Rewarding Learning

ADVANCED SUBSIDIARY
General Certificate of Education
2012

Centre Number

71	

Candidate Number

Physics

Assessment Unit AS 1

assessing

Module 1: Forces, Energy and Electricity

[AY111]

AY111

MONDAY 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 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(a)**.
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	

1 **Table 1.1** lists the magnitudes, quoted using a variety of prefixes, of the **same** physical quantity for five different machines.

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Marks	Remark

Table 1.1

	Physical quantity
Machine 1	2.73 mJ cs^{-1}
Machine 2	33.8 MJ μs^{-1}
Machine 3	44.6 μJ Ms^{-1}
Machine 4	7.12 kJ ms^{-1}
Machine 5	875 cJ ks^{-1}

(a) **(i)** Name the physical quantity being measured.

Physical quantity = ______________________________ [1]

(ii) Deduce the **base units** for the physical quantity being measured.

Base units = __________________ [2]

(b) Identify the machine, in **Table 1.1**, with the **largest** magnitude of the physical quantity being measured. State that magnitude in its S.I. base unit and name the derived S.I. unit of the quantity.

Machine = __________________

Magnitude = __________________

S.I. unit = __________________ [3]

2 **Fig. 2.1** is a velocity–time graph for the motion of a remote controlled car as it moves along a straight track.

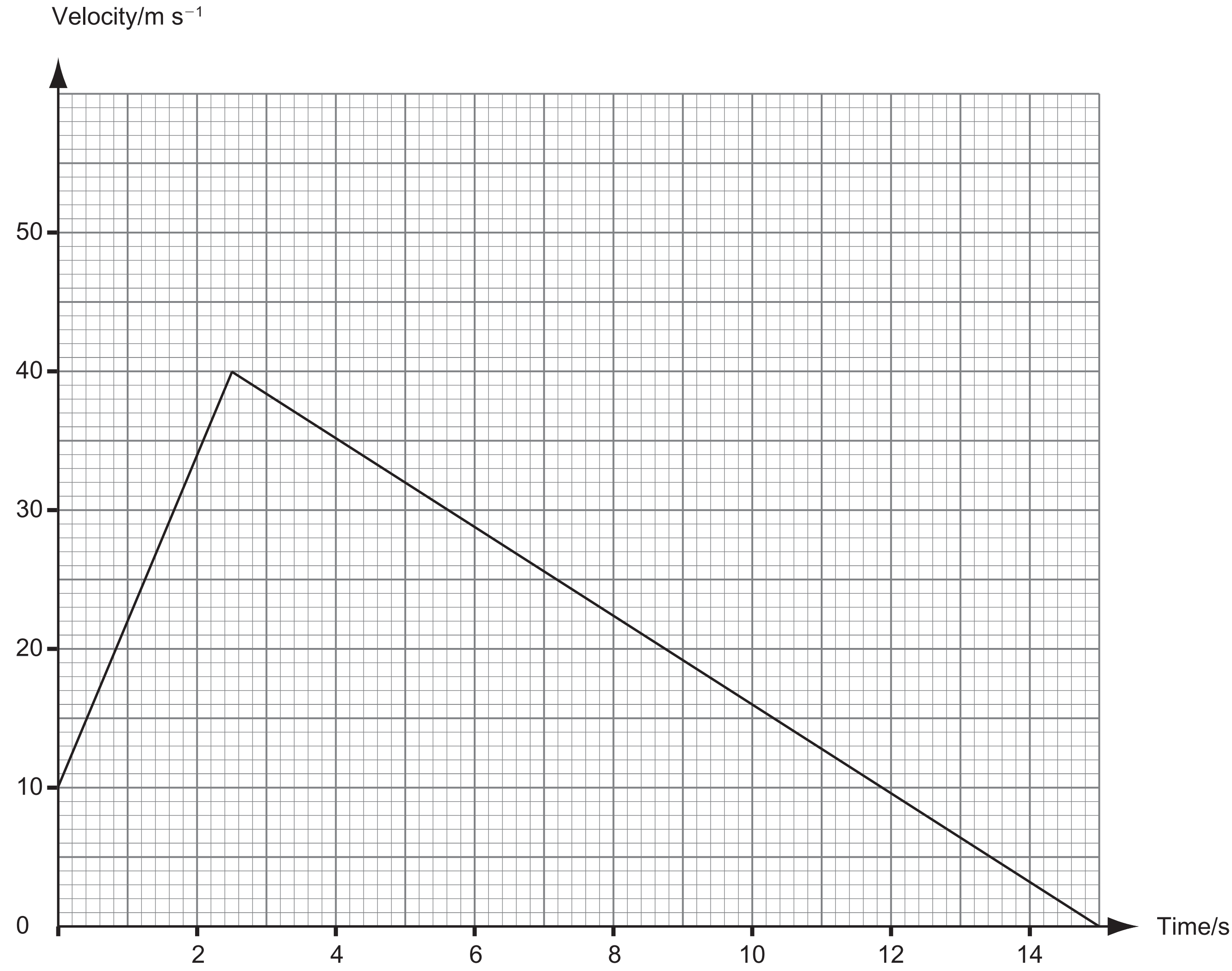

Fig. 2.1

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Marks	Remark

(a) Calculate the acceleration of the car between 2.5 s and 15 s.

Acceleration = ________________ $m\,s^{-2}$ [3]

(b) Determine the distance travelled by the car from 0 s to 15 s.

Distance = ________________ m [4]

3 The displacement, **s**, between Newtownards Airfield and Enniskillen Airfield may be taken to be 114 km and 250º measured clockwise from North. **Fig. 3.1** illustrates this situation.

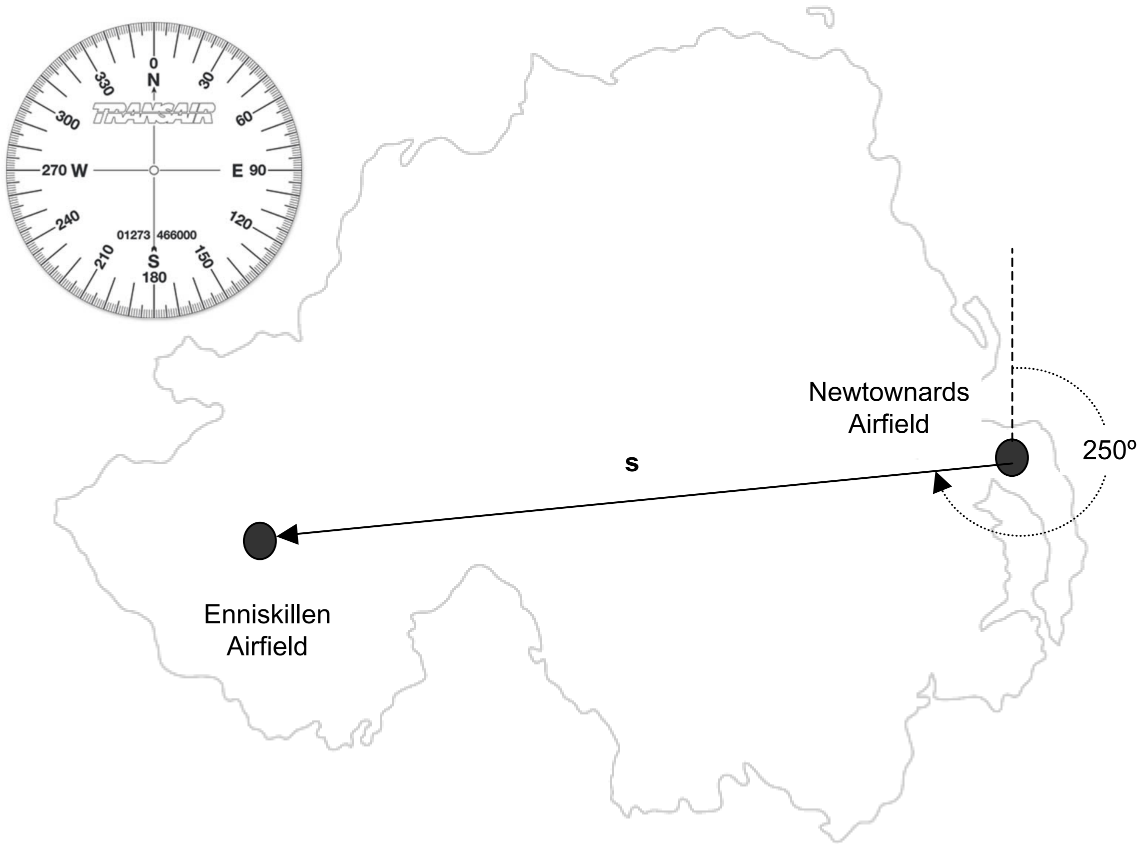

Fig. 3.1

Examiner Only	
Marks	Remark

(a) Explain the difference between distance and displacement.

____

____ [1]

(b) Calculate the perpendicular components of **s**, the displacement vector, between Newtownards Airfield and Enniskillen Airfield. Identify fully the direction of each component using the compass on **Fig. 3.1**.

Component 1: Magnitude = ________ km and Direction = ________

Component 2: Magnitude = ________ km and Direction = ________ [3]

Examiner Only	
Marks	Remark

(c) (i) On a day with no wind a pilot starts the plane flying on displacement vector **s** and does not then adjust the plane's controls. Calculate the journey time between Newtownards and Enniskillen if the average speed of the plane is 171 km h^{-1}.

Journey time = _______________ h [1]

(ii) On another day the pilot undergoes the same journey only this time there is a wind blowing with a constant speed of 36 km h^{-1} at 90º to the displacement vector **s**, as shown in **Fig. 3.2**.

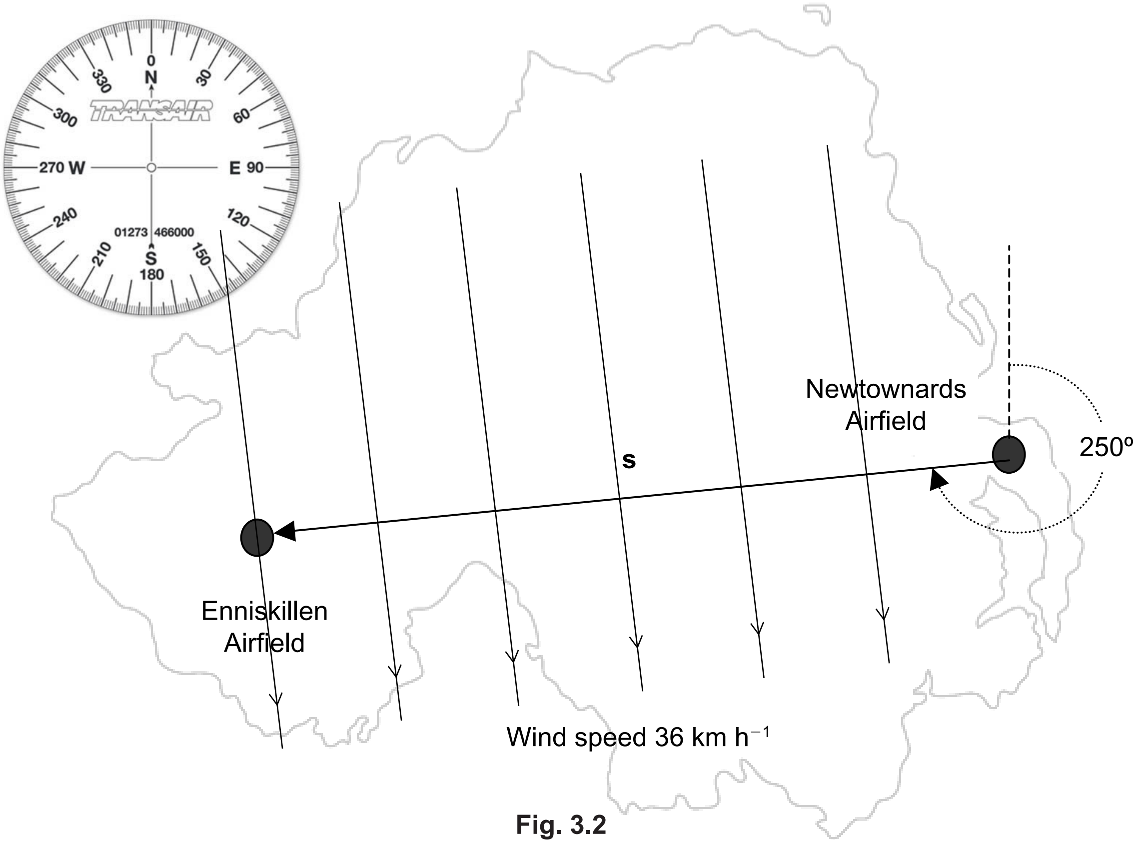

Fig. 3.2

Calculate the new average speed and the direction the plane must fly if it is to follow the original flight path **s** and reach Enniskillen in the same journey time. Also, state the angle to displacement vector **s**.

New speed = _______________ km h^{-1}

Direction = _____________º from displacement vector **s** [3]

4 **(a)** Describe projectile motion.

____

____

____

____ [2]

(b) A projectile lands at the same vertical height from which it is launched, 136 m from the launch point, after reaching a maximum height of 51.0 m.

(i) Show that the initial vertical component of velocity is 31.6 $m\,s^{-1}$.

[2]

(ii) Calculate the horizontal component of the velocity.

Horizontal component = ________________ $m\,s^{-1}$ [2]

(iii) Calculate the angle above the horizontal from which the projectile was launched.

Launch angle = ________________ ° [2]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

5 **(a)** State Newton's Second Law of motion.

____

____

____ [1]

(b) A car of mass 1800 kg is travelling at a velocity of 36 m s^{-1}. The driver applies the brakes resulting in a retardation of 8 m s^{-2}. The car comes to rest in 4.5 s.

(i) Calculate the average braking force exerted during the car's deceleration.

Force = _______________ kN [3]

(ii) In wet conditions the car comes to rest in 6.3 s, all other conditions being the same. Calculate the percentage reduction in the braking force compared to **(b)(i)**.

Percentage reduction in braking force = _______________ % [3]

6 **(a)** Define the terms power and efficiency.

Power: ____

____

Efficiency: ____

____ [2]

Examiner Only	
Marks	Remark

(b) **Fig. 6.1** illustrates a situation in which a drilling platform for use at sea is manoeuvred into position by a tugboat connected to the platform by a cable. **Fig. 6.1** is a plan (bird's eye) representation of the situation.

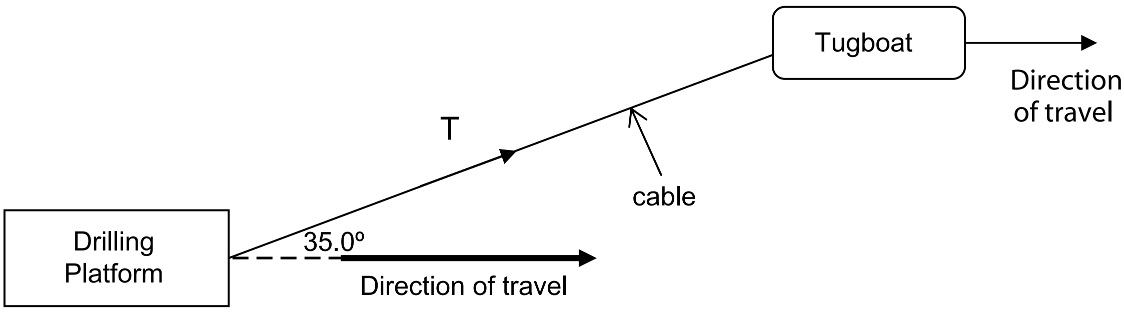

Fig. 6.1

(i) Calculate the work done in moving the drilling platform 240 m in the direction shown. The average tension T in the cable is 1.26 MN during the manoeuvre and the cable is at a 35.0º angle to the direction in which the drilling platform moves.

Work done = ____________ J [3]

Examiner Only	
Marks	Remark

(ii) If the manoeuvre is completed in 7.00 minutes and the tugboat engine has an efficiency of 0.803 (80.3%), calculate the power of the tugboat's engine as it converts energy from its diesel fuel.

Power = ________________ [3]

7 In an experiment to determine a value for the Young Modulus of a material the apparatus shown in **Fig. 7.1** was used.

Examiner Only	
Marks	Remark

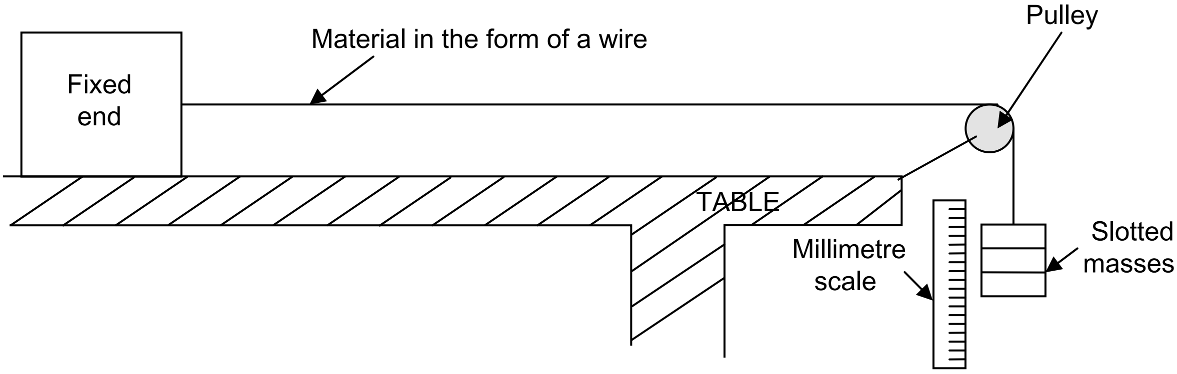

Fig. 7.1

(a) (i) Explain how you would be able to alter the stretching force over a range of values.

____

____ [1]

(ii) Explain how the extension of the wire is determined for each force added.

____

____ [1]

(b) The results in **Table 7.1** are for a piece of wire of length 2.52 m and cross-sectional area of 0.643 mm^2.

Table 7.1

Load/N	**Extension/mm**		
	Loading	**Unloading**	**Mean**
3.09	10.1	10.1	10.1
3.73	12.1	12.2	12.2
4.31	14.1	14.1	14.1
4.96	16.2	16.2	16.2
5.57	18.2	18.2	18.2

Examiner Only	
Marks	Remark

(i) In **Table 7.1**, explain why the mean extension under a load of 3.73 N is recorded as 12.2 mm when the calculated value is 12.15 mm.

____

____ [1]

(ii) In **Table 7.1**, the extension for each load is measured twice. Explain why it is good experimental practice to have multiple readings.

____

____ [1]

(iii) Define strain.

____

____ [1]

(iv) Use the data in **Table 7.1** to determine a reliable value for the Young Modulus of the material from which the wire is made. Give your answer to a suitable number of significant figures.

Young Modulus = ________________ Pa [3]

8 2.91×10^{21} electrons pass the same point in the heating element of a kettle every minute.

(a) (i) Show that the total charge flowing past a point in the heating element, every minute, is 466 C.

[1]

(ii) Hence, calculate the current flowing in the circuit.

Current = _______________ A [3]

(b) 107 kJ of electrical energy is converted to other forms of energy for every minute the kettle is switched on. Calculate the p.d. across the kettle.

p.d. = _______________ V [2]

Examiner Only	
Marks	Remark

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(Questions continue overleaf)

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.

9 Aluminium is a solid metal with a resistivity of $2.82 \times 10^{-8}\ \Omega$ m at room temperature. Resistivity may be defined using **Equation 9.1**.

$$\rho = \frac{RA}{l} \qquad \textbf{Equation 9.1}$$

(a) You are supplied with a reel of aluminium wire and the equipment found in a school Physics laboratory is available to you.

(i) Describe the procedure by which the quantity *R* can be determined.

____

____

____

____

____ [2]

(ii) Describe the procedure by which the quantity *A* can be determined.

____

____

____

____

____ [2]

Quality of written communication [2]

(b) Aluminium has a positive temperature coefficient of resistance. This means its resistance increases with increasing temperature. Aluminium has a transition temperature of 1.2 K. **Fig. 9.1** is a part of the graph showing the variation in resistance with temperature of aluminium.

Examiner Only	
Marks	Remark

(i) Use the information above to complete the sketch graph from 0 K to 2.25 K.

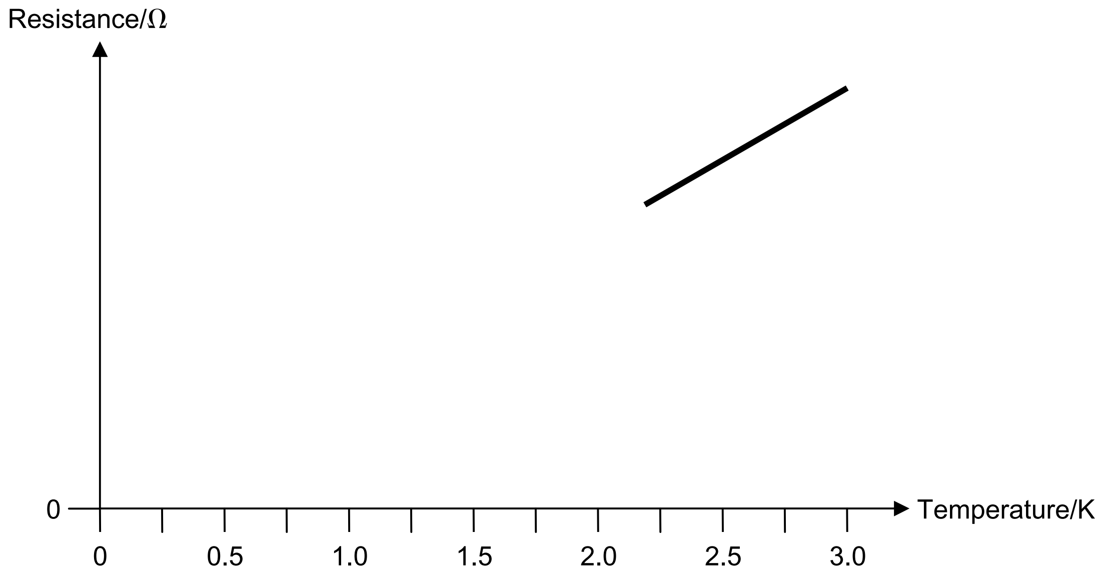

Fig. 9.1

[2]

(ii) What name is given to describe aluminium's ability to allow a charge to flow when it is cooled below its transition temperature?

_______________________________ [1]

(iii) 1.65 m of aluminium wire (diameter of 0.866 mm) is coiled around an iron core to make an electromagnet and then cooled to 1.0 K. A current of 16 A flows around the coil for 90 s during which time the electromagnet is strongly magnetic. Comment on the internal heat energy generated in the aluminium wire during the 90 s for which the current flows.

____

____ [1]

10 **Fig. 10.1** shows a potential divider circuit containing two series resistors of fixed value. A battery provides the input voltage V_{in}.

Examiner Only	
Marks	Remark

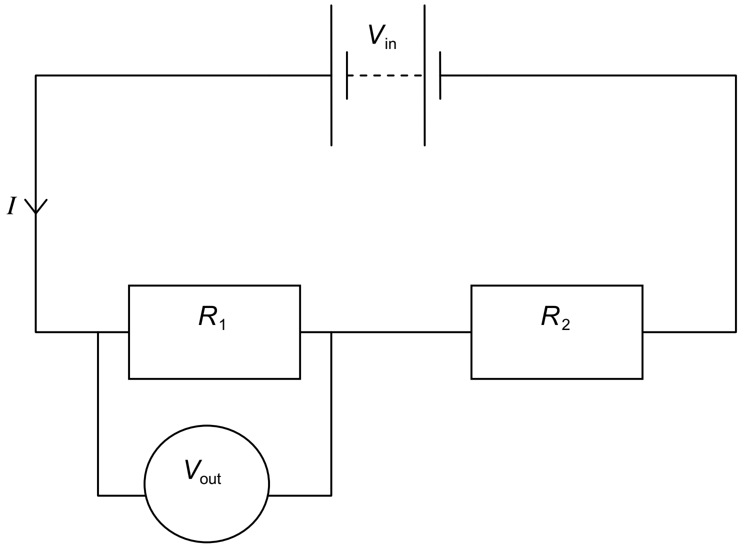

Fig. 10.1

(a) **(i)** State **two** expressions for the current I flowing through the resistors in terms of the quantities labelled in **Fig 10.1**. Assume the voltmeter is a perfect measuring instrument and does not affect the circuit.

[2]

(ii) The potential divider circuit is to be used to provide a ratio of $\frac{V_{out}}{V_{in}} = 0.625$.

If $R_1 = 500\ \Omega$ what size of resistance must be used for R_2?

$R_2 =$ ________________ Ω [2]

Fig 10.2 shows a current of 124 mA entering a junction where it splits three ways, into branches X, Y and Z. A current of 28 mA is measured in branch X and the resistance in branch Y is 3 times greater than that in branch Z.

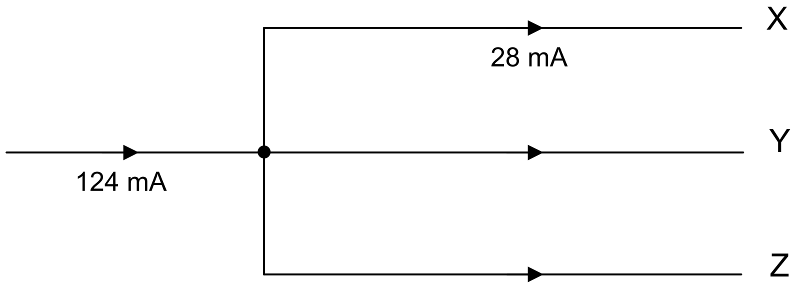

Fig. 10.2

(b) Determine the current flowing in branch Z of **Fig. 10.2**.

Current in branch Z = _______________ mA [3]

Examiner Only	
Marks	Remark

THIS IS THE END OF THE QUESTION PAPER

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