Let the mind manage the body
Que l'esprit gère le corps

MAURITIUS
EXAMINATIONS
SYNDICATE

NCE 2021-2022

Science (Physics)

Subject code: N530

EXAMINERS' REPORT

July 2023

INTRODUCTION

The second edition of the National Certificate of Education (NCE) Assessment in Science was held in October 2022. Candidates from the Extended Programme took the assessment for the first time after completing four years of lower secondary schooling.

As in the previous year, the NCE Science Assessment comprised three components, namely:

- Biology
- Chemistry
- Physics

This report focuses on the performance of candidates in the Physics component of the Science Assessment. It highlights the difficulties which candidates encountered and suggests possible ways of improving future performance in the subject.

The Physics Assessment is mainly based on the learning outcomes of the *Science Teaching and learning Syllabus* set at Grade 9. It aims at gauging the extent to which candidates achieve the three main Assessment Objectives (AOs) listed in Table 1.

Table 1: Weighting of the Assessment Objectives

	Assessment Objective	**Weighting (%)**
AO1	Knowledge with understanding	45 – 50
AO2	Application	25 - 35
AO3	Scientific Inquiry	20 - 25

GENERAL COMMENTS

Candidates performed better in the Physics Assessment 2021-2022 than in the Physics Assessment 2020-2021. Candidates achieved a mean score of 28.65 out of 50 in 2022. In 2021, the mean score attained was 21.20.

An analysis of candidates' scripts indicates that closed, objective-type questions such as Multiple-choice Questions and Fill-in-the-blank Questions with words given were well-received by candidates in general. However, it is important to note that these questions are often limited to the assessment of basic knowledge of facts and concepts. While they allow candidates to score marks, these questions rarely indicate firm understanding of the subject matter.

The difficulty which candidates encountered in responding to questions that required them to demonstrate deeper understanding and reasoning highlighted candidates' limited confidence and inadequate mastery of the subject.

The use of calculators is allowed in this paper. This should not hinder candidates from showing all their workings. It is important to note that a good number of partial marks were lost as a result of a lack of evidence of how candidates obtained their answers.

SPECIFIC COMMENTS

Question 1

Question 1 comprised 10 Multiple-Choice Questions. Candidates fared well in this question. The mean mark attained was 7.99 out of 10.

It is encouraging to note that the performance in this question improved markedly from last year. In 2020-2021, candidates achieved a mean score of 5 out of 10 in Question 1.

It is important to note that candidates are expected to encircle the letter corresponding to the correct answer when responding to Multiple-Choice Questions. When students wish to revise their answers, Educators are encouraged to advise them to:

1. cross out the letter encircled.
2. replace their crossed-out answer by encircling a new letter.
3. indicate, using an arrow, the final letter chosen.

An example is shown below.

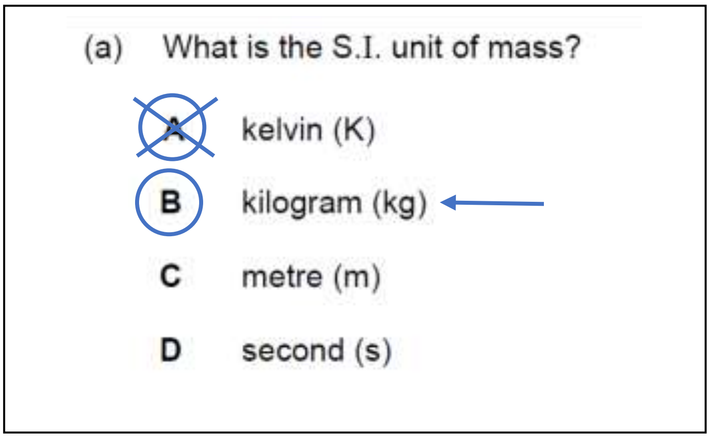


Table 2 lists the answers to the items in Question 1.

Table 2: Answer key to the items in Question 1

Item Number	Key	Item Number	Key
(a)	**B**	(f)	**C**
(b)	**A**	(g)	**D**
(c)	**A**	(h)	**B**
(d)	**C**	(i)	**D**
(e)	**A**	(j)	**B**

Items (c) and (d) were the most accessible questions in this series. About 9 out 10 candidates successfully answered these questions.

In contrast, items (f) and (j) were found to be the most difficult multiple-choice items. Fewer than 60 % of the candidates answered these questions correctly.

Items which were particularly accessible to candidates from the Extended Programme were items (a), (b), (c), (e) and (i). About 70 % of the candidates answered items (c) and (i) correctly.

Item (a)

(a) What is the S.I. unit of mass?

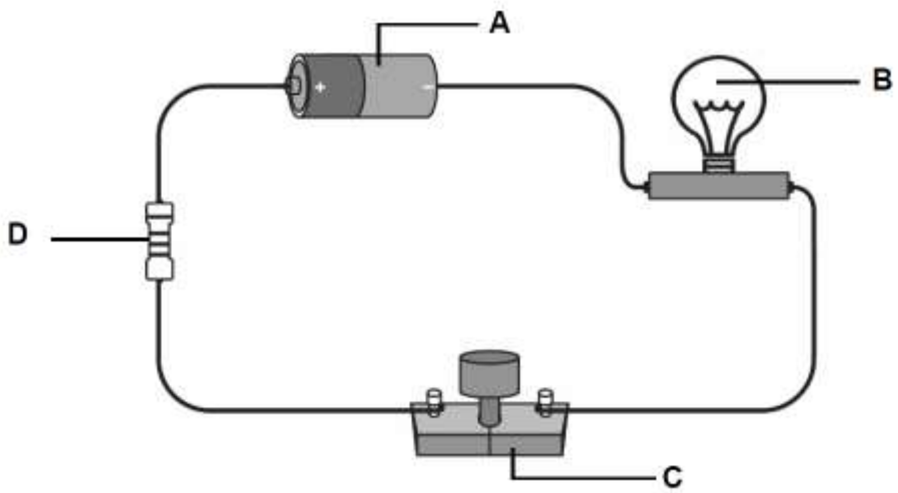
- **A** kelvin (K)
- **B** kilogram (kg)
- **C** metre (m)
- **D** second (s)

Performance in this question was very good. The majority of candidates recognised that the S.I. unit of mass is the kilogram. The small number of candidates who did not answer the question correctly gave ‘kelvin (K)’ as answer.

Item (b)

(b) Fig. 1.1 shows an electrical circuit.

Circle the letter which shows the cell.



Candidates also fared well in item (b). It was a basic question assessing candidates’ knowledge of the electrical components making up an electrical circuit which is taught as early as in upper primary.

Item (c)

(c) Which instrument is used to measure length?

- **A** A ruler
- **B** A clock
- **C** A balance
- **D** A thermometer

This was the most well-answered item in the series. It was a straightforward question to which candidates could easily relate. Candidates from both the Regular and Extended Programmes could clearly differentiate between the instruments used to measure the basic physical quantities: length, mass, time and temperature.

Item (d)

(d) Which one of the following is a non-polluting source of energy?

- **A** Bagasse
- **B** Diesel
- **C** Wind
- **D** Wood

Performance in item (d) was comparable to that in item (c). The concepts of polluting and non-polluting sources of energy were not foreign to candidates. These form part of the primary curriculum and explains candidates' confidence in answering item (d). Candidates often come across these concepts in Biology and Chemistry classes as well. This may have helped reinforce their capacity to recall which sources of energy are generally considered as non-polluting.

Item (e)

(e) What is the function of a switch in an electrical circuit?

A It opens and closes the circuit.

B It carries electrical energy throughout the circuit.

C It is the source of energy in the circuit.

D It resists the flow of current in the circuit.

Item (e) was accessible to the majority of candidates. It was particularly pleasing to note the relatively high number of candidates from the Extended Programme who answered this question correctly.

Item (f)

(f) Which one of the following is a scalar quantity?

A Acceleration

B Displacement

C Speed

D Velocity

About two thirds of the candidates were able to correctly identify ‘Speed’ (C) as a scalar quantity. Option **D**, ‘Velocity’, was a relatively strong distractor in this case.

It is important to note that item (f) proved to be the most difficult item for candidates from the Extended Programme. Terms such as scalars and vectors appear difficult for these candidates to grasp. It appeared from the analyses that candidates from the Extended Programme tend to be visual learners. It can help, therefore, if examples of scalar and vector quantities are listed in a table on Bristol paper and affixed in the classroom. Providing such visual aids can increase the retaining capacity of future candidates.

Item (g)

(g) What is a luminous object?

A An object that absorbs light.

B An object that reflects light.

C An object that refracts light.

D An object that produces light.

This question was well answered by the vast majority of candidates. They demonstrated firm understanding of what the term luminous means.

Item (h)

(h) What is the formula used to calculate the kinetic energy of a moving object?

A mgh

B $\frac{1}{2} mv^2$

C ma

D mv

About 75 % of the candidates answered this question correctly. Recalling the formula to calculate kinetic energy was unproblematic for many.

Item (i)

(i) Fig. 1.2 shows the letter **F** in front of a plane mirror.

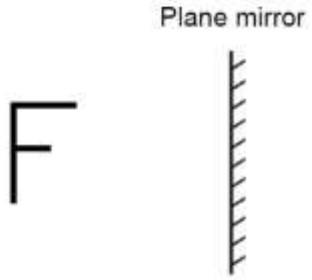
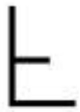
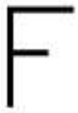


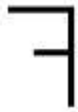
Fig. 1.2

Which one of the following is the image of the letter **F** formed in the plane mirror?

A 

C 

B 

D 

Candidates fared very well in this question. They demonstrated a good understanding of one particular characteristic of an image formed in a plane mirror namely, lateral inversion. It is encouraging to note that this item was well answered by candidates from both the Regular and Extended Programmes.

Item (j)

(j) Fig. 1.3 shows an athlete running.

Fig. 1.3

Which one of the following could be the average speed of the athlete?

A 0.05 m/s

B 5 m/s

C 50 m/s

D 500 m/s

This was the least well-answered multiple-choice item. Item (j) assessed candidates' ability to make sense of and compare different speeds. Almost two thirds of the candidates answered '5 m/s' (**B**) correctly. One fifth of the candidates chose Option **A** (*0.05 m/s) instead. This suggests that candidates could distinguish between very high and very low speeds in general. However, it was difficult for quite many to make finer estimates.

It is noteworthy that a considerable number of candidates from the Extended Programme answered this item correctly. The fact that the G9 Extended and the Grade 9+ textbooks provide many examples of the different speeds of common objects may have positively contributed to the result.

Question 2

Question 2 carried a total of 7 marks. The performance of candidates in this question was slightly below expectation. The mean mark scored was 4.23.

Question 2 (a)

Fig. 2.1 shows a thermal power station.

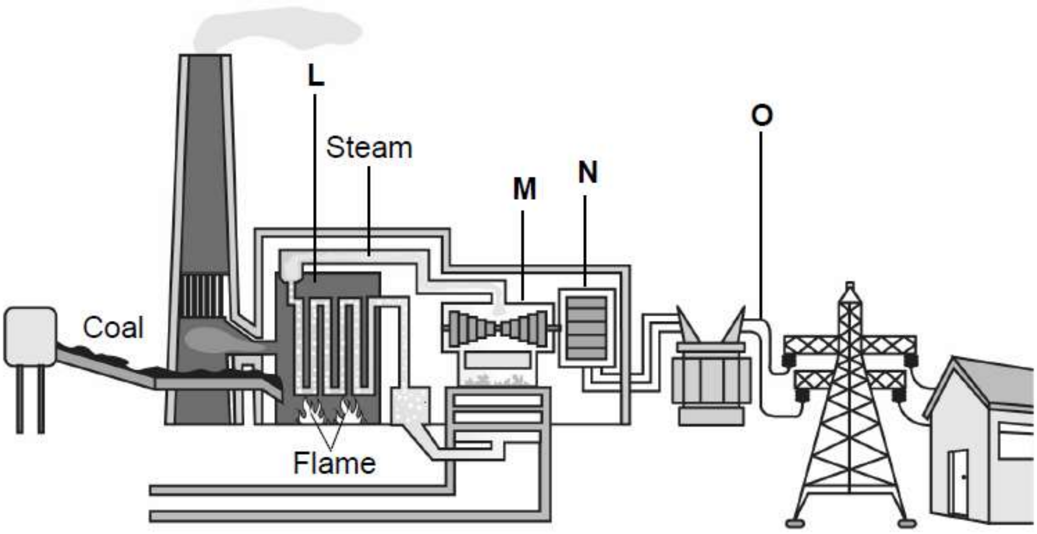


Fig. 2.1

(a) Choose the appropriate term from the list below to label parts **L**, **M**, **N**, and **O** of the power station.

Generator **Turbine** **Transformer**

Furnace **Power line**

Qu. 2(a) was well-received by candidates. Candidates readily recognised part **O** as the 'Power line'. The biggest difficulty they seemed to encounter was to distinguish between the turbine and the generator. Thus, a common mistake was to label part **M** as the generator and part **N** as the turbine.

Answers: ***(a)(i)*** **L:** *Furnace,* ***(a)(ii)*** **M:** *Turbine* ***(a)(iii)*** **N:** *generator*
(a)(iv) **O:** *Power line*

Question 2 (b)

Question 2(b) was a fairly easy question that assessed candidates' understanding of the transformation of energy that takes place at **L** and **N** specifically.

(b) Put a tick (✓) in the appropriate box to indicate the **main** energy conversion that takes place at **L** and at **N**.

(i) **At L:**

☐ Chemical energy to heat energy

☐ Heat energy to electrical energy

☐ Electrical energy to chemical energy

[1]

(ii) **At N:**

☐ Electrical energy to heat energy

☐ Heat energy to electrical energy

☐ Kinetic energy to electrical energy

[1]

Performance in this part question was satisfactory. About two thirds of the candidates answered the question correctly. The most common mistakes were to choose 'Heat energy to electrical energy' in both parts (b)(i) and (b)(ii).

Answers: ***(b)(i)*** *Chemical energy to heat energy*
(b)(ii) *Kinetic energy to electrical energy*

Question 2 (c)

(c)	Give one advantage of producing electricity in thermal power stations.
	....
	.... [1]

Candidates did not fare well in part 2 (c). The question was often left unanswered. In cases where candidates offered a response, it was usually poorly expressed. There is an urge to support students overcome their anxiety vis-a-vis open-ended questions. Question 2 (c) was not difficult per se. It required candidates to write as simple a sentence as '*It runs at a lower cost*' or '*Coal is available throughout the year*'. However, the high proportion of unanswered scripts suggests that a good number of candidates tend to shy away from such type of questions. It is important, therefore, that Educators' attention be drawn to the need for increased opportunities to practise opened-ended questions to help students overcome their apparent anxiety.

Typical Answers:

- *This source of energy is available all the time.*
- *Thermal power stations run at a relatively lower cost than other power stations.*
- *Power productions is not affected by climate conditions*

Question 3

Performance in Question 3 was satisfactory on the whole. It comprised mostly multiple-choice items and carried a total of 8 marks. Candidates scored a total of 5 marks on average in this question.

Question 3 (a)

(a) Fig. 3.1 shows some water in a measuring cylinder.

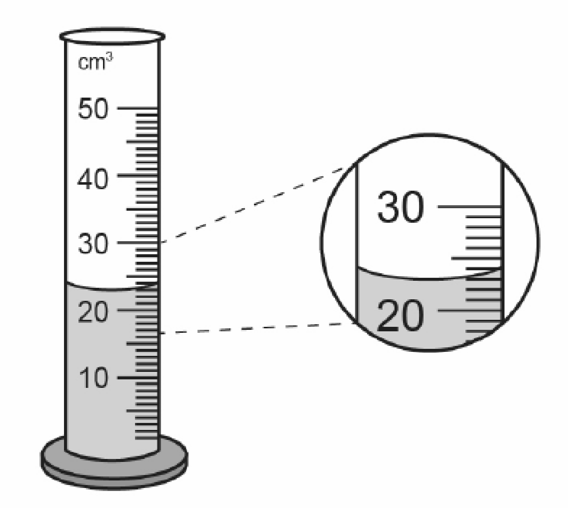


Fig. 3.1

(i) What is the volume of water in the measuring cylinder?

Tick (✓) the correct box.

☐ 22 cm^3 ☐ 23 cm^3 ☐ 24 cm^3

[1]

(ii) A stone is lowered completely into the measuring cylinder shown in Fig. 3.1. The level of water in the measuring cylinder rises to 28 cm^3.

Calculate the volume of the stone.

About 7 out of 10 candidates answered this part question successfully. 50 % of the candidates from the Extended Programme correctly read the volume of water in the measuring cylinder.

In part (a)(ii), the majority of candidates recognised that the volume of the stone is equal to the amount of displaced water. It is important to highlight that candidates who did not obtain the correct volume of water in part (a)(i), scored a partial mark in part (a)(ii) for subtracting their value from 28 cm^3. However, where candidates did not show their workings and where there was no evidence that candidates calculated the volume of displaced water, partial marks could not be awarded. It is important, therefore, to encourage students to always show all their workings in the answer space provided.

A quite common mistake was for candidates to calculate **23 cm^3 - 28 cm^3* and to give the correct answer 5 cm^3. Candidates should bear in mind that marks are not awarded in cases where a correct answer is obtained from an incorrect calculation.

Answers: ***(a)(i)*** *23 cm^3,* ***(a)(ii)*** *5 cm^3*

Question 3 (b)

(b) Fig. 3.2 shows a Vernier caliper.

(i) On Fig. 3.2, mark the tail of the Vernier caliper with the letter **T**. [1]

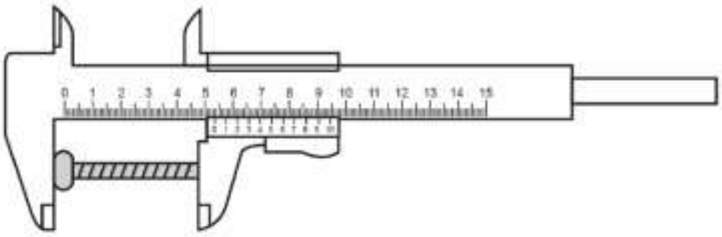


Fig. 3.2

(ii) What is the function of the tail of the Vernier caliper?

.... [1]

Performance in Qu. 3 (b) was below expectation. About 2 out of 5 candidates could locate the tail of the Vernier caliper and state its function.

Common mistakes were:

- **To hold the caliper*
- **To adjust the caliper*

Answers: ***(b)(ii)*** *To measure the depth (of small containers).*

Question 3 (c)

(c) Tina measures the diameter of a ball using a Vernier caliper.

Fig. 3.3 shows the scale of the Vernier caliper which Tina uses.

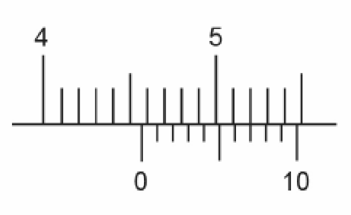


Fig. 3.3

(i) What is the **main scale** reading shown in Fig. 3.3?

Tick (✓) the correct box.

☐ 4.50 cm ☐ 4.60 cm ☐ 5.00 cm

[1]

(ii) What is the **Vernier scale** reading shown in Fig. 3.3?

Tick (✓) the correct box.

☐ 0.06 cm ☐ 0.07 cm ☐ 0.08 cm

[1]

(iii) Hence, calculate the diameter of the ball.

A good number of candidates successfully answered the whole of Qu. 3(c). There was a higher number of candidates from the Regular Programme who could identify the correct Vernier scale reading than identifying the correct main scale reading.

In contrast, a higher number of candidates from the Extended Programme found the correct main scale reading than the correct Vernier scale reading.

In part (c)(i), **4.60 cm* was the most popular distractor.

In part (c)(ii), the number of candidates who chose **0.06 cm* and **0.08 cm* was comparable.

In general, candidates scored at least a part mark in part (c)(iii) for recognising that the diameter of the ball is obtained by adding the main scale reading and the vernier scale reading. Arithmetical mistakes in adding the two numbers were sometimes noted.

Answers: ***(b)(i)*** *4.50 cm,* ***(b)(ii)*** *0.07 cm,* ***(b)(iii)*** *4.57 cm*

Question 4

Candidates did not fare very well in this question. The question did not prove as scoring as it set out to be. Out of a total of 7 marks, candidates managed to get 3.16 marks on average.

Question 4 (a)

(a) Draw the normal at the point of incidence on Fig. 4.2. [1]

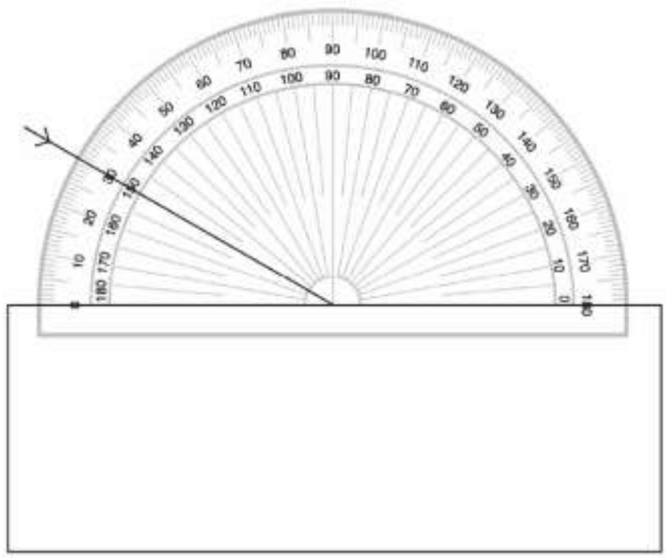


Fig. 4.2

The majority of candidates correctly drew the normal on the 90° mark shown on the protractor.

Some candidates drew the normal on Fig. 4.1 instead. When correctly drawn, candidates were awarded the marks. The normal was also quite often drawn using a solid line instead of using a dotted line. A few candidates mistook the normal for a ray of light and included an arrow on the normal.

Question 4 (b)

(b) Measure and write down the angle of incidence.

Angle of incidence = ...° [1]

Fewer candidates than expected answered this part question correctly. Mistakes usually arose from either incorrect reading of the scale on the protractor or from neglecting the fact that the angle of incidence is measured from the normal at the point of incidence. **3*0^o and **150*^{o} were thus common wrong answers given.

Answers: ***(b)*** *60*^{o}

Question 4 (c)

(c) On Fig. 4.2,

(i) draw the refracted ray of light. [1]

(ii) mark the angle of refraction with the letter **r**. [1]

This part question proved difficult on the whole. About a third of the candidates could draw the refracted ray correctly. In some cases where candidates incorrectly drew the refracted ray, a partial mark was nonetheless awarded for recognising that the angle of refraction was the angle between **their* refracted ray and the normal.

Question 4 (d)

(d)	(i)	What could be the value of the angle of refraction, **r** ? Tick (✓) the correct box. ☐ 35° ☐ 60° ☐ 65° [1] Give a reason for your answer. .... [1]

This was the least well-answered part question in Qu. 4. The relationship between the size of the angle of refraction when the refracted ray bends towards the normal in an optically denser medium does not seem to have been fully understood by the majority of candidates. This idea may need to be consolidated in the classroom. Visual illustrations that demonstrate how the size of the angle of refraction changes when the refracted ray bends away or towards the normal may enhance students' understanding.

Answers: ***(d)(i)*** *35^{o},*

(d)(ii) *The angle of refraction is smaller than angle of incidence when a ray of light travels from air into glass.*

Question 4 (e)

(e)	Give one precaution Jamil should take when using the protractor. .... [1]

The overall performance of candidates was far better in part (e) than in part (d). More than 50 % of the candidates were able to find a plausible precaution to take in the given context. Although often awkwardly expressed, candidates' ideas were sufficiently intelligible to deserve a mark.

Answers:

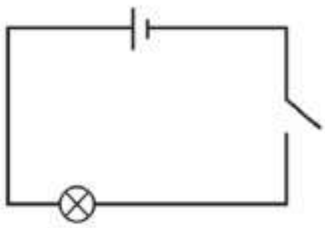
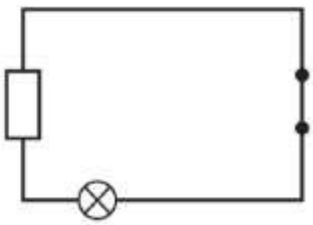
- *Place the protractor on a flat, horizontal surface*
- *Ensure that the zero mark is correctly aligned with the glass-air boundary*
- *Read the correct scale on the protractor*

Question 5

Candidates' performance in Qu. 5 was somewhat comparable to their performance in Qu. 4. The rather low performance underlines candidates' lack of self-assurance to tackle questions related to the topic on '*Electricity*'. The mean score achieved in this question was 4.14 out of 9 marks.

Question 5 (a)

(a) The table below shows two electrical circuits.
The bulbs in both circuits do not light up.
Complete the table below to explain why.

Electrical circuit	Reason why the bulb does not light up
(i) 	....
(ii) 	....

[2]

Question 5 (a) turned out to be scoring for the majority of candidates. Many did not go further than answering this part question. About 70 % of the candidates rightly recognised that the switch was open in part (a)(i) and that a source of energy was missing in part (a)(ii).

Question 5 (b)

(b) Fig. 5.1 shows an electrical circuit.

It consists of a cell of e.m.f. 3 V and two resistors of resistance 2 Ω and 6 Ω respectively.

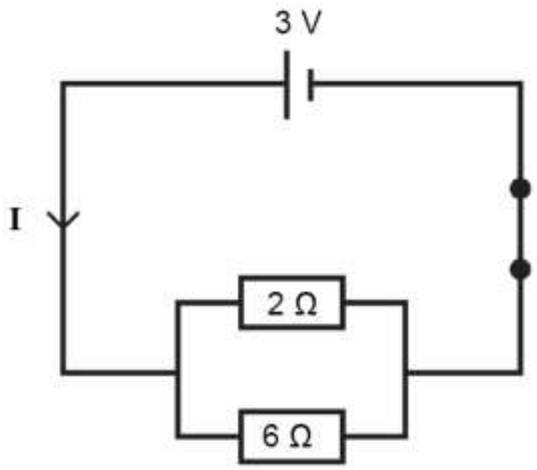


Fig. 5.1

Calculate

(i) the total resistance

(ii) the current, **I**, flowing in the circuit.

Question 5 (b) was challenging for many. About a third of the candidates were able to calculate the total resistance in part (b)(i). The most common mistake was to add 2 Ω to 6 Ω, neglecting that the resistors were connected in parallel. In some cases where candidates recognised that the resistors were connected in parallel, they omitted to take the reciprocal of 1/R to get the final answer. In other cases, candidates were careless and left arithmetical mistakes in their intermediate calculations.

In part (b)(ii), many wrote *V* = *IR* but did not seem to know which values to substitute in the formula.

Answers: ***(b)(i)*** *1.5 Ω,* ***(b)(ii)*** *2 A*

Question 5 (c)

(c) Another resistor is connected in series to the circuit as shown in Fig. 5.2.

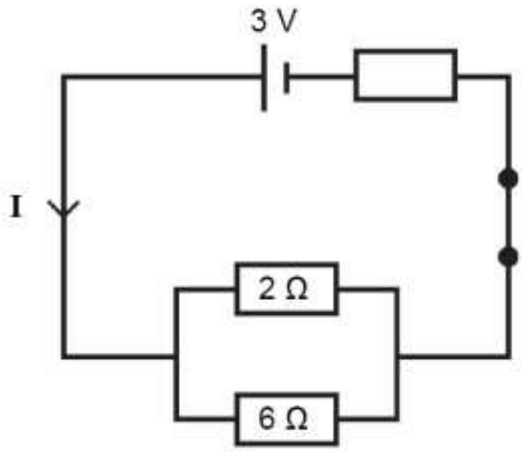


Fig. 5.2

State what happens to

(i) the total resistance of the circuit.

.... [1]

(ii) the current flowing in the circuit.

.... [1]

Very few candidates demonstrated understanding that the total resistance is inversely proportional to the current flowing in the circuit. It is important to highlight the relationship between the different quantities making up formula to students to help them make sense of formulae rather than learning these in a mechanical or rote way.

Answers: ***(c)(i)*** *Total resistance increases,* ***(c)(ii)*** *Current decreases.*

Question 6

Question 6 assessed the topic on '*Motion*'. It carried a total of 6 marks. Candidates' performance in this question improved compared to the performance of their counterparts in the same topic last year. While similar concepts were assessed in both years, the questions were set somewhat differently and included multiple choice items in 2022. This partly contributed to the improved performance observed.

It was pleasing to note that about two thirds of the candidates from the Extended Programme attempted parts (a), (b) and (c) of the questions which earned them a few marks.

Candidates achieved a mean score of 4.28 in the question.

Question 6 (a), (b)

Fig. 6.1 shows the speed-time graph of a car.

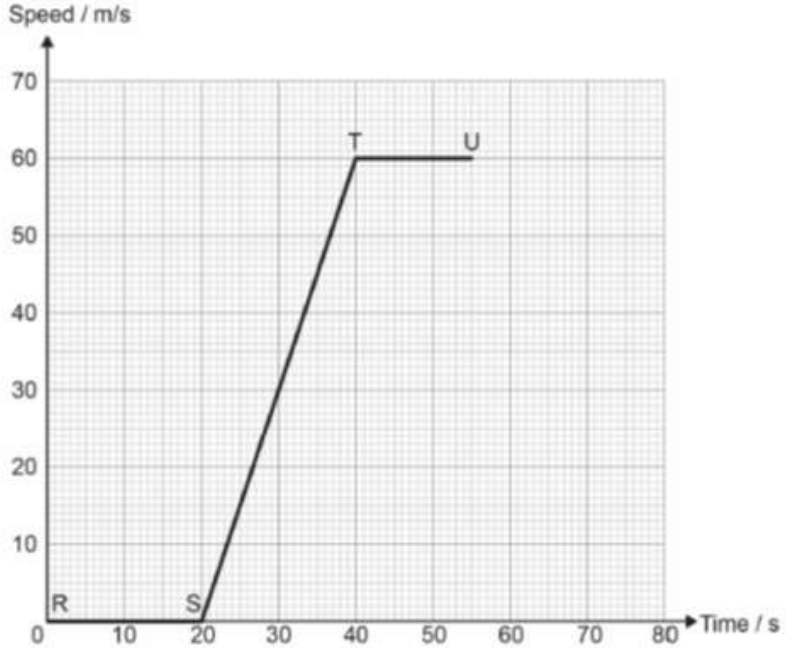


Fig. 6.1

(a) Which section of the graph shows the car when it is at rest?
Tick (✓) the correct box.

☐ **RS** ☐ **ST** ☐ **TU** [1]

(b) For how long does the car accelerate? Tick (✓) the correct box.

☐ 20 s ☐ 40 s ☐ 50 s [1]

Candidates fared very well in parts (a) and (b). The majority of candidates identified ***RS*** as the part of the graph which showed that the car is at rest. ****TU*** was a popular distractor among the few who could not answer part (a).

In part (b), a high number of candidates recognised that the car accelerated for 20 s. Nevertheless, a considerable number of candidates omitted to subtract 20 s from 40 s and gave 40 s as their final answer.

Answers: ***(a)*** ***RS**,* ***(b)*** *20 s.*

Question 6 (c)

(c) State

(i) the maximum speed of the car

Maximum speed = ... m/s [1]

(ii) the acceleration of the car in section **TU**

Acceleration = ... m/s^2 [1]

A large number of candidates was able to find the maximum speed of the car from the graph in part (c)(i).

In contrast, very few candidates successfully answered part (c)(ii). It seemed quite difficult for candidates to grasp the idea that the acceleration is given by the gradient of a speed-time graph. For some reasons, candidates seemed to look for a value of the acceleration on the graph.

Of particular interest was to note that some candidates who initially stated that the maximum speed was *60 m/s* in part (c)(i), struck off their answer to re-write the value as the answer to part (c)(ii) instead, overlooking the fact that the unit for acceleration is m/s^2, not *m/s*.

Answers: ***(c)(i)*** *60 m/s,* ***(c)(ii)*** $0\ m/s^2$

Question 6 (d)

(d) Calculate the distance the car travels **during the first 40 s**. Distance = ... m [2]

Very few candidates answered this question correctly. A common mistake was to calculate the area under the whole graph neglecting the fact that the question asked for the distance travelled during the first 40 s only. There was also evidence that candidates were unsure about how to deal with the part of the graph where the car was at rest. Some mistook this area to be equal to 20 s × 60 m/s.

Answers: ***(d)*** *600 m*

Question 6 (e)

(e) Calculate the average speed of the car **during the first 40 s**. Average speed of the car = ... m/s [2]

Performance in part (e) was slightly better than in part (d). A handful of candidates recognised that they had to divide their answer to part (d) by 40 s to obtain the correct answer. A common mistake in this part question was to divide the distance travelled by 20 s instead of 40 s.

Answers: ***(e)*** *15 m/s*

Question 6 (f)

(f)	After 55 seconds, the car decelerates uniformly for 15 s until it reaches a speed of 30 m/s. On the speed-time graph, draw a line to show the deceleration of the car. [1]

About 50 % of the candidates managed to score this final mark. The most common mistake in this part question was for candidates to overlook the fact that the car decelerated until 30 m/s. Many showed the deceleration until the car came to rest.

Concluding remarks

The improvement in the overall performance of candidates in 2022 is an encouraging sign. Boosting students' confidence to tackle open-ended questions is likely to further contribute to even better results in the future.

A key observation that emerged in the 2022 assessment session is that questions which are well illustrated tend to appeal to a good number of candidates. Rarely are these questions left unanswered. Tapping into this at classroom level will also help improve the results in the years to come.

In addition, supporting students to identify key terms used in a question, to pay attention to the units used, to practise answering open-ended questions and encouraging them to always show their workings can further enhance their performance in the Physics Assessment.