New Specification

Rewarding Learning

Centre Number	
71	

Candidate Number

ADVANCED SUBSIDIARY
General Certificate of Education
2010

Physics

Assessment Unit AS 1

assessing

Module 1: Forces, Energy and Electricity

[AY111]

AY111

MONDAY 14 JUNE, MORNING

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided in this question paper.

INFORMATION FOR CANDIDATES

The total mark for this paper is 75.
Quality of written communication will be assessed in question **6**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question.
Your attention is drawn to the Data and Formulae Sheet which is inside this question paper.
You may use an electronic calculator.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total Marks	

If you need the values of physical constants to answer any questions in this paper, they may be found on the Data and Formulae Sheet.

Answer **all ten** questions.

1 (a) The second is the S.I. base unit of the physical quantity time. Complete **Table 1.1** to show S.I. base units of the other physical quantities listed.

Table 1.1

Physical quantity	S.I. base unit
time	second
mass	
length	
temperature	
current	
amount of substance	

[3]

Examiner Only	
Marks	Remark

(b) The pascal, the coulomb, the watt, and the ohm are all S.I. units, but they are not S.I. base units.
Express each of these units in terms of S.I. base units. For example, the newton expressed in S.I. base units is kg m s^{-2}.

Examiner Only	
Marks	Remark

(i) the pascal

the pascal expressed in S.I. base units _____ [1]

(ii) the coulomb

the coulomb expressed in S.I. base units _____ [1]

(iii) the watt

the watt expressed in S.I. base units _____ [1]

(iv) the ohm

the ohm expressed in S.I. base units _____ [1]

Examiner Only	
Marks	Remark

2 A goalkeeper kicks a football into the air from the ground at a velocity of 25 m s^{-1}, at an angle of 30º to the horizontal, as shown in **Fig. 2.1**.

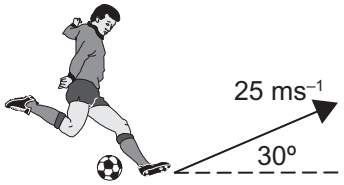


Fig. 2.1

(a) Calculate the maximum height the ball reaches above the pitch.

Maximum height = _____ m [2]

(b) Calculate the time that the ball is in the air before it hits the ground.

Time = _____ s [3]

(c) Calculate the horizontal distance between the point from which the ball was kicked and where it would land.

Distance = _____ m [2]

Examiner Only	
Marks	Remark

3 **(a)** State Newton's first and third laws of motion.

Newton's first law _____

_____

_____

Newton's third law_____

_____

_____ [2]

(b) A student considers a brick resting on the ground as shown in **Fig. 3.1**.

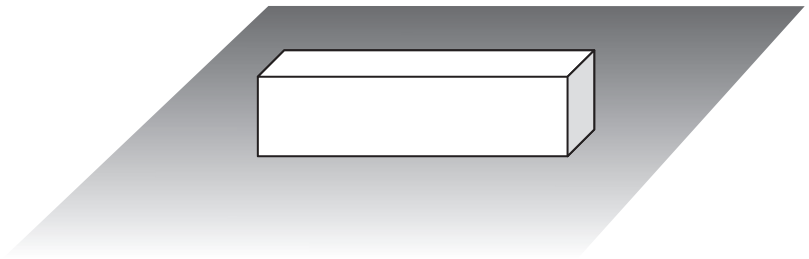


Fig. 3.1

He considered the following four forces which he names forces A, B, C and D.

Force A – The normal contact force exerted by the ground on the brick
Force B – The weight of the brick
Force C – The downwards force exerted by the brick on the ground
Force D – The gravitational attraction of the brick on the Earth

(i) Referring to the forces above, explain how Newton's first law applies to the brick.

_____

_____

_____ [2]

(ii) Referring to the forces above, explain how Newton's third law applies to the brick and the ground.

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

4 **(a)** Define the moment of a force about a point.

_____

_____ [1]

(b) State the principle of moments

_____

_____

_____ [2]

(c) A boy uses a uniform plank of wood of mass 30 kg and length 4.0 m to cross a river. He places one end of the plank on the river bank and rests the plank on a rock in the river as shown in **Fig. 4.1**.

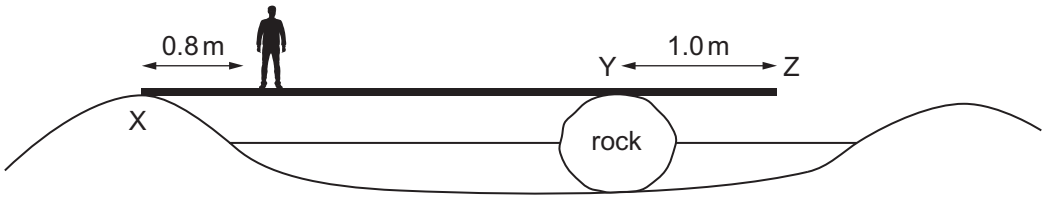


Fig. 4.1

(i) The rock is 1 m from the end of the plank. The boy, who has a mass of 65 kg, stands 0.8 m from the river bank at end X. Calculate the vertical support force, provided by the rock, at Y.

Force at Y = _____ N [3]

(ii) Will the boy be able to stand at end **Z without** the plank rising off the riverbank and the boy falling in the river?

Explain your answer.

_____

_____ [2]

Examiner Only	
Marks	Remark

5 An apple falls from a tree and hits the ground.

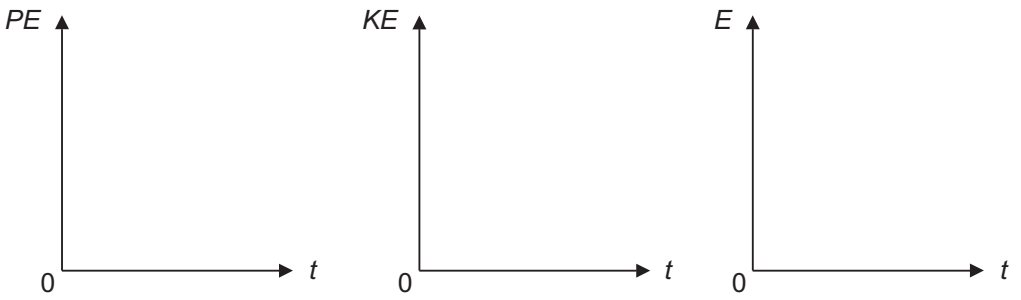
(a) Explain how the Principle of Conservation of Energy applies to this apple as it falls.

_____

_____

_____ [2]

(b) On **Fig. 5.1**, sketch graphs to show how the potential energy *PE* the kinetic energy *KE* and the total energy *E* of the apple changes with time *t* from the moment the apple starts falling from the tree until it reaches the ground.



[3]

Fig. 5.1

(c) The apple, which has a weight of 1.2 N, takes 0.8 seconds to reach the ground from the moment it starts to fall.
Calculate the potential energy of the apple when it was on the tree.

Potential energy = _____ J [3]

Examiner Only	
Marks	Remark

6 A copper wire, of length L and cross-sectional area A, is stretched by a force F causing it to increase in length by an amount e.

(a) The Young modulus E of the copper is the ratio of the stress in the wire to the strain of the wire, as shown by **Equation 6.1**.

$$E = \frac{stress}{strain} \qquad \textbf{Equation 6.1}$$

Use **Equation 6.1** to obtain an expression for the Young modulus E of the copper wire in terms of L, A, F and e.

$E =$ _____ [2]

(b) Describe an experiment to determine the Young modulus of copper.

In your answer:

(i) draw a labelled diagram of the arrangement;

(ii) give an account of the method, stating what is measured and how, and explaining how the measurements are used to determine the Young modulus.

Diagram

Method

Examiner Only	
Marks	Remark

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ [6]

Quality of written communication [2]

Examiner Only	
Marks	Remark

7 A steady electric current of 3 A flows through a copper wire XY which is connected in series to two identical bulbs, a switch and a cell as shown in **Fig. 7.1**.

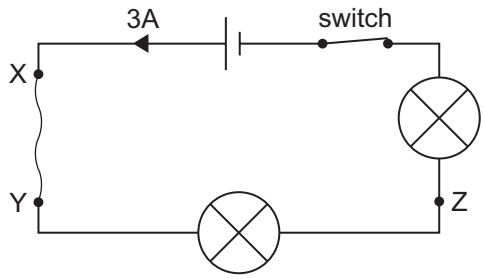


Fig. 7.1

(a) (i) Name the charge carriers responsible for the current.

Charge carriers = _____ [1]

(ii) Indicate the direction of flow of these charge carriers between the point X and Y on **Fig. 7.1**. with an arrow.

[1]

(b) Express the current of 3 A in terms of rate of flow of charge.

_____ [1]

(c) How many charge carriers pass the point Z in the wire in 4 minutes when this current flows?

Number of charge carriers = _____ [2]

(d) When the switch in the circuit shown in **Fig 7.1** is closed, both bulbs light simultaneously. Explain why there is no time delay between the lighting of the two bulbs.

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

8 An electrician finds two coils of resistance wire in his bag. The coils of wire are made of materials of different electrical resistivity.

(a) Define electrical resistivity.

_____

_____

_____ [1]

(b) **(i)** Coil A consists of wire 15 m long, with a diameter of 0.2 mm and a resistance of 9.0 Ω. Calculate the resistivity of the material of Coil A and state its unit.

Resistivity = _____ [3]

Unit = _____ [1]

(ii) Coil B, consists of wire of the same length and diameter as the wire in Coil A but with a resistivity 30 times that of Coil A. Calculate the resistance of Coil B.

Resistance of Coil B = _____ Ω [1]

(c) **(i)** The electrician has to fix two faults, a heating element and a break in the electrical circuit. He uses wire from the coils to mend the faults. Which coil of wire should the electrician select for each job?

To repair the heating element the electrician should choose

Coil _____

To repair the electrical connection the electrician should choose

Coil _____ [1]

(ii) Explain your choice of wire to repair the heating element.

_____

_____ [1]

Examiner Only	
Marks	Remark

9 A source of electromotive force has an *internal resistance*.

(a) Describe an effect of this internal resistance.

_____

_____ [1]

(b) An experiment is performed to determine the internal resistance *r* of a cell using the circuit in **Fig. 9.1**.

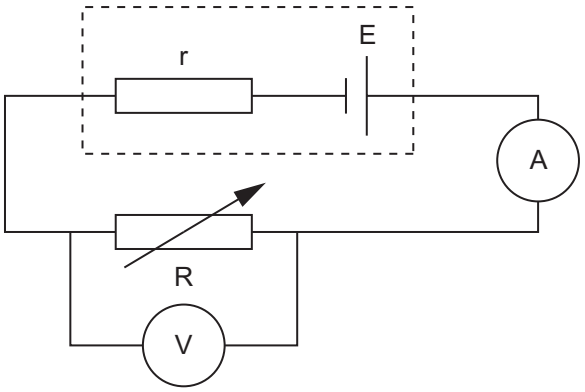


Fig. 9.1

By varying the load resistance, R, results were obtained for the terminal voltage V and the current drawn from the cell. A graph of the results was plotted and is shown in **Fig. 9.2**.

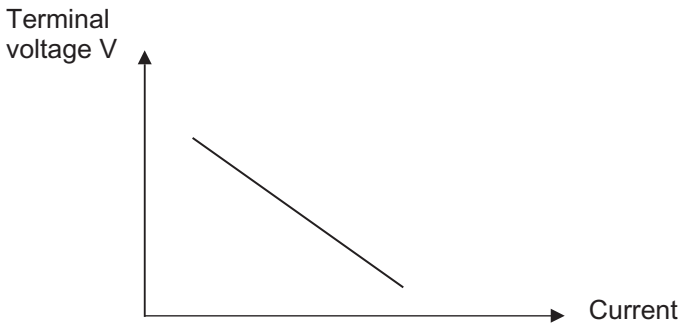


Fig. 9.2

(i) Explain how the internal resistance *r* may be obtained from the graph.

_____ [1]

(ii) Explain how the e.m.f. *E* of the cell may be obtained from the graph.

_____ [1]

(c) When no current is drawn from the cell, the potential difference between its terminals is 10.0 V. When a load resistor of 2.0 Ω is connected across the battery the potential difference between the terminals is 9.5 V. Calculate the internal resistance of the cell.

Internal resistance = _____ Ω [3]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

10 Four identical 6 Ω resistors are connected together in several different arrangements.

(a) **Fig 10.1** shows one arrangement of the resistors.

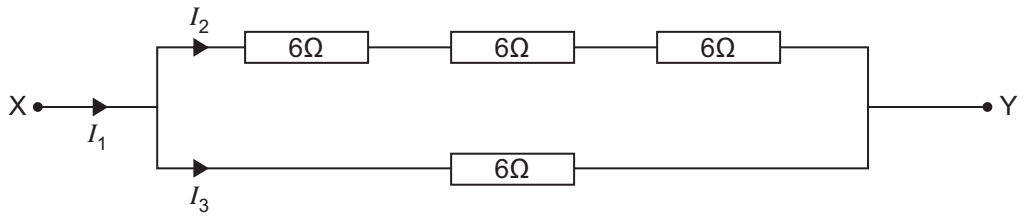


Fig. 10.1

(i) Calculate the total resistance between terminals X and Y.

Total resistance = _____ Ω [1]

(ii) State the relationship between I_1, I_2 and I_3.

Relationship between I_1, I_2 and I_3 _____ [1]

(iii) The value of current I_1 is 6 A. Determine the current I_3.

Current I_3 = _____ A [1]

Examiner Only	
Marks	Remark

(b) **Fig. 10.2** shows a different arrangement of the resistors.

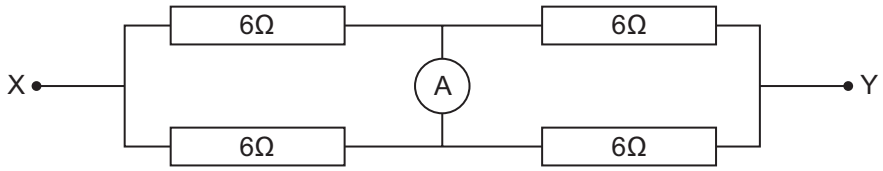


Fig. 10.2

The potential difference between X and Y is 10 V. What is the current through the ammeter?

Current through ammeter =_____ A [1]

(c) **Fig. 10.3** shows a third arrangement of the resistors.

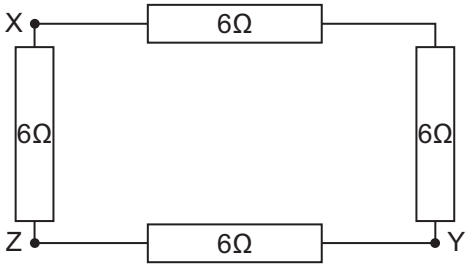


Fig. 10.3

(i) Calculate the resistance between terminals X and Y.

Resistance = _____ Ω [1]

(ii) An additional 6 Ω resistor is connected between terminals X and Y so that it is in parallel with both pairs of 6 Ω resistors. Calculate the total resistance between terminals Y and Z.

Resistance = _____ Ω [3]