New Specification

Rewarding Learning

Centre Number	
71	

Candidate Number

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
January 2010

Physics

Assessment Unit AS 1

Module 1: Forces, Energy and Electricity

[AY111]

AY111

WEDNESDAY 13 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	

Examiner Only	
Marks	Remark

1 The following is a list of physical quantities.

Energy Force Temperature Acceleration Distance

(a) (i) Underline those that are vectors [1]

(ii) State the difference between a vector and a scalar.

_____

_____ [1]

(b) (i) **Fig. 1.1** shows two children playing by pulling on a rope connected through a smooth hook on a beam.

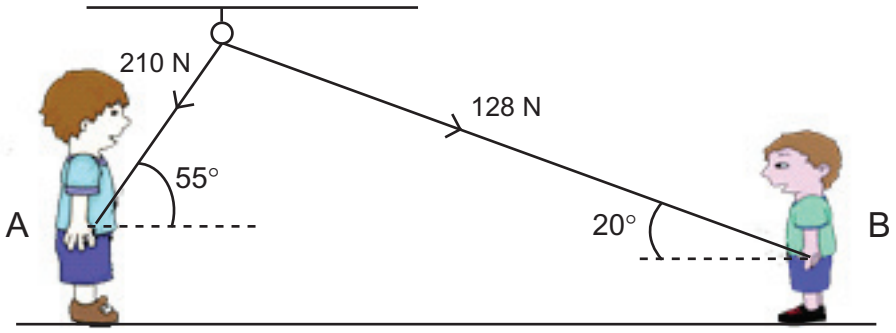

Fig. 1.1

Child A pulls with a force of 210 N at an angle of 55° from the horizontal.
Calculate the vertical component of the force with which child A is pulling.

Vertical component of force = _____ N [2]

(ii) When child B pulls on the rope with a force of 128 N at 20° above the horizontal, the rope does not move.

1. What condition must be met for this to happen?

_____

_____ [1]

2. Confirm, by calculation, that the forces given satisfy this condition.

[2]

Examiner Only	
Marks	Remark

2 Describe an experiment to measure the acceleration of freefall, g.

In your answer:

(a) draw a labelled diagram of the arrangement,

(b) give an account of the method, stating what is measured and how,

(c) explain how the measurements are used to determine a value for g.

Examiner Only	
Marks	Remark

(a) Diagram

[2]

(b) Method

_____

_____

_____

_____

_____ [3]

(c) Determining a value for g

_____

_____

_____

_____

_____ [3]

3 A train of mass 2.3×10^6 kg travels at a constant speed of $20\,m\,s^{-1}$. There are opposing forces on the train of 0.6 N for every 1 kg of its mass.

Examiner Only	
Marks	Remark

(a) (i) Calculate the opposing force acting on the train.

Opposing force = _____ N [1]

(ii) If the train then accelerates at $0.20\,m\,s^{-2}$, calculate the driving force required to overcome these opposing forces and produce this acceleration.

Force = _____ N [4]

(b) The train now goes onto a section of the track which has been covered by leaves and is slippery as a result. Describe and explain what effect this would have on the motion of the train.

_____

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

4 A diver stands on the end of an adjustable springboard as shown in **Fig. 4.1**.

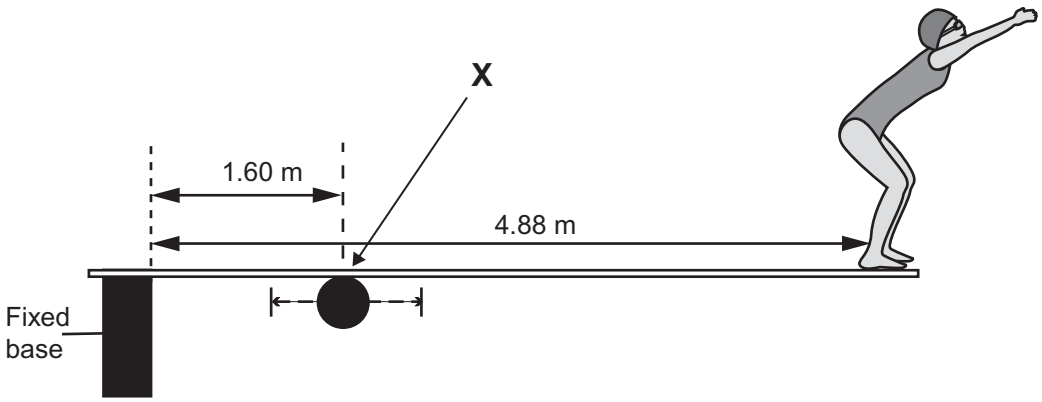

Fig 4.1

The diver exerts a moment on the springboard about the pivot at point **X**.

(a) On what two factors will the size of the moment the diver exerts depend?

_____

_____ [2]

(b) The total length of the springboard is 4.88 m and the pivot **X** can be adjusted to move a distance of 0.28 m on either side of its centre position as shown in **Fig. 4.1**.

(i) Show that the **maximum** moment that a diver of mass 65 kg can exert when she stands on the end of the springboard is 2270 N m.

[3]

(ii) A different diver of mass 75 kg now stands on their own on the end of the springboard. By how much, and in what direction, will the pivot need to be moved from its **central position** for this diver to exert the same moment as the 65 kg diver in **(b)(i)**?

Distance = _____ m

Direction _____ [4]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

5 **(a)** State the principle of conservation of energy.

_____

_____ [1]

(b) A cyclist starts from rest at the top of a hill which has a vertical height of 8 m. See **Fig. 5.1**. As she freewheels down the hill, 15% of her energy is dissipated as heat due to friction.

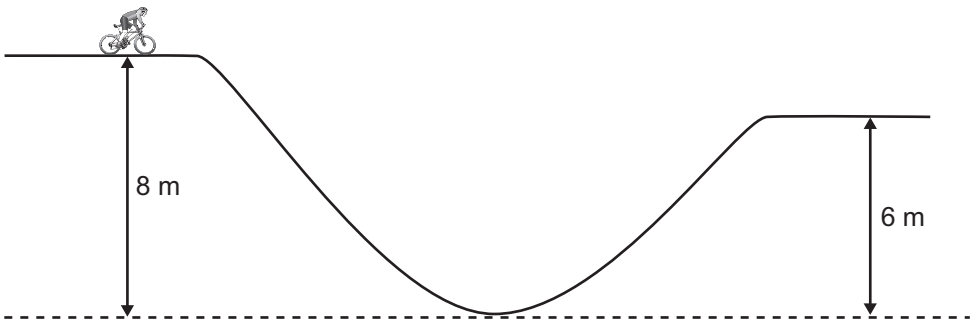

Fig. 5.1

The combined mass of the bicycle and cyclist is 90 kg.

(i) Calculate the speed with which she reaches the bottom of the hill.

Speed = _____ m s^{-1} [2]

(ii) The cyclist starts to pedal at the bottom of the next hill which is 6 m high. She reaches the top of this hill at a speed of 8.9 m s^{-1}. Assuming there are no energy losses after the cyclist reaches the bottom of the first hill, calculate how much work the cyclist does as she pedals to the top of the second hill.

Work done = _____ J [4]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

6 **(a)** State Hooke's Law.

_____

_____ [1]

A student carried out an experiment to investigate the stretching of a spring as various masses were added to provide the stretching force. The results obtained are shown in **Table 6.1**.
The original length of the spring was 5.2 cm.

Table 6.1

Mass added/ kg	Load/N	Length of spring/cm	Extension/cm
1.00		6.1	
2.00		7.0	
3.00		7.9	
4.00		8.8	
5.00		9.7	

(b) Calculate values for the load and the extension for each added mass and fill in the appropriate columns in **Table 6.1**. [2]

(c) **(i)** Use values from the table to prove that load is directly proportional to extension and hence calculate a value for the spring constant of the spring, *k*.

k = _____ N m^{-1} [3]

(ii) How could a value of *k* be obtained graphically from these results?

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

7 **(a)** **(i)** The accepted unit for force is the newton and the accepted unit for electromotive force is the volt. Express both the newton and the volt in base units.

Base unit of the newton = _____ [1]

Base unit of the volt = _____ [2]

(ii) With reference to **(a)(i)**, explain whether or not electromotive force should be considered to be a force.

_____

_____ [1]

(b) **(i)** Define the potential difference.

_____

_____ [1]

(ii) Under what condition does the potential difference across the terminals of a battery equal its electromotive force?

_____

_____ [1]

8 A network of resistors is shown in **Fig. 8.1**.

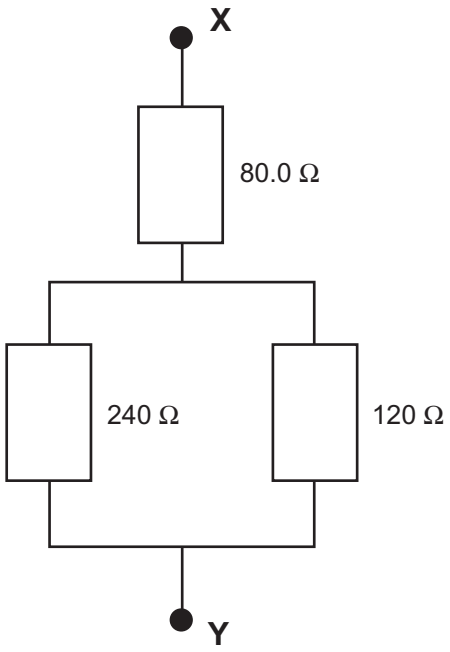

Fig. 8.1

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

Resistance = _____ Ω [2]

(b) (i) The 80.0 Ω resistor in the circuit has a power rating of 1.00 W. Show the maximum current that can flow through the 80.0 Ω resistor without exceeding its power rating is 112 mA.

[2]

Examiner Only	
Marks	Remark

(ii) Calculate the current flowing through the 120 Ω resistor when 112 mA flows through the 80.0 Ω resistor.

Current = _____ mA [3]

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

9 A student carried out an experiment to investigate the relationship between current and voltage for a metallic conductor in the form of the filament of a bulb.

(a) Draw a suitable circuit diagram that could be used to carry out this experiment.

[3]

The graph obtained by the pupil is shown in **Fig 9.1**.

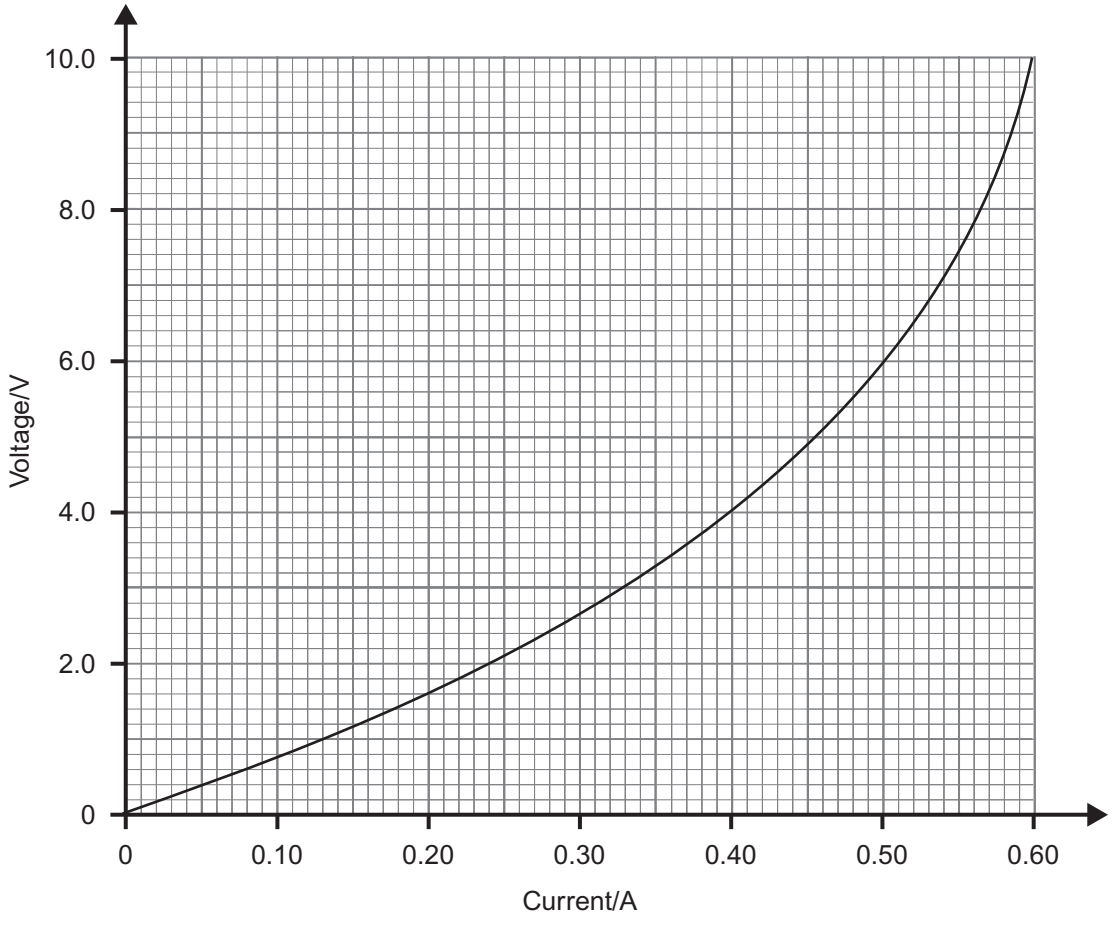

Fig 9.1

(b) State what happens to the resistance of the filament of the lamp as current increases and explain why this change in resistance happens.

Examiner Only

Marks	Remark

_____

_____

_____

_____

_____

_____ [3]

Quality of written communication [2]

(c) Take suitable readings from the graph to calculate the resistance of the filament lamp at a current of 0.50A.

Resistance = ____ Ω [2]

Examiner Only	
Marks	Remark

10 A circuit to turn on a light automatically when it gets dark is shown in **Fig. 10.1**. It makes use of a light dependent resistor, LDR, the resistance of which depends on the amount of light shining on it and a fixed resistor of resistance 10 kΩ.

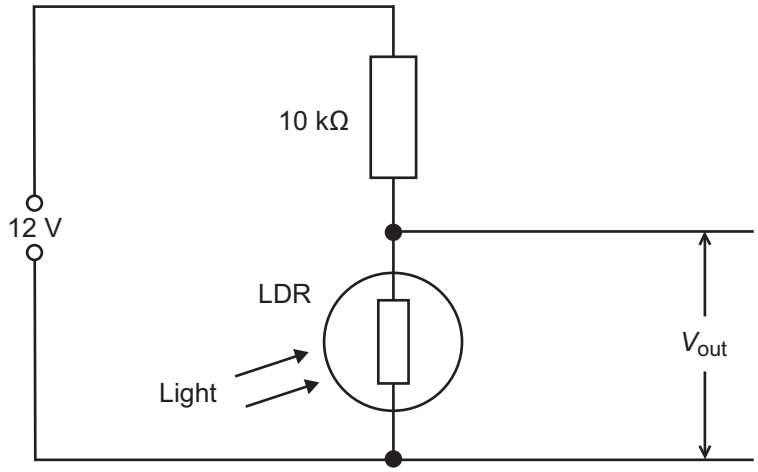

Fig. 10.1

(a) The LDR has a resistance of 500 Ω in bright light and 200 kΩ when it is dark.

(i) Calculate the output voltage V_{out}, when the LDR is in bright light.

[2]

(ii) The lamp connected across the output, V_{out} lights when V_{out} is greater than 10 V. Show that the lamp will light in the dark.

[2]

(b) Describe and explain what effect swapping the positions of the LDR and the fixed resistor in the circuit would have.

Examiner Only

Marks	Remark

_____

_____

_____ [2]

THIS IS THE END OF THE QUESTION PAPER