Rewarding Learning

Centre Number	
71	

Candidate Number

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2014

Physics

Assessment Unit AS 1

assessing

Module 1: Forces, Energy and Electricity

[AY111]

AY111

WEDNESDAY 11 JUNE, 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 answer 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 **4**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each part of the 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	
11	
Total Marks	

Examiner Only	
Marks	Remark

1 **(i)** State the SI unit of resistance.

SI unit _____ [1]

(ii) The SI unit of resistance is known as a **derived unit**. Explain what is meant by the words in **bold** type.

_____

_____

_____ [1]

(iii) Use the relationship $P = I^2R$, where P is power and I is current to express resistance, R, in SI base units.

SI base units _____ [3]

(iv) Is resistance a scalar quantity or a vector quantity? Place a tick in the appropriate box.

Scalar ☐

Vector ☐

Why have you chosen this option?

_____

_____

_____ [1]

2 **(a)** A passenger jet airliner has a landing velocity of $72.0\,m\,s^{-1}$ as its wheels touch the runway. Its velocity is reduced to its taxiing velocity of $8.50\,m\,s^{-1}$ in 12.0 seconds as it travels along the runway. Show that the jet reaches its taxiing velocity in a distance of 483 m.

[3]

(b) **(i)** The airliner is refuelled and passengers, with their luggage, board in preparation for the next flight. The airliner must attain a speed of $80.0\,m\,s^{-1}$ from a standing start to be able to lift off. If the acceleration of the airliner under these conditions is considered constant at $0.96\,m\,s^{-2}$, calculate by how much the 2780 m long runway is short.

Runway is short by _____ m [2]

(ii) The airliner is refused permission to take off. Suggest a course of action that could be taken and explain fully how this action will result in the airliner being able to take off from this runway.

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

3 An athlete is taking part in a shot-put event. The shot leaves the athlete's hand at a height of 2.0 m above the ground and the velocity of the shot at the instant it leaves the athlete's hand is 13.5 m s^{-1} at an angle of 40° to the horizontal. The path of the shot is shown in **Fig. 3.1**. Air resistance can be neglected.

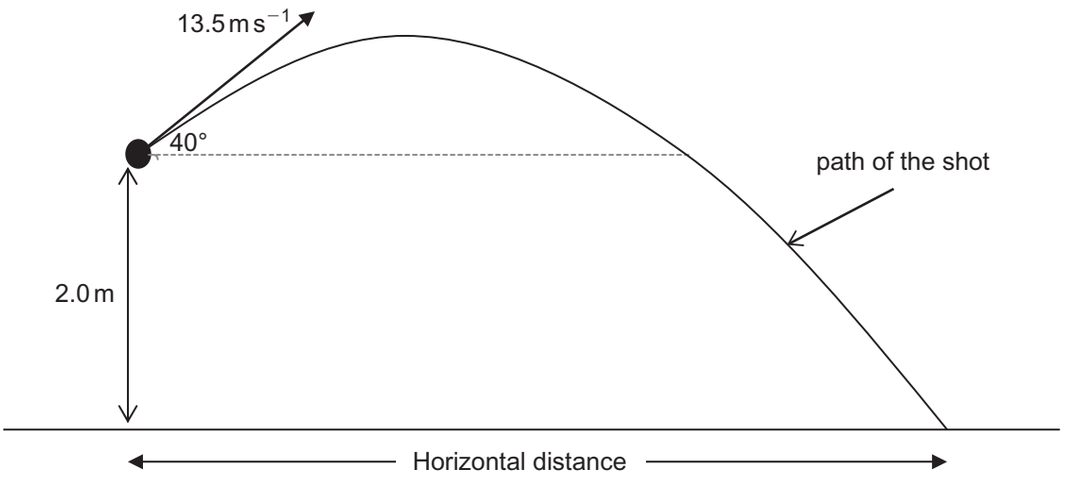

Fig. 3.1

(i) Calculate the time taken for the shot to reach its maximum height.

Time = _____ s [2]

(ii) Calculate the maximum height reached by the shot **above the ground**.

Height = _____ m [2]

(iii) Calculate the horizontal distance travelled by the shot, see **Fig. 3.1**.

Distance = _____ m [5]

Examiner Only	
Marks	Remark

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

Examiner Only	
Marks	Remark

4 Curling is a sport in which players slide heavy granite stones across a sheet of ice towards a target area called the House. The stone is launched from a line called the Hogline. The House is segmented into 4 rings as shown in **Fig. 4.1** and the winning team is the one with a stone closest to the centre (D) of the House.

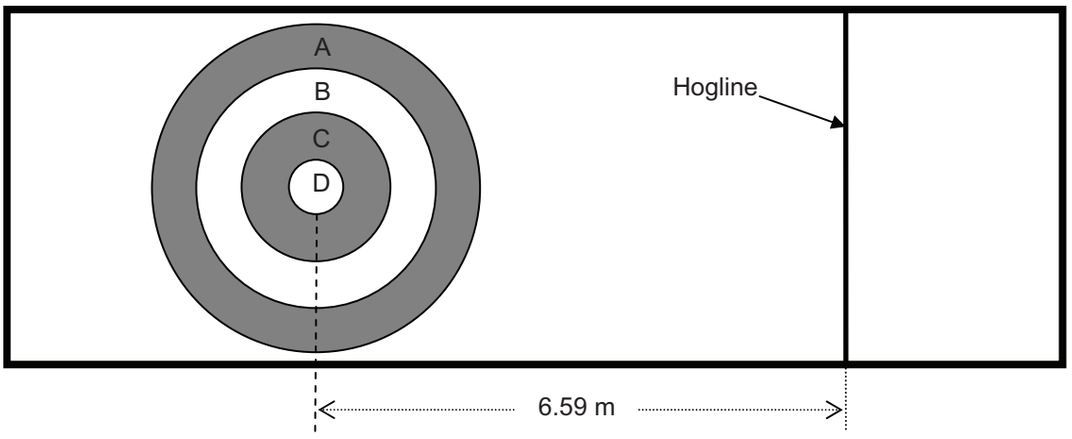

Fig. 4.1

(a) During a practice session, a stone launched with a kinetic energy of 19.2 J from the Hogline travels 6.59 m and stops in segment D of the House.

(i) Determine the magnitude of the average opposing force acting on the stone during its passage across the ice from its launch point.

Average force = _____ N [2]

(ii) The rules of curling allow the ice to be swept. This reduces the size of the average opposing force by 12% on the day of the practice. Calculate the kinetic energy with which a stone must be released if it is to stop in zone D of the house if the ice is swept for the last 3.00 m of its journey.

Kinetic energy = _____ J [2]

(b) It is customary when releasing the stone to cause it to rotate or "curl". This results in the stone's path bending or "curling". The slower the speed of the stone the more it curls. Two other members of the team have brushes. What effect does sweeping have on the motion of the stone and the path taken?

_____

_____

_____

_____

_____

_____ [2]

Quality of written communication [2]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

5 **(a)** Define the moment of a force.

_____

_____

_____ [1]

(b) An extendable wrench is often used to remove the wheel nuts from a car. The length, l, of the shaft of the wrench can extend from 32 cm to 54 cm as shown on **Fig. 5.1**.

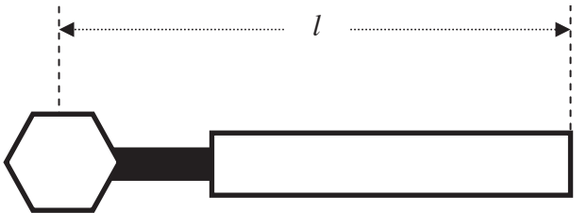

Fig. 5.1

(i) Calculate the percentage reduction in the force required to perform the same task with the wheel wrench at its longest compared to when it is at its shortest.

Percentage reduction = _____ % [2]

A 62 kg woman attaches the wrench to a wheel nut and finds it makes an angle of 34° to the horizontal. She finds that by standing on the extreme end of the wrench, which is at its minimum length of 32 cm, she can just loosen the nut attached to the wheel. See **Fig. 5.2**.

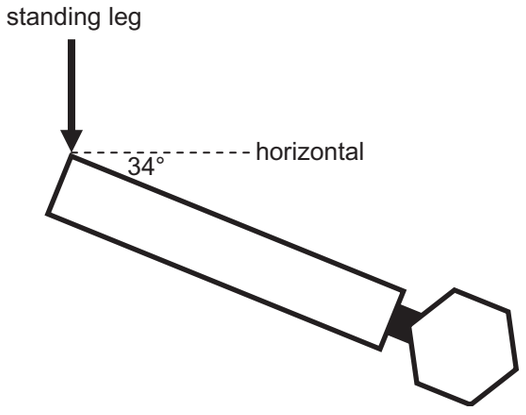

Fig. 5.2

(ii) Calculate the moment produced by the woman under these conditions.

Moment = _____ N m [3]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

6 **(a)** Define Power

_____

_____ [1]

A soldier of mass 76.0 kg is carrying a backpack of mass 28.5 kg. He is taking part in an assault course. Part of the course involves climbing a vertical wall of height 2.75 m using a rope as shown in **Fig. 6.1**.

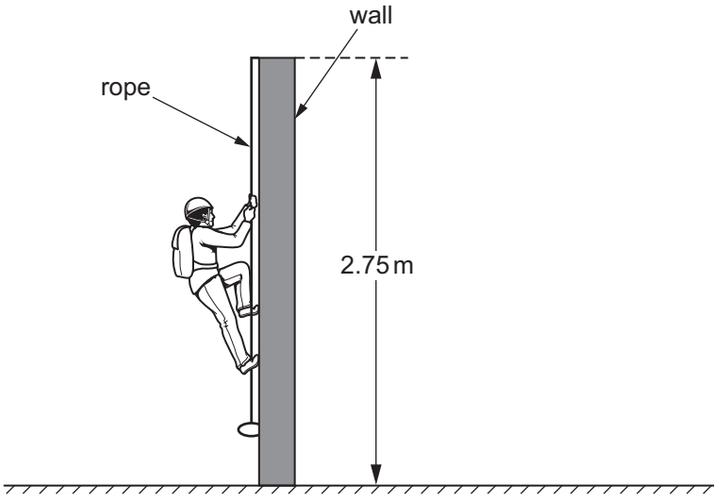

Fig. 6.1

(b) The soldier climbs the wall and stands on top of it. Calculate the average power developed by the soldier in climbing the wall if he takes 65.0 s to climb it.

Power = _____ W [3]

(c) After climbing the wall, the soldier runs along a walkway to a platform which is 5.2 m above the ground as shown in **Fig. 6.2**. He stops and grabs hold of a wooden bar attached to a pulley on a rope. Calculate the speed with which his feet hit the ground. Assume friction between the pulley and the rope converts 35% of the kinetic energy into heat and sound as the soldier slides down to the ground.

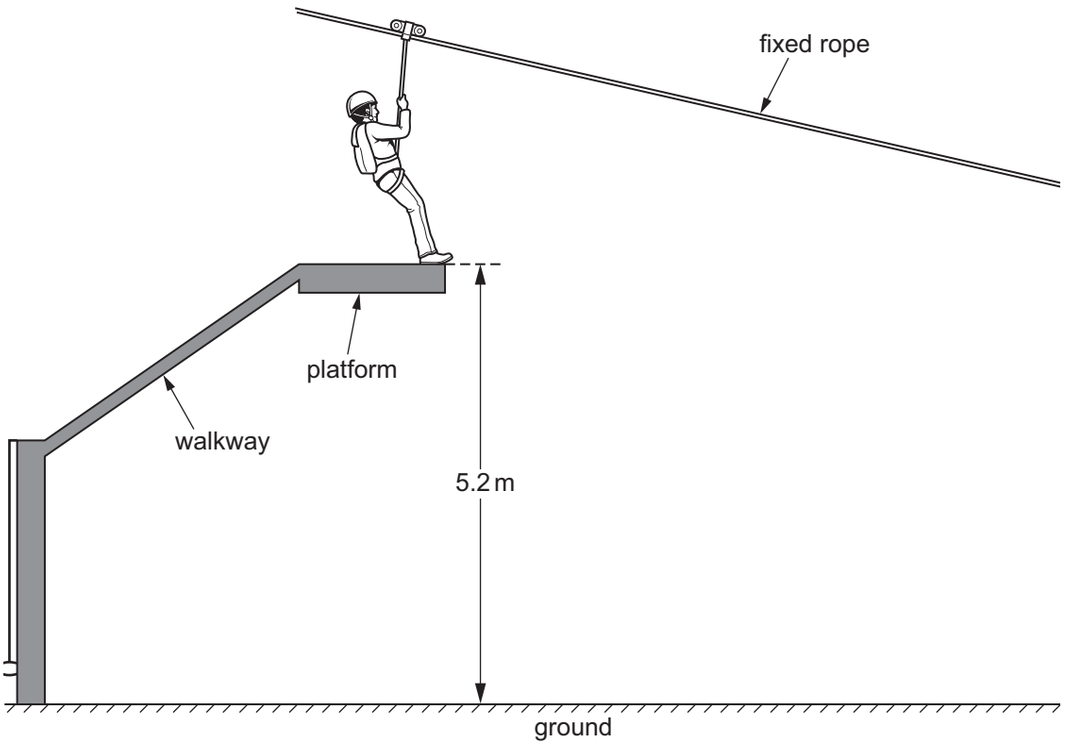

Fig. 6.2

Speed = _____ $m\,s^{-1}$ [3]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

7 The graph of **Fig. 7.1** shows the extension produced in a steel wire, of length 3.24 m and diameter 0.193 mm, when tensile forces up to 60 N are added.

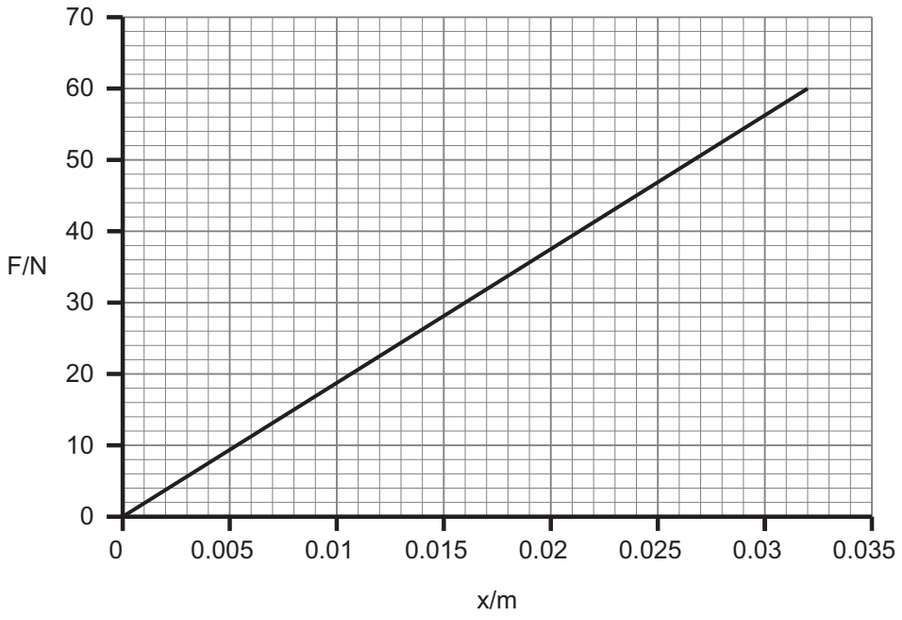

Fig. 7.1

(a) Determine the Young modulus of steel and state its units.

Young modulus = _____ [3]

Unit = _____ [1]

(b) The **Ultimate Tensile Stress** of steel is 990 MPa. Explain the phrase in **bold** type.

_____

_____

_____

_____ [3]

Examiner Only	
Marks	Remark

8 A constant potential difference of 6.3 V is applied between the ends of a uniform metal wire causing a steady current of 12 mA.

(a) (i) Deduce the charge passing a point in the wire every second.

Charge = _____ C [1]

(ii) Determine the amount of energy converted from electrical energy while the charge deduced in **(a)(i)** passes.

Energy = _____ J [2]

(b) If the 12 mA current in the wire flows for 90 s, calculate the number of electrons which flow past any point in the circuit.

Number of electrons = _____ [3]

Examiner Only	
Marks	Remark

9 **(a)** The fuse fitted to a three pin plug is designed to melt when the current exceeds 13A. It is made of a piece of fuse wire, 25.4 mm long, of resistivity $1.45 \times 10^{-6} \Omega$m and has a resistance of 0.19Ω. What is the minimum diameter of fuse wire which must be used if it is to allow 13.0A to pass through the fuse?

Diameter = _____ mm [4]

(b) If it was required that the fuse wire melted with a smaller current, how must the wire be changed if it has the same length and is made of the same material? Explain your answer.

_____

_____

_____ [3]

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(Questions continue overleaf)

Examiner Only	
Marks	Remark

10 **Fig. 10.1** shows the graphical result of an experiment to determine the internal resistance of a battery. A software package has been used to add a trend line (best-fit line) and to give the equation for the linear trend line.

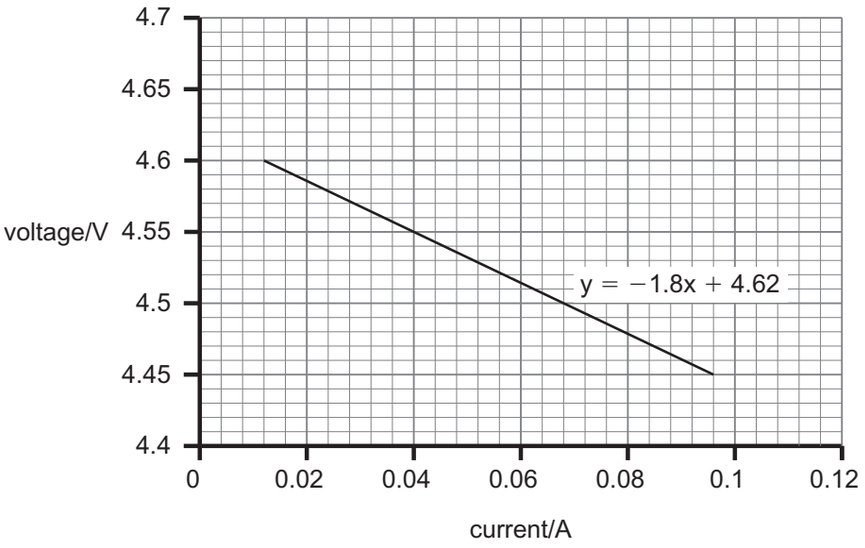

Fig. 10.1

(a) Analyse the equation for the trend-line and state the information it provides about the battery.

_____

_____

_____ [2]

(b) **(i)** Draw a circuit diagram that would facilitate the gathering of the data represented graphically in **Fig. 10.1**.

[3]

(ii) Describe how the experiment is conducted to obtain the data required.

Examiner Only	
Marks	Remark

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

11 **Fig. 11.1** shows a potential divider circuit. A voltmeter of resistance 20 kΩ is connected as shown. The values of R_1 and R_2 are both equal to 20 kΩ.

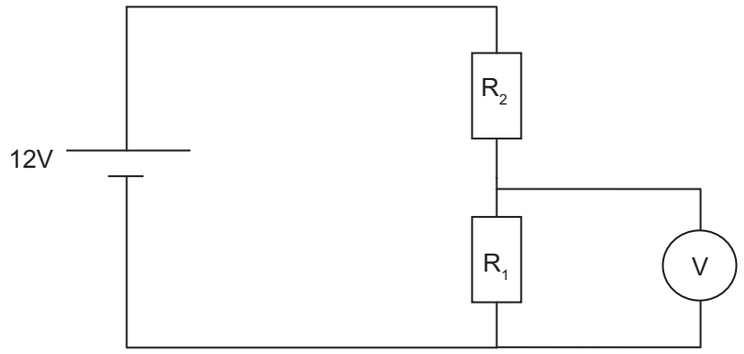

Fig. 11.1

(a) Calculate the value of the reading on the voltmeter.

Voltmeter reading = _____ V [3]

(b) The voltmeter is removed from the circuit and replaced by another voltmeter of resistance 10 MΩ.

Explain why the output voltage is the same as when no voltmeter is connected across resistor R_1.

_____

_____

_____ [2]

THIS IS THE END OF THE QUESTION PAPER

178878

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 eV $= 1.60 \times 10^{-19}$ 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	$\lambda = \frac{h}{p}$