Centre Number

71	

Candidate Number

Rewarding Learning

ADVANCED SUBSIDIARY
General Certificate of Education
January 2011

Physics

Assessment Unit AS 1

assessing

Module 1: Forces, Energy and Electricity

[AY111]

AY111

WEDNESDAY 12 JANUARY, 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 **9**.
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	

6456

Examiner Only	
Marks	Remark

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

Answer **all ten** questions.

1 **(a)** **(i)** What is a **scalar** quantity?

____

____

(ii) What is a **vector** quantity?

____

____ [2]

(b) Six physical quantities are listed below. Indicate which of the physical quantities are **vectors** by placing a tick (✓) in the box corresponding to the quantity.

Potential energy ☐

Frequency ☐

Velocity ☐

Charge ☐

Force ☐

Power ☐ [2]

(c) **Fig. 1.1** shows a force of 12 N acting on a brick resting on a horizontal surface.

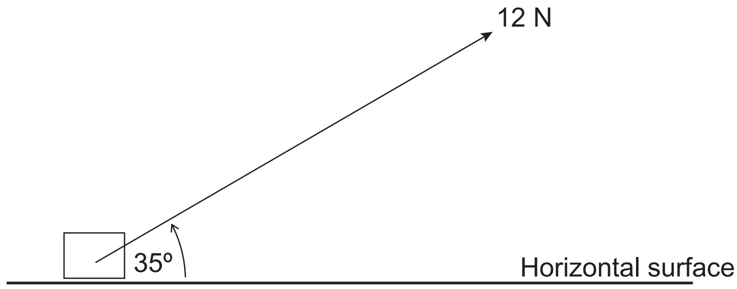


Fig. 1.1

(i) Find by calculation the horizontal and vertical components of this force.

Horizontal component = _______________ N

Vertical component = _______________ N [2]

(ii) What is the resultant vertical force acting on the horizontal surface if the brick has mass 3.0 kg?

Force = _______________ N [2]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

2 **(a)** A catapult is used to project a ball **vertically upwards** with an initial velocity of $5.0\,m\,s^{-1}$.

(i) Calculate the maximum height reached by the ball.

Maximum height = _______________ m [2]

(ii) Calculate the total flight time (from launch until it returns to the starting point).

Flight time = _______________ s [2]

(b) **Fig. 2.1** is a simplified sketch graph of velocity *v* against time *t* for a car travelling along a straight road between two sets of traffic lights.

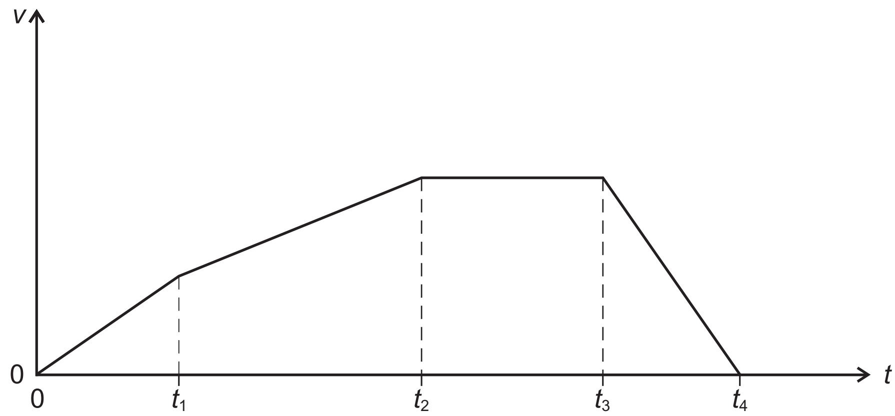


Fig. 2.1

(i) Describe in words how the **acceleration** of the car varies in the following time intervals from t_1 to t_4.

From t_1 to t_2: ______________________________

From t_2 to t_3: ______________________________

From t_3 to t_4: ______________________________ [2]

(ii) State how the distance between the traffic lights could be deduced from **Fig. 2.1.**

____

______________________________ [2]

Examiner Only	
Marks	Remark

Examiner Only: Marks | Remark

3 (a) State Newton's second law of motion.

____

____

____ [2]

(b) A person, of mass 55.0 kg, stands on bathroom scales in a lift. The scales are calibrated to measure in newtons.

(i) The lift starts to ascend vertically upwards with constant acceleration of 1.5 m s^{-2}. Calculate the scale reading while the lift is accelerating upwards.

Reading = ______________ N [2]

(ii) After this initial acceleration the lift continues to travel upwards at constant speed.

Determine the scale reading in this case.

Reading = ______________ N [1]

(iii) The lift then starts to slow down with constant retardation of 1.0 m s^{-2}. Calculate the scale reading while the lift is slowing down.

Reading = ______________ N [2]

4 **Fig. 4.1** shows a uniform plank, of weight 30 N and length 3 m, resting on two supports. The supports are 0.5 m and 2.0 m from the left hand end of the plank. A weight of 18 N is suspended from the left hand end of the plank.

Examiner Only	
Marks	Remark

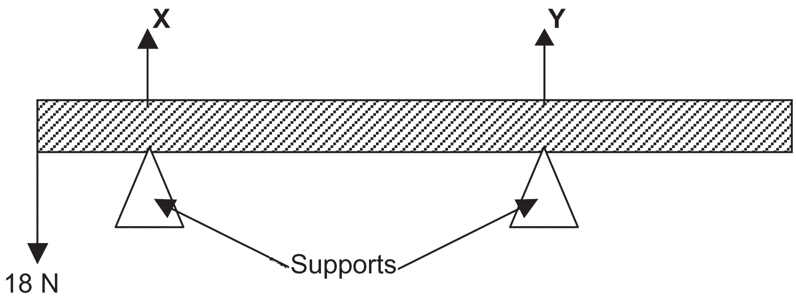


Fig. 4.1

(a) Find the reactions, **X** and **Y,** at the two supports.

X = _______________ N **Y** = _______________ N [3]

(b) By how much should the weight on the left hand end be increased so that the reaction **Y** becomes zero?

Increase in weight = _______________ N [2]

5 A small car has a mass of 800 kg and can accelerate from rest to a velocity of 27.8 m s^{-1} in 13.5 seconds.

Examiner Only	
Marks	Remark

(a) (i) Calculate the kinetic energy of the car when moving at 27.8 m s^{-1}.

Kinetic energy = _______________ J [1]

(ii) Calculate the useful power output of the engine to produce this acceleration.

Power output = _______________ W [1]

(iii) The efficiency of the engine in converting chemical energy to useful kinetic energy is 29%. Calculate the chemical energy from the petrol needed to produce this amount of kinetic energy.

Chemical energy = _______________ J [2]

(b) The car, travelling at 27.8 $m\,s^{-1}$, reaches the bottom of the slope as shown in **Fig 5.1.** The driver switches off the engine and allows the car to free wheel up the slope. Ignoring friction, calculate how far the car travels along the slope before coming to rest.

Examiner Only	
Marks	Remark

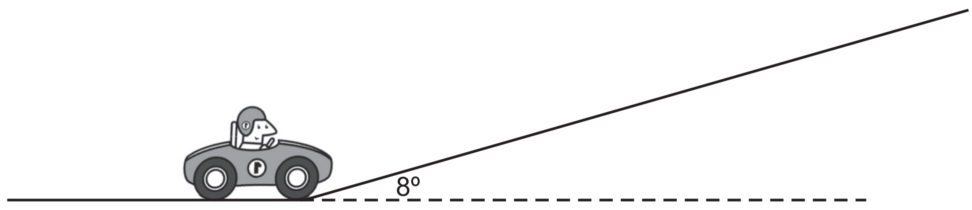


Fig. 5.1

Distance up the slope = _______________ m [3]

Examiner Only	
Marks	Remark

6 **(a)** **(i)** Draw and label an experimental arrangement which could be used to measure the Young modulus of the material of a long wire.

[3]

(ii) Apart from measuring the force on the wire, there are three other quantities to be measured when determining the Young modulus. In the table below list the other measurements you would make, and state the instruments you would use to make the measurements.

Measurement	Instrument

[3]

(b) A stretching force of 5.5 N is applied to a copper wire of length 2.5 m, producing a strain of 7.8×10^{-4}. The Young Modulus of copper is 1.2×10^{11} N m^{-2}.

(i) Calculate the extension produced in the wire.

Extension = _______________ mm [1]

(ii) Calculate the cross-sectional area of the wire.

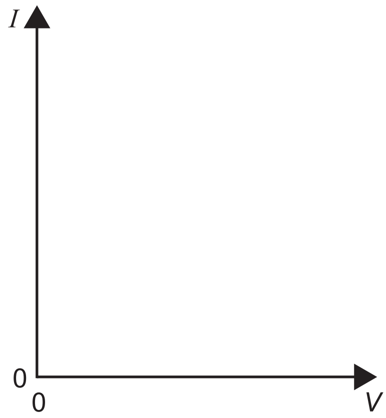
Cross-sectional area = _______________ mm^2 [3]

Examiner Only	
Marks	Remark

7 (a) Name one example of an ohmic conductor.

____

On **Fig. 7.1**, sketch a graph to illustrate how the current through the conductor you have named varies with the potential difference across it. Assume the temperature of the conductor remains constant.



[2]

Fig. 7.1

(b) (i) Explain what is meant by superconductivity. On **Fig. 7.2** sketch a graph to illustrate this effect for a wire made of a superconducting material, both below and above the superconducting transition temperature. Label the transition temperature T_s.

____

____

[3]

Fig. 7.2

Examiner Only	
Marks	Remark

(ii) State one application of superconductivity.

____

____

____ [1]

Examiner Only	
Marks	Remark

8 A current of 60 mA flows through a resistor of resistance 80 Ω for 12 minutes.

Examiner Only	
Marks	Remark

(a) (i) Calculate the amount of charge which passes through the resistor in this time.

Charge = _______________ C [1]

(ii) Hence calculate the number of electrons which pass through the resistor in this time.

Number of electrons = _______________ [1]

(b) (i) Calculate the potential difference across the resistor.

Potential difference = _______________ V [1]

(ii) Calculate the heat energy dissipated by the resistor in 12 minutes.

Energy = _______________ J [2]

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(Questions continue overleaf)

In this question you should answer in continuous prose where appropriate. You will be assessed on the quality of your written communication.

Examiner Only	
Marks	Remark

9 **(a)** Describe an experiment to determine the internal resistance of a battery. Include a circuit diagram.

Circuit diagram

[2]

Description of experiment:

____

____

____

____

____

____ [2]

Examiner Only	
Marks	Remark

(b) **(i)** Internal resistance can be obtained graphically. Label the axes of **Fig 9.1** to enable internal resistance to be determined. Sketch a graph of the results obtained from such an experiment.

Fig. 9.1

(ii) How is the internal resistance obtained from your graph?

____

____ [3]

Quality of written communication [2]

(c) A car battery has e.m.f 12.6 V and internal resistance 0.02 Ω. When the starter motor is connected to the battery, the battery delivers a current of 145 A. Calculate the terminal potential difference when the starter is connected.

Terminal potential difference = _______________ V [2]

Examiner Only	
Marks	Remark

10 **Fig. 10.1** depicts two fixed resistors and a variable resistor connected in series to an 18 V power supply of negligible internal resistance. The arrangement can be used to give a variable output voltage between C and D.

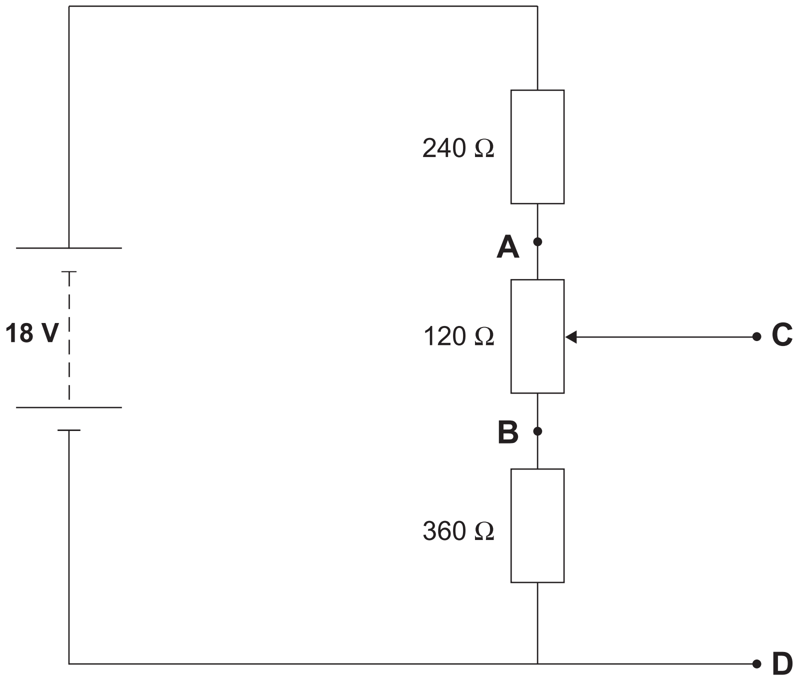

Fig. 10.1

(i) Calculate the current flowing round the circuit.

Current = _______________ mA [2]

(ii) Hence calculate the potential difference across the 120 Ω variable resistor (the voltage between **A** and **B**).

Potential difference = _______________ V [1]

Examiner Only	
Marks	Remark

(iii) Calculate the potential difference between the point **D** and the slider contact of the variable resistor (labelled **C**), when it is mid-way between **A** and **B**.

Potential difference = _______________ V [2]

(iv) A 210 Ω resistor is now placed across the output between **C** and **D**. Calculate the new potential difference between **C** and **D**.

Potential difference = _______________ V [3]

THIS IS THE END OF THE QUESTION PAPER

111604

GCE (AS) Physics

Data and Formulae Sheet

Values of constants

speed of light in a vacuum	$c = 3.00 \times 10^{8}$ m s^{-1}
elementary charge	$e = 1.60 \times 10^{-19}$ C
the Planck constant	$h = 6.63 \times 10^{-34}$ J s
mass of electron	$m_e = 9.11 \times 10^{-31}$ kg
mass of proton	$m_p = 1.67 \times 10^{-27}$ kg
acceleration of free fall on the Earth's surface	$g = 9.81$ m s^{-2}
electron volt	1 e$V = 1.60 \times 10^{-19}$ J

Useful formulae

The following equations may be useful in answering some of the questions in the examination:

Mechanics

Conservation of energy	$\frac{1}{2}mv^2 - \frac{1}{2}mu^2 = Fs$ for a constant force
Hooke's Law	$F = kx$ (spring constant k)

Sound

Sound intensity level/dB	$= 10 \lg_{10} \frac{I}{I_0}$

Waves

Two-source interference	$\lambda = \frac{ay}{d}$

Light

Lens formula	$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$
Magnification	$m = \frac{v}{u}$

Electricity

Terminal potential difference	$V = E - Ir$ (E.m.f. E; Internal Resistance r)
Potential divider	$V_{out} = \frac{R_1 V_{in}}{R_1 + R_2}$

Particles and photons

de Broglie equation	$\lambda = \frac{h}{p}$

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