 per cent of candidates earned full marks, more than 55 per cent earned none. Many candidates began with the final equation and worked backward, instead of starting with the two fundamental centripetal equations.

Candidate's Response to Part (e) (i)

(e)   The experimental procedure was repeated using the same apparatus in Figure 1 on page 8 and the period T was determined for four different values of M, at a fixed value of $m = 0.013$ kg and $r = 0.80$ m. The results obtained were recorded in Table 2.

TABLE 2: RESULTS OF EXPERIMENT

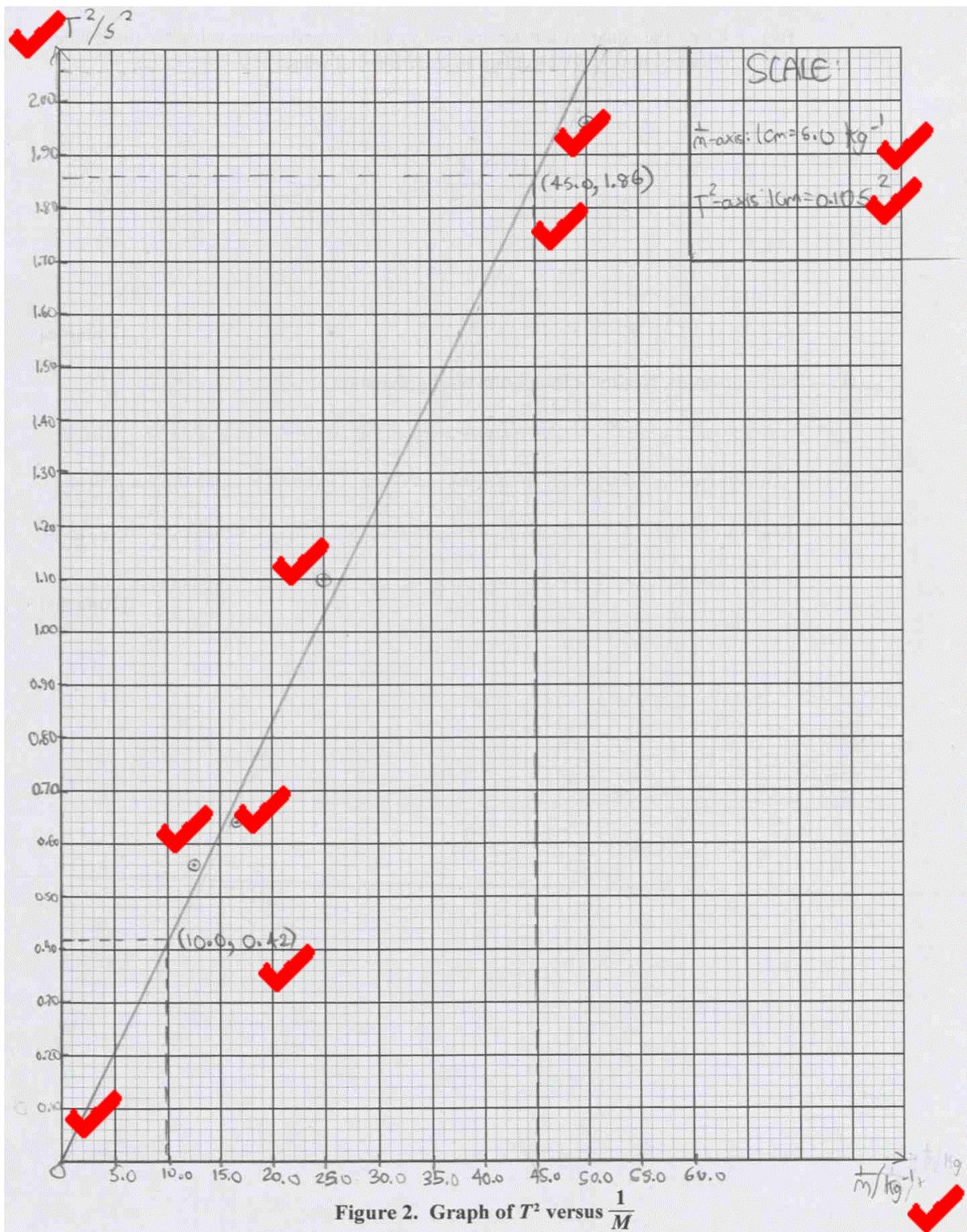| Mass, M/kg	Period, T/s	$\frac{1}{M}$/kg^{-1}	T^2/s^2
0.020	1.40	50.0	1.96
0.040	1.05	25.0	1.10
0.060	0.80	16.7 ✔	0.64 ✔
0.080	0.75	12.5	0.56

(i)   Complete Column 3 and Column 4 of Table 2.   [2 marks]

Examiner's Comments

Most candidates were confused about when to prioritize significant figures versus decimal places. In general, the number of decimal places takes precedence when recording raw or measured data and is determined by the precision of the measuring instrument. When the data is manipulated by calculation, the result should be recorded using the number of significant figures in the raw data as a guide. Typically, one additional significant figure beyond that in the raw data is acceptable.

Candidate's Response to Part (e) (ii)

Figure 2. Graph of T^2 versus $\frac{1}{M}$

Candidate's Response to Part (e) (iii)

(iii) Write the equation $T = 2\pi \sqrt{\dfrac{mr}{Mg}}$ in the form $y = mx + c$, to show that the gradient is given by $\dfrac{4\pi^2 mr}{g}$. From your graph in (e) (ii), determine an experimental value for the gradient.

$$T = 2\pi \sqrt{\frac{mr}{Mg}}$$

$$T^2 = \frac{4\pi^2 mr}{Mg}$$

$$T^2 = \frac{4\pi^2 mr}{g} \cdot \frac{1}{M} \quad \Rightarrow \text{ In the form } y = mx + c$$
$$\text{whence } m = \frac{4\pi^2 mr}{g}$$

$$y = T^2$$
$$x = \frac{1}{M}$$

$$\therefore \; m = \text{gradient} = \frac{4\pi^2 mr}{g}$$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1.7 - 0.4}{42 - 10}$$

$$= 0.041 \; s^2 \, kg$$

[4 marks]

Candidate's Response to Part (e) (iv)

(iv) Using the equation for the gradient and the experimental value for the gradient obtained in (e) (iii), calculate an experimental value for *g*.

$$\text{gradient} = \frac{4\pi^2 \, mr}{g}$$

$$0.041 = \frac{4\pi^2 \, mr}{g}$$

$$g = \frac{4\pi^2 \, mr}{0.041}$$

$$= \frac{4\pi^2 (0.013)(0.3)}{0.041}$$

$$\frac{kg \cdot m}{s^2 \, kg}$$

$$= 10.01 \, ms^{-1}$$

[2 marks]

Examiner's Comments

This was a well-executed response. Many candidates calculated the gradient of the graph but appeared unsure of the next step.

Candidate's Response to Part (f)

(f) State, in words, Newton's law of universal gravitation.

Newton's Law of Universal gravitation States that
there exists a force of attraction between any 2
bodies existing in space which is directly proportional
to the product of their masses and inversely
proportional to the square of their mean   [2 marks]
separation

$$F \propto \frac{Mm}{r^2}$$

$$F = \frac{-GMm}{r^2} \quad, \text{ where } F = \text{gravitational force}$$

$$G = \text{Universal gravitation constant}$$

$$M = \text{mass of one body}$$
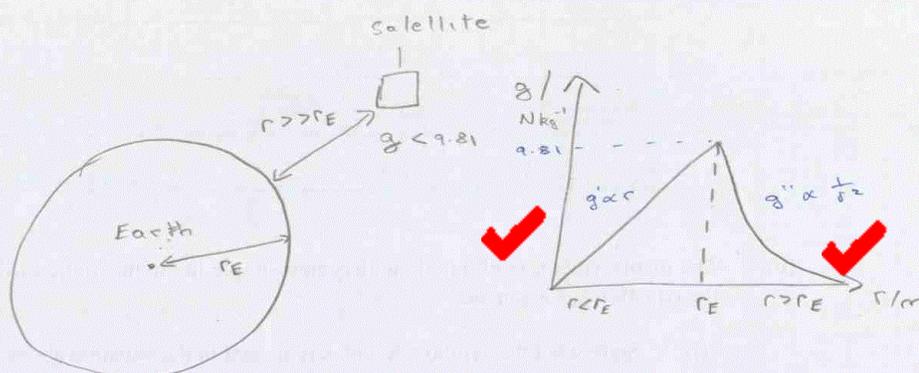
$$m = \text{mass of second body}$$

$$r = \text{distance between the}$$

Examiner's Comments

Approximately 50 percent of candidates stated Newton's law of universal gravitation correctly.

Candidate's Response to Part (g)

(g) With the aid of a sketch, explain why the equation $E_p = mgh$, in which $g = 9.81$ m s^{-2}, cannot be used to calculate the potential energy of an orbiting Earth satellite.

satellite

$r \gg r_E$

$g < 9.81$

Earth

r_E

g /
$N kg^{-1}$

9.81

$g \propto r$

$g'' \propto \frac{1}{g^2}$

$r < r_E$ r_E $r > r_E$ r/m

The value of g is only a ~~cont~~ constant of 9.81 ms^{-2} for bodies near to Earth's surface.

The gravitational ~~field~~ field strength is inversely proportional to the square of the distance of the body from the surface of ~~Earth~~. $g \propto \frac{1}{r^2}$

Earth

Therefore, since the satellite exists at an

[3 marks]

Total 30 marks

extremely ~~high~~ large distance above the Earth's surface, the value for g would no longer be a constant of ~~9.81~~ but would instead exponentially decrease, therefore the equation $E_p = mgh$ is no longer valid but instead, the equation $U = -\frac{GMm}{r}$, should be used where U is the gravitational potential energy.

Examiner's Comments

The candidate was one of the few who produced the graph. While less than two per cent of candidates earned full marks, 98 per cent of them did not produce a graph. Additionally, less than 30 per cent of candidates provided an adequate explanation.

Recommendations

- Teachers should consistently emphasize that physical quantities form the foundation of physics and always include both a numerical value and a unit. Students should be encouraged to provide correct units with every value.
- Teachers should reinforce the rules governing correct graphing, placing emphasis on proper scaling, axis labelling and drawing a best fit line.
- Extra time may be required to clarify the correct use of decimal places and significant figures in tabular data.
- Students need regular practice in deriving equations and rewriting them in the linear form $y = mx + c$.
- Teachers may need to emphasize that g represents both acceleration due to gravity and gravitational field strength. They should also stress that weightlessness on an orbiting satellite does not mean gravity is absent or that no gravitational force exists in space.

Question 2

This question tested the candidate's knowledge of simple harmonic motion and of the functioning of a diffraction grating. Overall performance was fair. A few candidates did not attempt the question and those who did earned most of their marks from the graphical component.

Candidate's Response to Part (a)

(a) State the TWO conditions that must be satisfied for the oscillatory motion of an object to be considered simple harmonic.

① The acceleration of the object is proportional to its distance away from a fixed point known as the equilibrium or rest position. $(a = -\omega^2 x)$

② The acceleration of the object is always directed towards the fixed point (equilibrium position). $(a \propto -x)$

[2 marks]

> **Examiner's Comments**
>
> The candidate correctly identified two conditions for simple harmonic motion (SHM). This section required basic recall, and most candidates earned at least one mark. However, given that these conditions represent fundamental knowledge, it is concerning that not all candidates secured both marks.

Candidate's Response to Part (b) (i)

(b) The displacement, y, of a body undergoing simple harmonic motion (SHM) is given by the equation $y = A \sin \omega t$.

(i) State what the symbols A and ω represent in the equation above.

A represents the amplitude (or maximum displacement), measured in metres (m).

ω represents the angular velocity of the body, given in radians per second (rad s^{-1}).

[2 marks]

> **Examiner's Comments**
>
> The candidate correctly identified A as amplitude and ω as angular frequency or angular velocity. Most candidates demonstrated similar understanding of the symbols and earned two marks for this section.

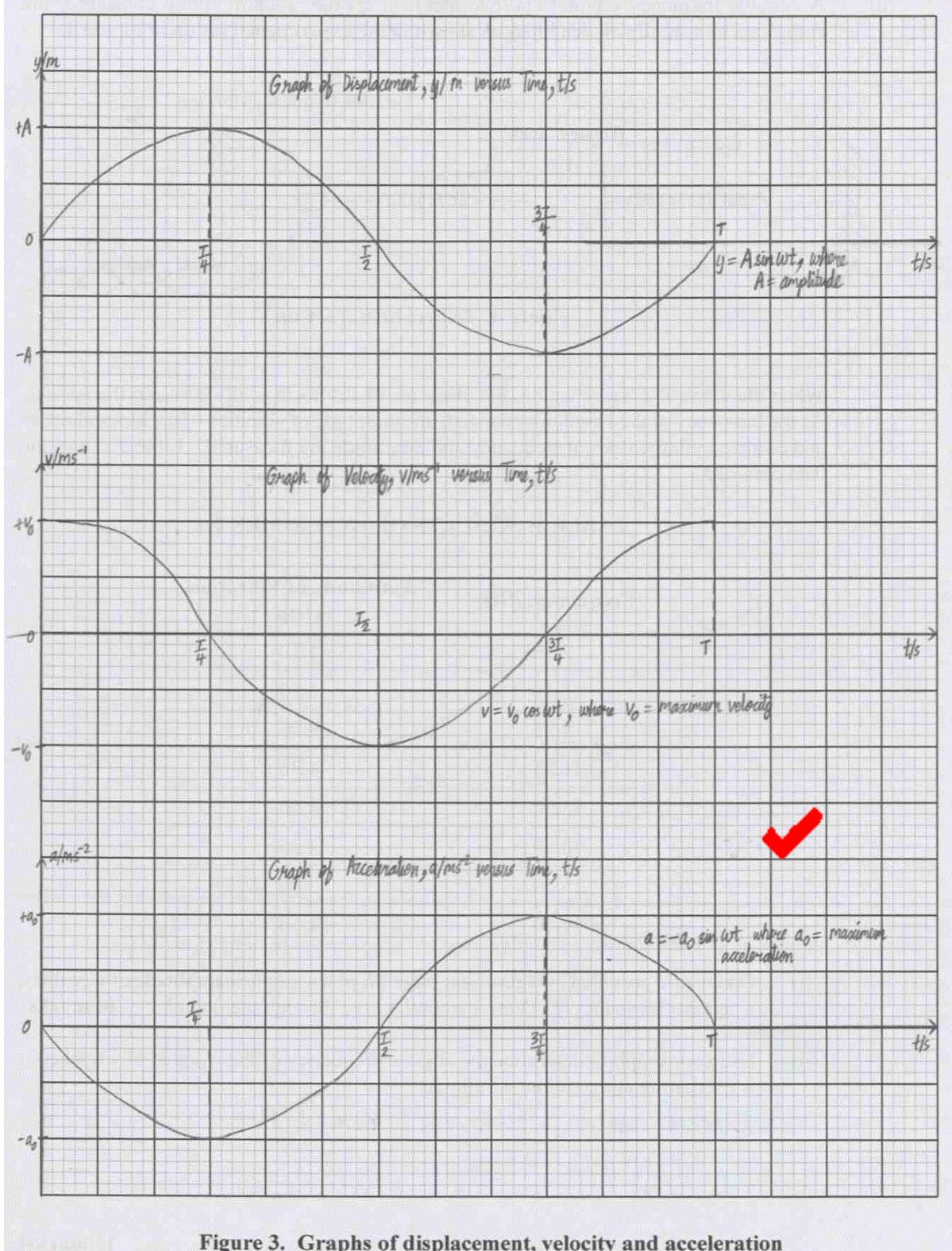**Candidate's Response to Part (b) (ii)**

Figure 3. Graphs of displacement, velocity and acceleration

Candidate's Response to Part (c) (i)

(c)   A light helical spring of spring constant 30 N m^{-1} hangs vertically from a fixed support and carries a mass, $m = 0.3 \text{ kg}$, at its lower end.

    (i)   Assuming that Hooke's law is obeyed, calculate the extension produced in the spring.

Given that the system is in equilibrium,

$T = W$

$ke = mg$

$e = \dfrac{mg}{k} = \dfrac{(0.3)(9.81)}{30} = 0.0981 \text{ m}$

[2 marks]

Candidate's Response to Part (c) (ii)

(ii)·   Calculate the maximum kinetic energy of the mass if it is displaced a further 0.045 m.

$A = 0.045 + 0.0981 = 0.1431 \text{ m}$

Maximum E_k occurs at maximum velocity, V_0

$T = 2\pi\sqrt{\dfrac{m}{k}} = 2\pi\sqrt{\dfrac{0.3}{30}} = 0.628 \text{ s}$

$\omega = \dfrac{2\pi}{T} = \dfrac{2\pi}{0.628} = 10 \text{ rad s}^{-1}$

$V_0 = A\omega = (0.1431)(10) = 1.431 \text{ ms}^{-1}$

$\therefore$ Maximum kinetic energy, E_{k0}

$= \tfrac{1}{2}mV_0^2$

$= \tfrac{1}{2}(0.3)(1.431)^2$

$= 0.307$

[3 marks]

Examiner's Comments

The candidate correctly added the initial extension to the new extension and applied the appropriate equation to calculate the maximum kinetic energy of the wave. However, only a few candidates recognized the need to include the additional 0.045 m before performing the calculation, although most knew the correct equation.

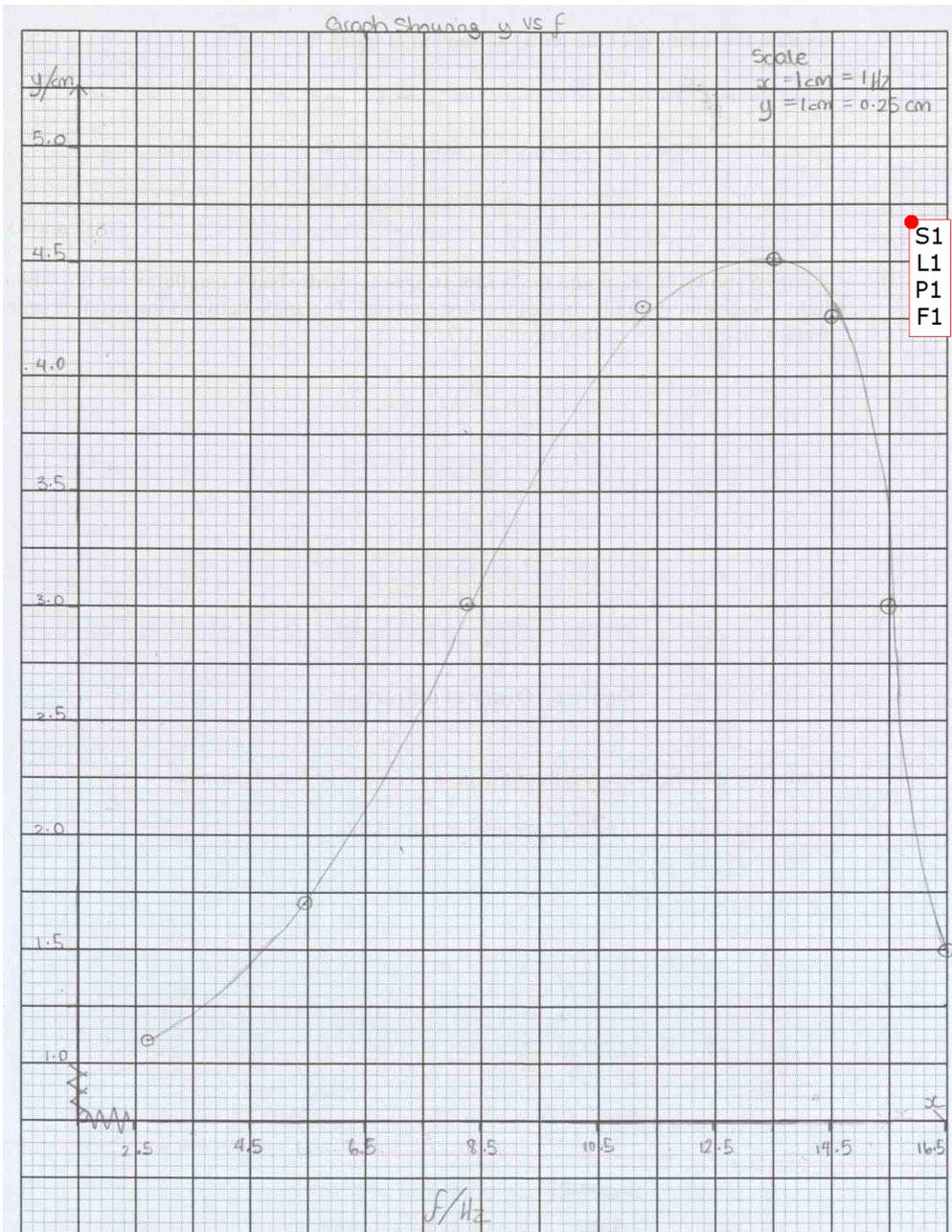**Candidate's Response to Part (d) (i)**

Figure 5. Graph of amplitude of vibration, y, against frequency, f

Candidate's Response to Part (d) (ii)

(ii)   Use your graph to determine the angular frequency of the wooden block when it is oscillating at maximum amplitude.

At maximum amplitude $y = 4.50\ cm$, from the graph, $f = 12\ Hz$ ✓

$\omega = 2\pi f = 2\pi (13.50) = 848\ rad\ s^{-1}$ ✓

[3 marks]

Candidate's Response to Part (e)

(e)   Explain the meaning of the term 'diffraction of light'.

...Diffraction refers to the diverging ✓ or spreading ✓ of light as it...

...passes through a gap, or ~~across~~ a slit..................................

....

[2 marks]

Candidate's Response to Part (f) (i)

(i)   the number of rulings per mm on the grating

$$d\sin\theta = n\lambda$$

$$d = \frac{n\lambda}{\sin\theta}$$

$$= \frac{(1)(5.89 \times 10^{-7})}{\sin(27.7)}$$

$$d = \frac{(5.89 \times 10^{-7})}{0.239}$$

$$d = 2.46 \times 10^{-6} \, m$$

$$N = \frac{1}{2.46 \times 10^{-6}}$$

where N is no. of rulings.

$$N = \cancel{\hspace{1cm}} \text{rulings per m} \quad 406504 \text{ ruling per m}$$

$$\frac{N}{1000} = \cancel{\hspace{1cm}} \text{rulings per mm} \quad 407 \text{ rulings per mm}$$

[5 marks]

Examiner's Comments

The candidate correctly divided the angle in half to represent the angle between the zeroth and first orders, then substituted it into the appropriate equation to calculate d. He/she also calculated the number of lines per millimeter and recognized that the final answer should be rounded down to a whole number.

Only a few candidates completed this part successfully. While some candidates knew the equation, they failed to divide the angle in half. Others who managed that step did not know how to calculate the number of lines per millimeter. Consequently, very few candidates earned more than one or two marks.

Candidate's Response to Part (f) (ii)

(ii)   the highest order of fringes obtained on EACH side of the normal.

$$d\sin\theta = n\lambda$$

$$n = \frac{d\sin\theta}{\lambda}$$

assume $\theta = 90°$ max angle.

$\sin 90° \approx 1$

$$= \frac{(2.46 \times 10^{-6})(1)}{5.89 \times 10^{-7}}$$

$$n \leqslant 4.07$$

$$n = 4$$

Examiner's Comments

The candidate used the correct equation. He/she recognized that sin 90° corresponds to the largest observable order and applied this to calculate n, which must be rounded down to a whole number. However, while some candidates knew the equation, many of them did not realize that sin 90° determines the highest order of fringes. Consequently, most candidates earned no marks or omitted this part entirely.

Recommendations

- Teachers should incorporate more practice questions and hands-on activities.
- Students need regular practice in drawing graphs for simple harmonic motion (SHM).

Question 3

This question assessed the candidates' ability to

- outline differences between boiling and evaporation
- define the term *specific latent heat of fusion* of a given substance
- plot a graph of temperature (θ) versus time (t) and determine the melting point of a substance
- calculate the specific latent heat of fusion of a substance using its mass and heating rate
- calculate the temperature change of water in a Callender and Barnes continuous-flow calorimeter
- state advantages and disadvantage of using the continuous flow method to determine the specific heat capacity of a liquid
- show that the ratio of the temperature drops across the layers of a furnace wall constructed from two types of brick, is inversely proportional to the thermal conductivity of the layers, given that both layers are of the same thickness
- state applications of thermal insulation.

Overall, candidates' performance was fairly good. Approximately 60 per cent of candidates earned more than 15 marks. Candidates generally understood the objectives and subsections and so they gained full marks. This suggests adequate syllabus coverage and alignment between teaching and learning with syllabus objectives.

Candidate's Response to Part (a) (i)

(a)   (i)   Outline TWO differences between boiling and evaporation.

1. Boiling can only occur at ✓ temperature (the boiling point of the liquid) while evaporation can occur at any temperature. ✓

2. Evaporation only occurs on the ✓ surface of of a liquid while boiling takes place throughout. ✓

[4 marks]

Examiner's Comments

The candidate accurately differentiated between boiling and evaporation, supporting the response with characteristics of both processes.

Most candidates were able to identify at least two differences between boiling and evaporation; however some did not attempt this part.

Candidate's Response to Part (a) (ii)

(ii)   Explain what is meant by the 'specific latent heat of fusion' of a substance.

The specific latent heat of fusion of a substance is the heat energy required to change 1kg of a solid to 1kg of a liquid ✓ whilst remaining at constant temperature. ✓

[2 marks]

Examiner's Comments

The candidate accurately defined specific latent heat of fusion by including the correct phase change and the mass of the substance and by recognizing that this change occurs at a fixed temperature. However, some candidates omitted the conversions between solid and liquid states in their definition, earning only one of two marks.

Candidate's Response to Part (b) (i)

(b)   Table 4 shows the variation in temperature, θ, with time, t, for a substance, Y, as it is heated.

TABLE 4: VARIATION OF TEMPERATURE AND TIME

Time, t/min	Temperature, θ/°C
0.0	20
1.0	30
2.0	42
3.0	51
4.0	61
5.0	71
6.0	71
7.0	71
8.0	71
9.0	80

(i)   On the axes provided in Figure 7 **on page 21**, plot a graph of temperature, θ, versus time, t. Use the graph to determine the melting point of Y.   **[4 marks]**

Melting point of $Y = 71°C$
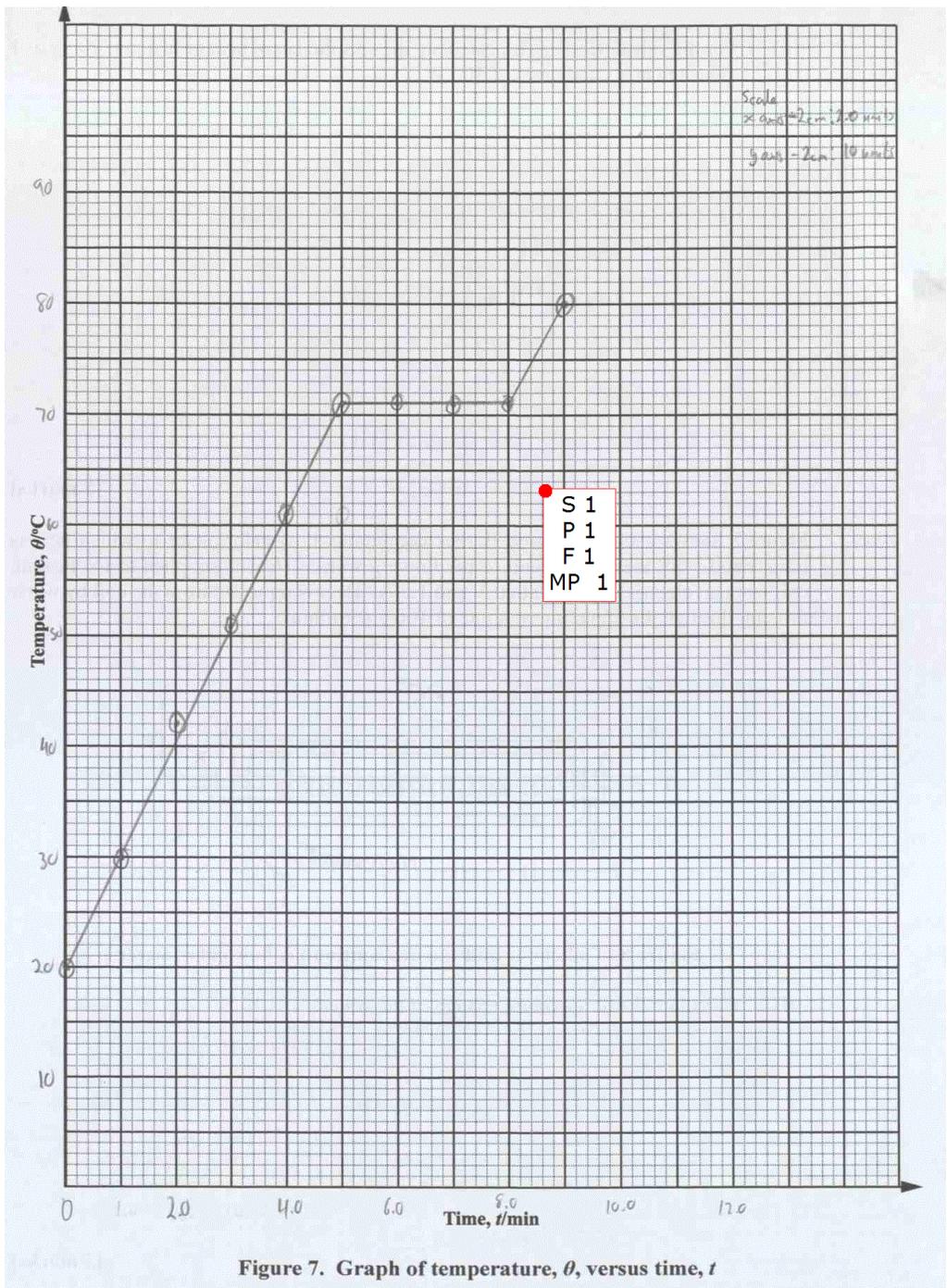
Figure 7. Graph of temperature, θ, versus time, t

Candidate's Response to Part (b) (ii)

(ii) For the substance Y in (b), calculate the specific latent heat of fusion if 200 g of Y is heated at a steady rate of 500 W.

$$E_H = m \, l$$

$$IVt = m l_f$$

$$Pt = m \, l_f$$

$$500 \times ((8-5) \times 60) = 0.2 \cdot l_f$$

$$\frac{500 \times 180}{0.2} = l_f$$

$$l_f = 450000 \ J\,kg^{-1}$$

$$l_f = 4.5 \times 10^5 \ J\,kg^{-1}$$

[5 marks]

Candidate's Response to Part (c) (i)

(i) Calculate the temperature change of the water.

$$E_H = mc\Delta\theta$$
$$Pt = mc\Delta\theta$$
$$P = \frac{m}{t} \cdot c \cdot \Delta\theta$$
$$\dot{IV} = \frac{m}{t} \cdot c \cdot \Delta\theta$$

1.5×20 $20 \times 1.5 = \frac{100 \times 10^{-3}}{60} \times 4200 \times \Delta\theta$

$\Delta\theta = \frac{20 \times 1.5 \times 60}{100 \times 10^{-3} \times 4200}$

The change in temp = 4.3k

unit can be Kelvin or Celsius

[3 marks]

GO ON TO THE NEXT PAGE

Candidate's Response to Part (c) (ii)

$$V \cdot 1.5 = \frac{0.1}{60} \times 4200 \times \Delta\theta$$

$$\Delta\theta = 9.5\,^\circ C$$

(ii) An unknown liquid is then passed through the same calorimeter at a flow rate of 120 g per minute. In order to obtain the same temperature change, the electrical supply was changed to 13 V and 1.2 A. Calculate the specific heat capacity of the unknown liquid.

$$I_1 V_1 = \frac{m \times c \times \Delta\theta}{t_1} + L$$

$$20 \times 1.5 = \frac{100 \times 10^{-3}}{1 \times 60} \times c_x + L$$

$$I_2 V_2 = \frac{m_2 \times c \times \Delta\theta}{t_2} + L$$

$$1.2 \times 13 = \frac{120 \times 10^{-3}}{1 \times 60} \times c_x + L$$

$$E_H = mc\Delta\theta$$

$$IVt = mc\Delta\theta \checkmark$$

$$IV = \frac{m}{t} \cdot c \cdot \Delta\theta \checkmark$$

$$1.2 \times 13 = \frac{120 \times 10^{-3}}{60} \times c_x \times 4.3 \checkmark$$

$$C = \frac{1.2 \times 13 \times 60}{120 \times 10^{-3} \times 4.3}$$

$$C = 1813 \text{ J/K/kg}$$

$$C = 1810 \text{ J/K/kg}$$

$$C = 1813 \text{ J kg}^{-1} \text{ K}^{-1}$$

$$C = 1810 \text{ J kg}^{-1} \text{ K}^{-1} \checkmark$$

[4 marks]

Examiner's Comments

The candidate demonstrated very good analytical skills in determining the heat capacity of the substance.

There were two categories of candidates: those who correctly applied the equation $IVt = mc\Delta\theta$ to calculate the temperature change and therefore earned full marks and those who were unable to determine an approach and therefore scored zero. The performance of candidates was evenly split between these two categories of candidates.

Candidate's Response to Part (c) (iii)

(iii) State TWO advantages and ONE disadvantage of using the continuous flow method to determine the specific heat capacity of a liquid.

Advantages

① The specific heat capacity of the apparatus does not need to be taken into account ✓

② Can quickly achieve steady state ✓

Disadvantage

① Requires a large quantity of the liquid ✓

Examiner's Comments

The candidate demonstrated that he/she knew the operation of the Callender and Barnes continuous-flow calorimeter by identifying both advantages and a disadvantage of the method. Overall, candidates' performance was poor. Many were unfamiliar with the advantages and disadvantages of the continuous-flow method.

Candidate's Response to Part (d) (i)

(i) Show that the ratio of the temperature drop across each of the layers is inversely proportional to the ratio of the thermal conductivities of the layers, given that both layers are of the same thickness. Let $\dfrac{d\theta_2}{d\theta_1} = \Delta T$ and $\dfrac{k_2}{k_1} = r$

When in steady state

$$\frac{Q}{t} = \frac{k_1 \times A \times d\theta_1}{x} \qquad \frac{Q}{t} = \frac{k_2 \times A \times d\theta_2}{x}$$
✓ ✓

$$\therefore \frac{k_1 \times A \times d\theta_1}{x} = \frac{k_2 \times A \times d\theta_2}{x} \quad \text{since } \frac{Q}{t} \text{ is the same}$$

$$k_1 \times d\theta_1 = k_2 \times d\theta_2 \checkmark$$

$$\frac{k_1}{k_2} = \frac{d\theta_2}{d\theta_1} \checkmark$$

which means $\dfrac{d\theta_2}{d\theta_1} \propto \dfrac{1}{(k_2/k_1)}$ **[4 marks]**

$$\Delta T \propto \frac{1}{r}$$

Examiner's Comments

The candidate accurately provided a mathematical proof relating the temperature drop across two different materials of similar dimensions (thickness and area). Most candidates did not provide a response possibly because they did not understand what the question required.

Candidate's Response to Part (d) (ii)

(ii) State ONE application of thermal insulation, other than the application described in (d).

It is used to keep the warmth in houses during cold periods. Such as winter ✔

[1 mark]

Examiner's Comments

The candidate performed both qualitative and quantitative analysis of the thermal properties of a material and was able to identify a suitable application of thermal insulation.

A large percentage of candidates were unable to provide an application other than the example given (a vacuum flask).

Recommendations

Teachers are encouraged to do the following.

- Review conversion of energy beyond mechanical energy conversion.
- Highlight that energy conversion extends beyond mechanical energy conversion and it can be applied to the concepts of thermal energy.
- Review the relationship between power and energy in contexts other than mechanical energy.
- Relate energy conversion to both thermal processes and power.
- Incorporate more practice questions and hands-on activities.
- Review and discuss the continuous-flow method.
- Expose students to the concept of proportionality beyond graphical representation.
- Emphasize the importance of checking units on graph axes rather than assuming a particular unit.
- Provide examples of applications of heat flow and other areas of physics throughout the syllabus.