1.7 Energy, work and power

01. 0625_m20_qp_62 Q: 4

A student investigates a wind turbine, which is an electrical generator driven by a propeller blade.

Plan an experiment which will enable him to investigate how the current in a resistor connected across the terminals of the turbine varies with the speed of the air flow through the turbine.

The apparatus available includes:

a model wind turbine as shown in Fig. 4.1
an electric fan to provide the moving air to turn the turbine
a device for measuring air speed.

In your plan, you should:

- list any additional apparatus needed
- complete the wind turbine circuit diagram on Fig. 4.1
- state the key variables to be kept constant
- explain briefly how to carry out the experiment, including how the speed of the air flow is to be changed
- explain how to use the readings to reach a conclusion.

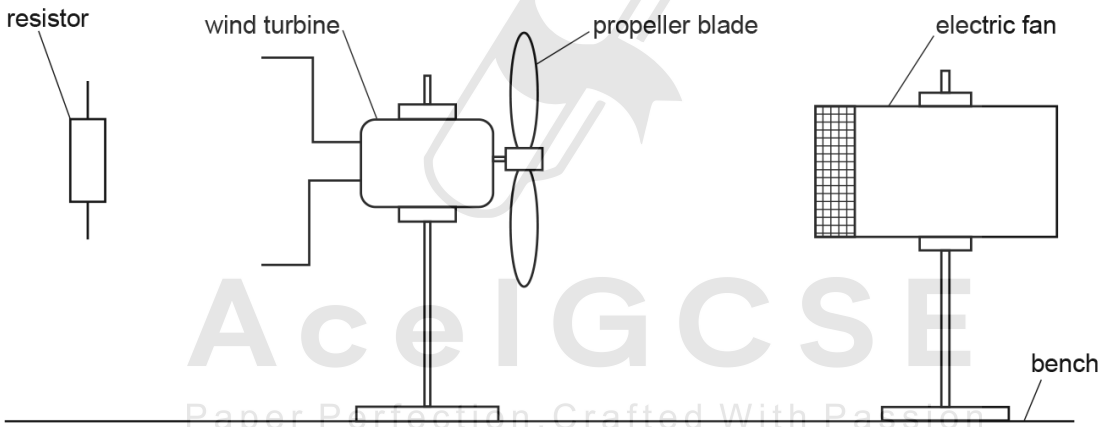

Fig. 4.1

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[Total: 7]

02. 0625_s20_qp_63 Q: 4

A student investigates the factors affecting the electrical output of a solar cell. A solar cell is a device which transforms light energy into electrical energy.

Plan an experiment which will enable him to investigate how the potential difference across the terminals of the solar cell varies with the angle of the incident light.

The apparatus available includes:

a solar cell as shown in Fig. 4.1
a laboratory lamp.

In your plan, you should:

- list any additional apparatus needed
- state the key variables to be kept constant
- explain briefly how to carry out the experiment, including any precautions that must be taken to ensure reliable results
- draw a table, with column headings, to show how to display the readings (you are **not** required to enter any readings in the table)
- explain how to use the readings to reach a conclusion.

You may add to Fig. 4.1 or draw another diagram if it helps to explain your plan.

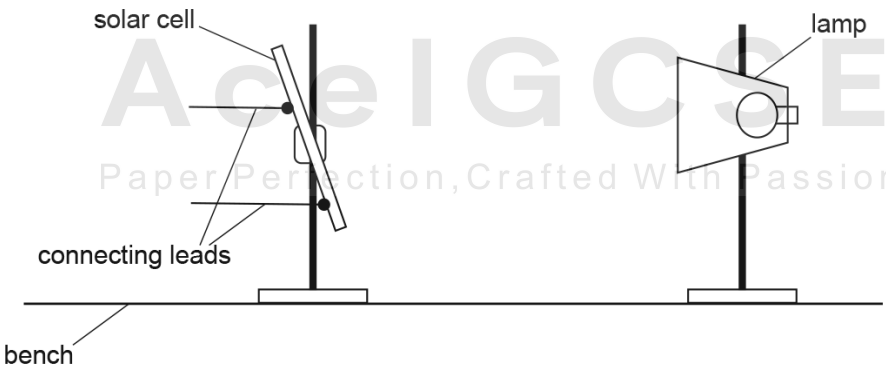

Fig. 4.1

[7]

[Total: 7]

03. 0625_s19_qp_61 Q: 4

A student is investigating the work required to pull a box containing some masses up a sloping wooden board. Fig. 4.1 shows the board and the box.

Plan an experiment to investigate how the work required to pull the box up the slope depends on the mass of the box and its contents.

Work done is calculated using the equation:

work done = force × distance moved in the direction of the force.

The following apparatus is available to the students:

a wooden board
a box with a length of string attached
a selection of masses that fit in the box
a metre rule
an electronic balance.

In your plan, you should:

- list any other apparatus that you would use
- explain briefly how you would carry out the investigation, including the measurements you would take
- state the key variables that you would control
- draw a suitable table, with column headings, to show how you would display your readings (you are **not** required to enter any readings in the table)
- explain how you would use the results to reach a conclusion.

You may add to the diagram if it helps your explanation.

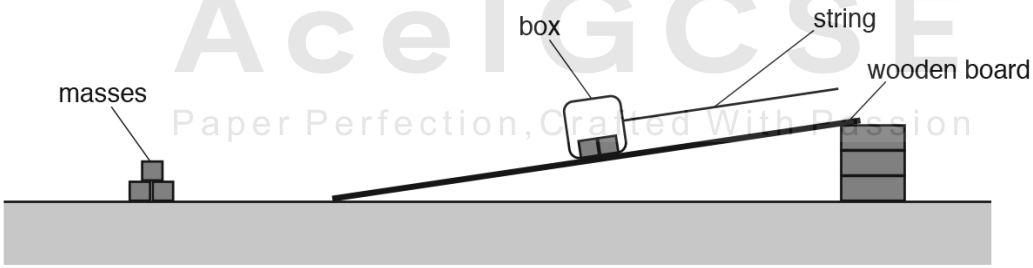

Fig. 4.1

[7]

[Total: 7]

04. 0625_s19_qp_63 Q: 4

A student wants to investigate the factors that affect the height to which a ball bounces when it is dropped.

Plan an experiment that will enable him to investigate in detail how the height from which a ball is dropped affects how high it bounces.

The apparatus available includes:

balls of different materials and sizes
sheets of different floor coverings.

Write a plan for the experiment.

In your plan, you should:

- list any additional apparatus needed
- explain briefly how you would carry out the experiment
- describe a precaution which could be taken to ensure that measurements of the height of bounce are reliable
- state the key variables that you would control
- draw a table, with column headings, to show how you would display your readings (you are **not** required to enter any readings in the table)
- explain how you could analyse your readings to reach a conclusion.

You may draw a diagram if it helps to explain your plan.

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[Total: 7]

05. 0625_m18_qp_62 Q: 4

A student is investigating the factors that affect the size of the crater (hole) a ball makes when it is dropped into sand.

Plan an experiment which would enable you to investigate one factor which might affect the size of the crater.

The apparatus available includes

metal balls of different sizes
a tray of sand

Write a plan for the experiment.

In your plan you should:

- state which factor is being investigated,
- state the key variables that you would control,
- list any additional apparatus needed,
- explain briefly how you would carry out the experiment including what would be measured and how this would be done,
- state the precautions which should be taken to obtain reliable results,
- suggest a suitable graph which could be drawn from the results.

You may draw a diagram if it helps to explain your plan.

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[Total: 7]

06. 0625_s15_qp_63 Q: 5

A student is investigating the behaviour of a solar panel.

She is using the apparatus shown in Fig. 5.1.

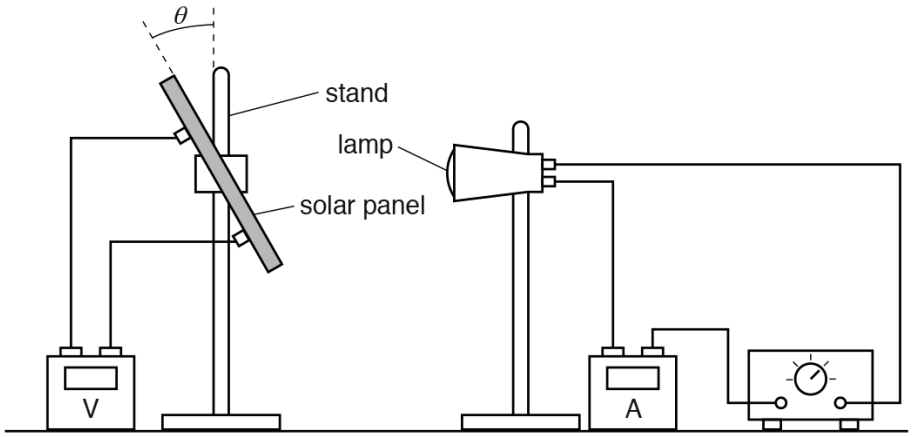

Fig. 5.1

She switches the lamp on. She changes the angle θ between the solar panel and the vertical and measures the voltage produced at each angle.

Figs. 5.2 and 5.3 show the solar panel at two different angles. The voltmeter readings for these angles are shown in Table 5.1.

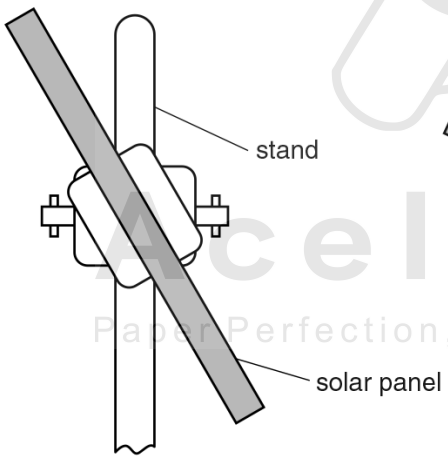

Fig. 5.2

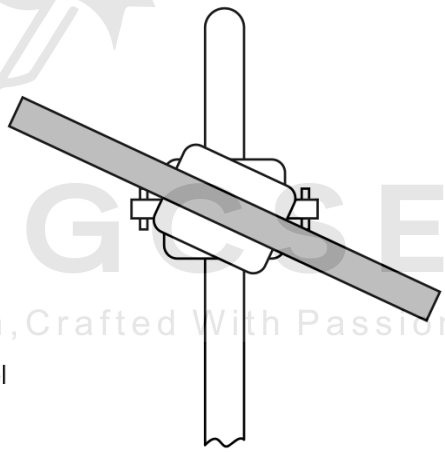

Fig. 5.3

(a) **(i)** Measure each value of the angle θ and record it in the table.

Table 5.1

	θ/°	V/V
Fig. 5.2		3.62
Fig. 5.3		2.50

[1]

(ii) Explain what practical steps should be taken to obtain accurate measurements of θ in the experiment. You may draw a diagram to show the procedure.

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.....[1]

(b) The student finds that a reading of 0.63V is obtained even when the lamp is switched off.

Suggest a reason for this and explain what she could do to overcome this problem.

reason .....

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solution .....

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[2]

(c) Suggest two aspects of the apparatus that should be kept constant in order to make the results of the experiment as reliable as possible.

1. .....

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2. .....

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[2]

[Total: 6]

07. 0625_w15_qp_62 Q: 5

The class is investigating the motion of a small steel ball when it is dropped on to a tray full of sand. Fig. 5.1 shows the apparatus.

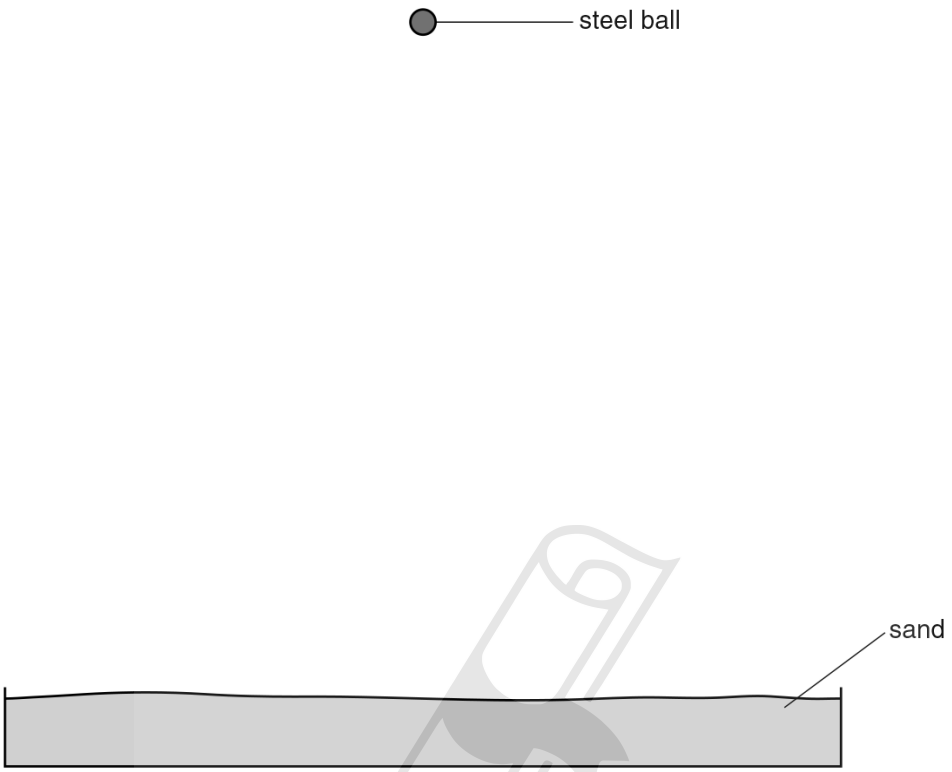

Fig. 5.1

(a) A student is measuring the time it takes for the steel ball to fall through 2.00 m on to the sand. He uses a stopwatch.

Suggest a cause of inaccuracy in the timing.

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.....[1]

(b) When the steel ball falls into the sand it creates a circular hole.

Suggest how you would measure the diameter of the hole as reliably as possible. Name the measuring device that you would use. You may draw a diagram.

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.....[2]

(c) The student suggests that the diameter of the hole depends on the height from which the ball is dropped, because this affects the speed.

Suggest two other variables on which the size of the hole may depend.

1. .....

2. .....
[2]

[Total: 5]

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08. 0625_w15_qp_63 Q: 3

Some students are carrying out experiments on a model wind turbine.

Some of their apparatus is shown in Fig. 3.1.

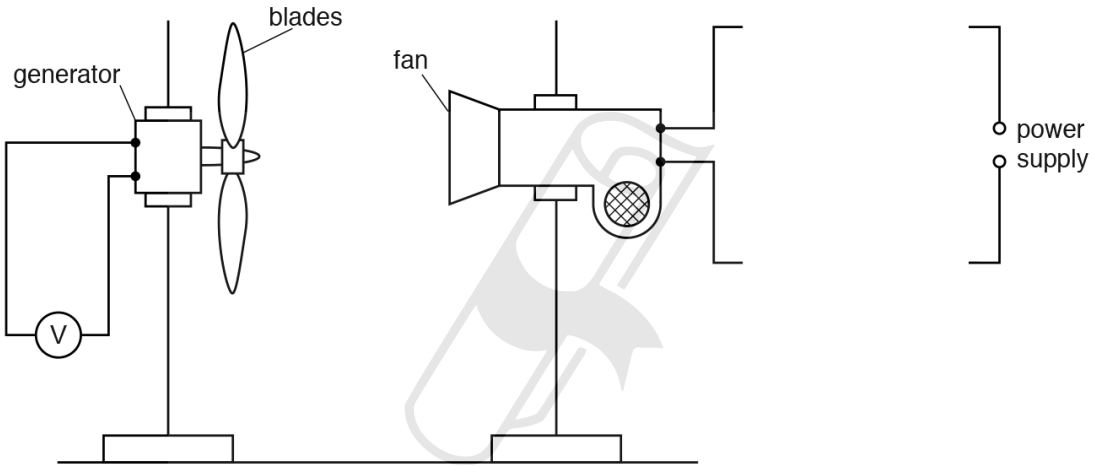

Fig. 3.1

The turbine blades have been cut from cardboard. An electric fan is used to make the blades rotate. When they rotate, they turn a small generator.

(a) One student is studying the effect of changing the electric current in the fan.

(i) Using standard symbols, complete the circuit in Fig. 3.1 to show a variable resistor and an ammeter connected for this purpose. [2]

(ii) The student is carrying out the investigation over a number of days.

Suggest a variable that he must keep constant in each of his tests.

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.....[1]

(b) Other students wish to test different aspects of the model wind turbine.

Suggest two variables, other than that already mentioned in **(a)(ii)**, which they could change and which would affect the output of the generator.

1. .....

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2. .....

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[2]

[Total: 5]

09. 0625_w12_qp_63 Q: 5

Some IGCSE students are carrying out an experiment to investigate how a tennis ball bounces on various surfaces.

Fig. 5.1 shows how they are doing this. The ball is dropped from a known height and the height of the bounce is measured.

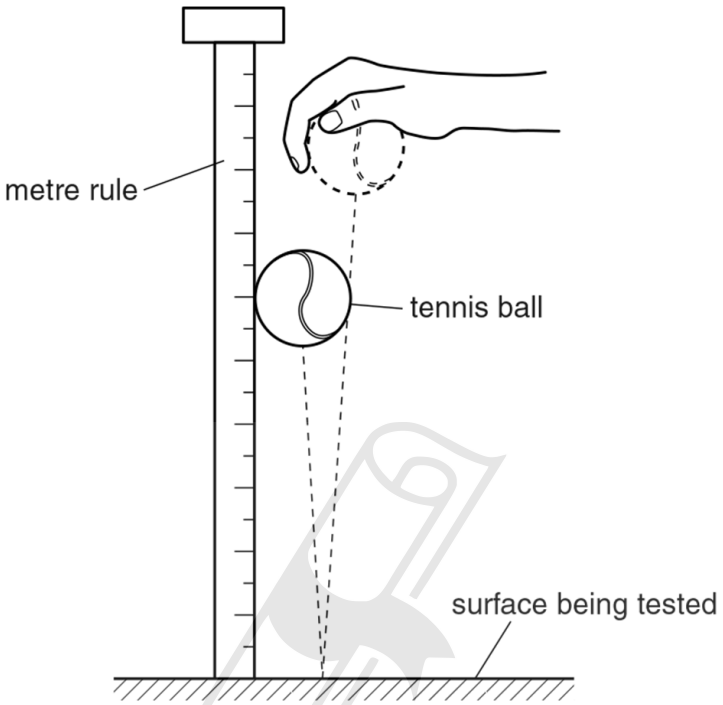

Fig. 5.1

(a) One student drops the ball several times from a height of 100 cm. Each time he measures the height to which the ball bounces. His measurements are shown in Table 5.1.

Table 5.1

test	1	2	3	4	5
height of bounce/cm	74	70	72	53	69

Explain how a valid average value for the height of the bounce could be achieved from these results. You are not asked to calculate it.

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.....[2]

(b) Another student releases the ball from a height of 100 cm on to a stone floor. It bounces to a height of 75 cm.

Calculate the efficiency of the bounce on the stone floor using the equation

$$\text{efficiency} = \frac{\text{height of bounce}}{\text{height of release}} \times 100\%.$$

efficiency = ... [1]

(c) A third student releases the ball from a height of 85 cm on to a concrete floor and it bounces to a height of 75 cm.

Without any further calculation, state whether the efficiency for the concrete floor is less than, greater than, or roughly the same as the efficiency for the stone floor. Explain your reasoning.

statement .....

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explanation .....

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[2]

[Total: 5]

01. 0625_m20_MS_62 Q: 4

	MP1 **circuit diagram:** ammeter in series with resistor and circuit correct	**1**
	MP2 **apparatus:** ammeter and means of measuring candidate's independent variable if other than air speed e.g. (metre) rule if distance is independent variable, protractor if angle of air flow is independent variable	**1**

	MP3 **control variable** (one from): speed of fan (if distance / angle varied) or distance / angle between fan and turbine (if fan speed varied), height of fan / turbine, angle of air flow	**1**
	MP4 **method:** measure / record independent variable (allow turbine to turn and) measure / record current,	**1**
	MP5 repeat for different value of independent variable	**1**
	MP6 **analysis:** compare readings (in a table) to see if change in independent variable produces change in current / plot line graph (with correct axes specified)	**1**
	MP7 **additional point** (one from): at least 5 sets of data taken, repeat each measurement and take average, 2nd valid control variable stated, repeat for different resistor and compare pattern preliminary experiment to determine suitable range for independent variable measure air speed at same point each time	**1**

02. 0625_s20_MS_63 Q: 4

	MP1 **additional apparatus:** voltmeter, protractor, metre rule	**1**
	MP2 **control variable (one from):** distance of lamp from solar panel height of lamp / height of solar panel brightness of lamp	**1**
	MP3 **method (one from):** measure angle between panel and stand / other fixed datum (switch on lamp) measure potential difference	**1**
	MP4 repeat for different angle	**1**
	MP5 **table:** appropriate columns with clear headings and units	**1**
	MP6 **analysis:** suitable analysis of readings, e.g. calculation of rate of change of potential difference with angle draw a suitable graph with correct axes stated	**1**

	MP7 **additional point / precaution (one from):** reading with only ambient light first / subtract ambient light reading make room dark fix protractor keep axis of solar panel and line of lamp perpendicular to each other at least five sets of data taken repeat each reading and take an average repeat for different distance of lamp	**1**

03. 0625_s19_MS_61 Q: 4

	MP1	Apparatus: Forcemeter/Newtonmeter or pulley and weights arrangement	**1**
	MP2	Method: Pull box up slope, measure force and measure distance moved	**1**
	MP3	Method: Repeat with different masses	**1**
	MP4	Variable: Angle of slope or height of blocks	**1**
	MP5	Variable: Distance moved	**1**
	MP6	Table to include columns for mass and force, both with unit (g or kg for mass and N for force)	**1**
	MP7	Calculate work done and compare with mass. OR Compare work done with mass (if there is a work done column in the table). OR Plot graph of work done against mass	**1**

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04. 0625_s19_MS_63 Q: 4

	MP1 Apparatus metre rule / measuring tape	**1**
	MP2 Method drop ball from measured height measure height of bounce repeat for different height of release	**1**
	MP3 Precaution any one from: • repeat (for each height of release) and average • measure to same part of ball each time • measure height of bounce at eye level • release without throwing/impeding • use of video (for height of bounce)	**1**
	MP4 Control variable any one from: • same (diameter/mass/material) ball • type of floor covering	**1**
	MP5 Table columns for release height and bounce height and units	**1**
	MP6 Analysis any one from: • suitable analysis of readings • draw a suitable graph of drop height against bounce height	**1**
	MP7 Additional point any one from: • additional control variable • at least 5 sets of data taken • repeat experiment for different diameter of ball/floor covering • automatic release to eliminate differences	**1**

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05. 0625_m18_MS_62 Q: 4

	MP1	**factor:** clear statement of appropriate variable to test	**1**
	MP2	**control variable:** named variable which should be kept constant	**1**
	MP3	**apparatus:** metre rule and any apparatus essential to variable under test	**1**
	MP4	**method:** measure factor under test and drop ball and measure diameter / depth of depression	**1**
	MP5	repeat for new value of variable under test	**1**
	MP6	**additional point:** repeat experiment or each value of factor and average / means of measuring depth / diameter of crater accurately / apparatus for measuring diameter of ball accurately / measure diameter of ball / crater in different places (and take mean) / smooth / flatten sand surface / at least 5 sets of data taken / reliable means of releasing ball / sensible values for factor quoted	**1**
	MP7	**graph:** diameter / depth of depression vs appropriate continuous variable	**1**

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06. 0625_s15_MS_63 Q: 5

(a) (i) $\theta = 30^{\circ}$ and 65° both to ± 2° [1]

(ii) suitable procedure e.g.: [1]
- use of plumb line
- measure from line of stand
- use of spirit level
- attach protractor behind solar panel

(b) any one reason from: [1]
- ambient light owtte
- zero error on meter

corresponding solution: [1]
- do experiment in complete darkness
- subtract zero reading (from each voltage measurement)

(c) any two aspects relating to apparatus e.g.: [2]
- same distance between panel and lamp
- lamp at same height
- panel at constant height
- same pd across lamp OR same current in lamp OR same brightness of lamp

[Total: 6]

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07. 0625_w15_MS_62 Q: 5

(a) (human) reaction time [1]

(b) ruler or metre rule [1]
repeat for different diameters around the hole [1]

(c) any two from:
- size / mass / weight / volume / diameter / density of ball
- size of the sand grains / type of sand / nature of the sand
- dampness / depth of sand [2]

[Total: 5]

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08. 0625_w15_MS_63 Q: 3

(a) **(i)** correct symbol for variable resistor AND ammeter [1]
correctly shown in series [1]

(ii) any one from: [1]
- distance between fan and blades
- length / area / width of blades / same blades
- direction / height of fan
- height of blades

(b) any two from: [2]
- length of blades
- width of blades
- number of blades
- mass of blades
- pitch / angle of blades
- angle of turbine

[Total: 5]

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09. 0625_w12_MS_63 Q: 5

(a) Discard 53 cm value [1]
Add remaining values together and divide by 4 [1]

(b) 75% [1]

(c) Greater than [1]
Height of release less but bounces to same height (owtte) [1]

[Total: 5]
