Rewarding Learning

Centre Number

71	

Candidate Number

ADVANCED SUBSIDIARY
General Certificate of Education
January 2012

Physics

Assessment Unit AS 1

assessing

Module 1: Forces, Energy and Electricity

[AY111]

AY111

THURSDAY 12 JANUARY, AFTERNOON

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 **3**.
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 in the Data and Formulae sheet.

Answer **all ten** questions.

Examiner Only	
Marks	Remark

1 **(i)** What are base units?

_____

_____ [1]

(ii) State six base S.I. units.

_____

_____

_____

_____

_____

_____ [3]

(iii) The unit of stress is the pascal. Express the pascal in base units.

Base units = _____ [2]

Examiner Only	
Marks	Remark

2 Two forces of 2 N and 5 N act on a body B as shown in **Fig. 2.1**.

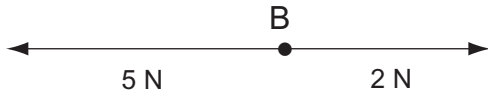

Fig. 2.1

(a) State the magnitude and direction of the resultant force on B.

Magnitude = _____ N

Direction = _____ [2]

(b) The 2 N force is now turned through 90º as shown in **Fig. 2.2** (not to scale).

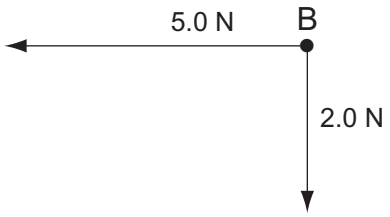

Fig. 2.2

By calculation or by use of a scale drawing, determine the magnitude and direction of the resultant force on the body B.

Magnitude = _____ N

Direction = _____ º to horizontal [4]

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

In this question you are to outline an experiment to measure the acceleration of free fall, *g*. Make use of the following headings:

(i) Labelled diagram of the experimental arrangement.

[2]

(ii) Measurements that are required for *g* to be determined accurately. (N.B.: If a data logging method is chosen, comment on data that is input as well as output data.)

_____

_____

_____ [2]

(iii) How the measurements would be used to obtain the value of *g*.

_____

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

(iv) The measurements taken in **(ii)** are subject to uncertainty. Which of these uncertainties do you consider to be the most significant in determining the value of *g*? Explain your answer.

_____

_____

_____

_____ [1]

Quality of written communication [2]

Examiner Only	
Marks	Remark

4 A clay pigeon is a disc made of clay which when launched into the air acts as a target for people to shoot at. A clay pigeon launcher is situated 4 m behind a protective fence as shown in **Fig. 4.1**. The clay pigeon leaves the launcher at a speed of 26 m s^{-1} at an angle 50º to the horizontal.

Fig. 4.1

(a) (i) Show that it takes the clay pigeon 0.24 s to reach the top of the fence after launch.

[2]

(ii) Calculate the height of the fence if the clay pigeon just clears it.

Height = _____ m [3]

Examiner Only	
Marks	Remark

(b) The person holding the gun is standing at the point P. He has been told that at the top of the clay pigeon's trajectory the clay pigeon **comes to rest**.

(i) Do you agree or disagree with this statement? Explain your answer.

_____

_____

_____ [1]

(ii) Calculate the length of time between the person seeing the clay pigeon appearing at the top of the fence and it reaching the top of its trajectory.

Time = _____ s [4]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

5 **(a)** State the principle of moments.

_____

_____

_____

_____ [2]

(b) A uniform iron bar of length 4.0 m and weight 200 N is secured to a wall. The bar is held horizontally by a wire fixed to one end as shown in **Fig. 5.1**. The angle between the wire and the bar is 30º.

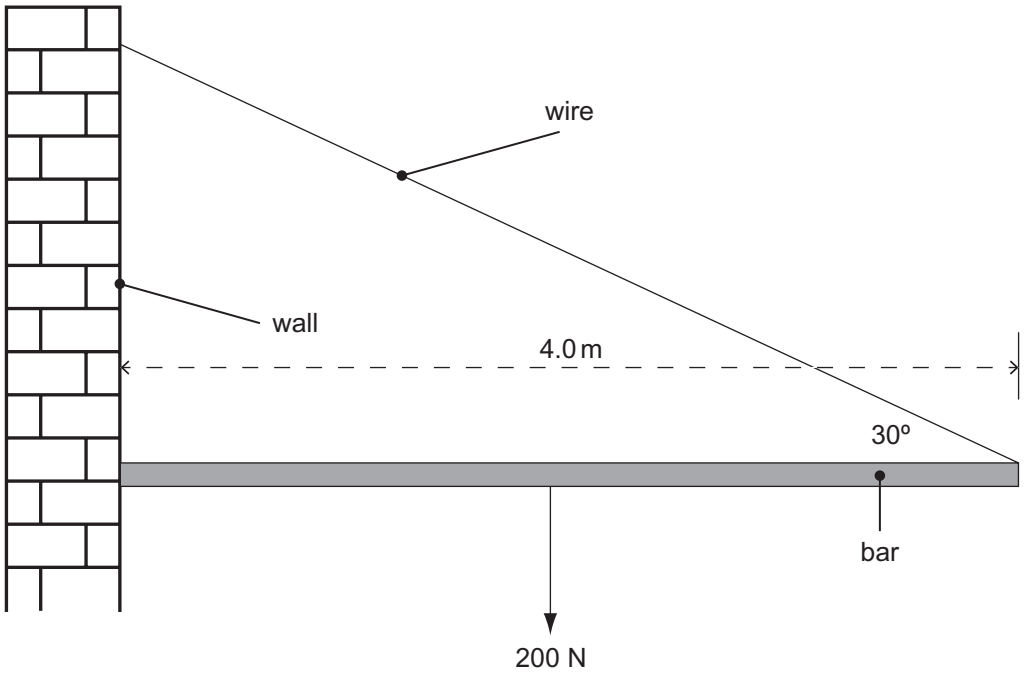

Fig. 5.1

(i) Calculate the tension in the wire.

Tension = _____ N [3]

Examiner Only	
Marks	Remark

(ii) The tension calculated in **(i)** represents 40% of the maximum tension that the wire can withstand before breaking. A youth of mass 60 kg jumps up and grabs the bar with one hand at the point C, 1.2 m from the wall. This is shown in **Fig. 5.2**.

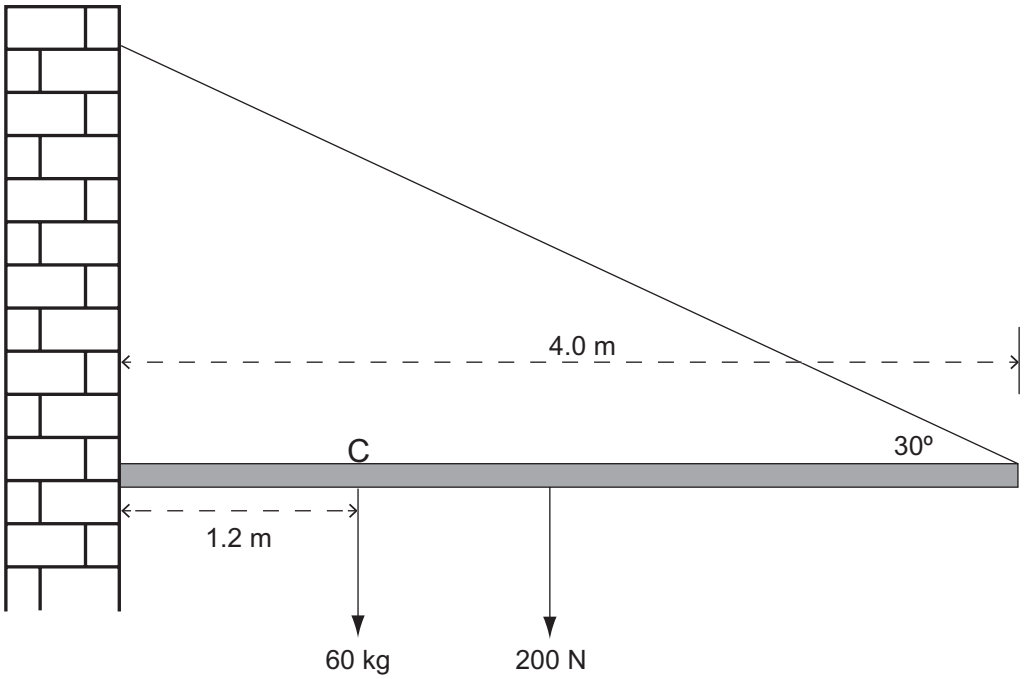

Fig. 5.2

By making an appropriate calculation, state, with an explanation, what will happen.

_____

_____

_____ [3]

Examiner Only	
Marks	Remark

6 An electric motor is used to pull up a bucket of water from the bottom of a well as shown in **Fig. 6.1**. The motor is attached to the bucket by a rope which passes over a pulley.

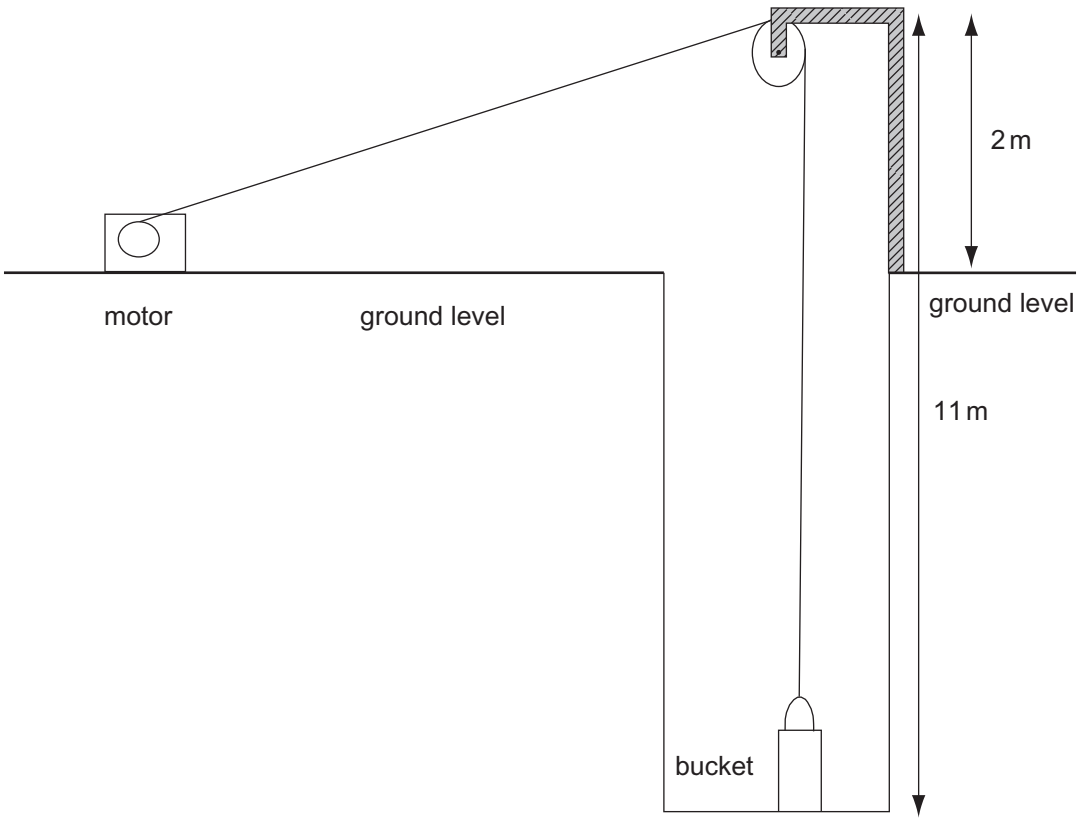

Fig. 6.1

The mass of the bucket and the water is 8 kg.

(a) Calculate the gain in potential energy of the bucket and water when it is raised from the bottom of the well to **ground level**.

Gain in PE = _____ J [2]

(b) (i) The motor is rated at 240 V, 1.5 A. Calculate the power of the motor.

Power = _____ W [2]

(ii) If the motor is 80% efficient, calculate how long it will take to raise the bucket and water from the bottom of the well to ground level.

Time = _____ s [3]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

7 **(a)** An iron wire PQ is fused at one end, Q, to a copper wire QR as shown in **Fig. 7.1**. The wire is clamped tightly at P.

Fig. 7.1

The copper wire is 0.90 m long and its force constant $k_c = 130\,\text{N}\,\text{cm}^{-1}$. The iron wire is 1.40 m long and its force constant $k_i = 195\,\text{N}\,\text{cm}^{-1}$. A stretching force of 780 N is applied at R.

Calculate the total length of the combined wire PR when the 780 N force is applied. Ignore the weight of the wires.

Length of wire PR = _____ m [3]

(b) **Fig. 7.2** shows a force–extension graph for another wire.

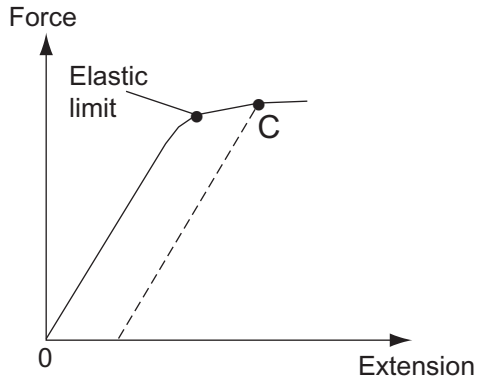

Fig. 7.2

(i) With reference to **Fig. 7.2**, explain why Hooke's law does not apply up to the elastic limit.

_____

_____

_____

_____ [3]

(ii) Explain why, when the extension is increased to point C, the wire does not return to its original length when the force is removed.

_____

_____

_____ [2]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

8 **(a)** Define the electromotive force of a battery.

_____

_____

_____ [2]

(b) A 12 Ω resistor is joined to the terminals of a battery of e.m.f. 10 V and internal resistance 4 Ω, as shown in **Fig. 8.1**.

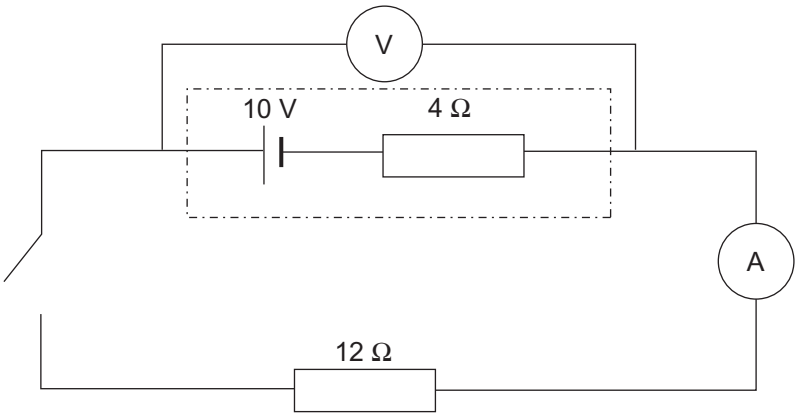

Fig. 8.1

The switch is closed.

(i) Calculate the reading on the ammeter.

Current = _____ A [2]

(ii) Calculate the reading on the voltmeter, attached as shown in **Fig. 8.1**.

p.d. = _____ V [2]

(iii) An alternative battery of the same e.m.f. but lower internal resistance is used. State **two** of the changes this would make to the performance of the circuit.

Examiner Only

Marks	Remark

_____

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

9 **(a)** Explain what non-ohmic behaviour means.

_____

_____

_____ [1]

(b) **(i)** A thermistor is made from a semiconducting material which has a negative temperature coefficient.

Sketch a graph to show the variation with temperature of the resistance of a negative temperature coefficient thermistor.

[2]

(ii) What property of ntc semi-conductors gives rise to this resistance change with temperature increase?

_____

_____

_____ [1]

10 The circuit in **Fig. 10.1** consists of three resistors of values shown with a switch S between B and C.

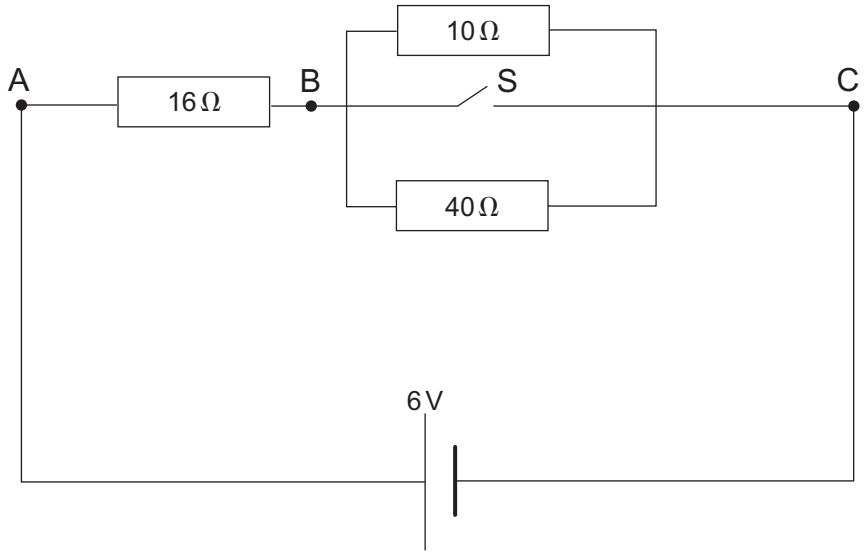

Fig. 10.1

(a) (i) Calculate the current flowing through the 16 Ω resistor, when switch S is open.

Current = _____ A [4]

(ii) Calculate the current flowing through the 40 Ω resistor, when the switch S is open.

Current = _____ A [2]

Examiner Only

Marks	Remark

(b) (i) The switch S between B and C is now closed. Calculate the current flowing through the 16 Ω resistor.

Current = _____ A [2]

(ii) What is the current flowing through the 40 Ω resistor?

Current = _____ A [1]

THIS IS THE END OF THE QUESTION PAPER

Examiner Only	
Marks	Remark

112604

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	$\lambda = \frac{h}{p}$