 PHYSICS

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**IGCSE Physics**

**Grade 10**

**Term 2 Project/Investigation 5**

**2012-2013**

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| **Unit/Topic** | **Outcomes** | **Assessment Event** | **Date/Time allowed** |
| **General physics/Forces, moments and terminal speed** | **6.2, 6.3, 6.8, 6.9, 6.10,6.11,7.1,7.2,****7.3,7.4,8.1,9.1,9.2,****10.1,10.2,10.3** | **Project/Investigation** |  |  |
| **Student Name** | **Teacher** | **Class** | **Total Mark** |
|  |  | **G10** | **20** |

The cases to explore and study are based on Paper 6 in the IGCSE specification

This paper is designed to test candidates’ familiarity with laboratory practical procedure. Questions may ask candidates to do the following:

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| 1 | Follow instructions for drawing diagrams e.g. Ray-tracing, simple electrical circuits |
| 2 | Select a measuring device suitable for the task |
| 3 | Give reasons for making a choice of apparatus |
| 4 | Draw, complete and/or label diagrams of apparatus |
| 5 | Describe in simple terms how they would carry out practical procedures e.g.: when determining a (derived) quantity such as the extension per unit load for a spring; when testing/identifying the relationship between two variables, such as between the p.d. across a wire and its length; when comparing physical quantities such as the thermal capacity of two metals |
| 6 | Take readings from their own diagrams, drawn as instructed, and/or from printed diagrams including: reading a scale with appropriate precision/accuracy; consistent use of significant figures; use of appropriate units; interpolating between scale divisions |
| 7 | Recognise the need to take repeated measurements and obtain an average value |
| 8 | Record observations systematically, with appropriate units |
| 9 | Process data as required |
| 10 | Present data graphically, using suitable axes and scales (appropriately labelled) and plotting the points accurately |
| 11 | Take readings from a graph by interpolation and extrapolation |
| 12 | Determine a gradient, intercept or intersection on a graph |
| 13 | Draw and report a conclusion or result clearly |
| 14 | Describe precautions taken in carrying out a procedure |
| 15 | Explain and/or comment critically on described procedures or points of practical detail |
| 16 | Comment on a procedure used in an experiment and suggest an improvement |
| 17 | Plan an investigation, including suggesting suitable techniques and apparatus |

**Mandatory Field:**

Use the above list of practical skills, list the laboratory practical procedures used in this Project/investigation:

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**Perform the following project/investigation:**

**Task 1**

A solid plastic sphere falls towards the Earth.

Fig. 1.1 is the speed-time graph of the fall up to the point where the sphere hits the Earth’s surface.

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**(a)** Describe in detail the motion of the sphere shown by the graph.

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**(b)** On Fig. 1.2, draw arrows to show the directions of the forces acting on the sphere when it is at the position shown by point S on the graph. Label your arrows with the names of the forces.

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 **(c)** Explain why the sphere is moving with constant speed at S.

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**(d)** Use the graph to calculate the approximate distance that the sphere falls

**(i)** between R and T,

 distance = ………………. [2]

**(ii)** between P and Q.

 distance = ………………. [2]

**Task 2**

A student sets up the apparatus shown in Fig. 2.1 in order to find the resultant of the two tensions T1 and T2 acting at P. When the tensions T1, T2 and T3 are balanced, the angles between T1 and the vertical and T2 and the vertical are as marked on Fig. 2.1.

 

In the space below, draw a scale diagram of the forces T1 and T2. Use the diagram to find the resultant of the two forces.

State

**(a)** the scale used, scale = ........................................

**(b)** the value of the resultant, value = ........................................

**(c)** the direction of the resultant. direction = ........................................[6]

**Task3**

**1** Fig. 1.1 shows a car travelling at 30 m/s on a level road. At this speed the car has to

overcome a total force of 600 N opposing the car.

** (a) (i)** Calculate the distance travelled by the car in 10 s.

distance = ......................................

**(ii)** State the value of the driving force produced by the engine for a steady speed of

30 m/s.

..................................................................................................................................[2]

**(b)** Explain why the car slows down when it climbs a hill, even though the driving force is

unchanged.

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**(c)** While on the level road and travelling at 30 m/s, the driving force becomes zero. The

mass of the car is 800 kg. Calculate the deceleration of the car.

deceleration = ......................................[2]

**2. The diagram shows the horizontal forces acting on a cyclist while she is accelerating.**

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**(a) Explain how the unbalanced force acting on the cyclist changes as she accelerates and then cycles at a constant speed.**

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**(b) Some racing cycles have lightweight frames. Why is it an advantage for the cycle to have a lightweight frame?**

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**3. (a) The diagram shows the forces acting on a box at one instant as it falls through the air.**

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**(i) State the equation connecting weight and mass.**

**.............................................................................................................................**

**(ii) Calculate the mass of the box.
(The value of g is 10 N/kg.)**

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**(iii) Calculate the unbalanced force on the box.**

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**(b) The box continues to fall and reaches terminal velocity.**

**(i) State and explain what happens to the unbalanced force as the box falls.**

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**.............................................................................................................................**

**(ii) State values for the drag and acceleration of the box when it reaches its terminal velocity.**

**drag ............................................................................................................................**

**acceleration ................................................................................................................**

**4. (a) The diagram shows a book resting on a table. The weight of the book is 5 N.**

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**Two forces are shown acting on the book.
P is the upward push of the table on the book.**

**(i) State the value of P.**

**...........................................................................................................................**

**(ii) Explain your answer.**

**...........................................................................................................................**

**(b) The diagram below shows the book falling through the air.**

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**(i) Name the force R.**

**...........................................................................................................................**

**(ii) Complete the equation for the unbalanced force on the book.**

**unbalanced force =**

**5. The weight of an object of mass m can be calculated using the equation**

**W = mg**

**On Earth, the value of g is taken to be 10.**

**(i) What is g?**

**................................................................................................................................**

**(ii) Give a unit for g.**

**................................................................................................................................**

**6. A hot air balloon is tied to the ground by two ropes.**

 **The diagram shows the forces acting on the balloon.**

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**The ropes are untied and the balloon starts to move upwards.**

**(a) Calculate the size of the unbalanced force acting on the balloon.
State the direction of this force.**

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**Task 4**

**1 (a)** A small pin is fixed to the edge of a bench. A triangular piece of card with a small hole in each corner is hung on the pin from corner A and allowed to settle, as shown in

Fig. 12.1. A plumb-line is then hung from the pin and the vertical line AP is marked on

the card.

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This procedure is then repeated with the card hanging from C and the vertical line CQ is

marked. After this, the card is as shown in Fig. 12.2.

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On Fig. 12.2,

**(i)** draw the vertical line that would be obtained if the card were hung from B,

**(ii)** clearly mark the centre of mass of the card using a dot labelled G. [2]

**(b)** Fig. 12.3a shows a glass ornament standing on a shelf. Fig. 12.3b shows an identical ornament filled with coloured glass beads.

 

State which ornament is more stable, and why.

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.....................................................................................................................................[2]

**(c)** Fig. 12.4 shows two wooden blocks standing on a hinged board with a rough surface.

****The board is slowly tilted. The blocks do not slip. State which block falls over first, and

explain why.

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**2 (a)** State the two factors on which the turning effect of a force depends.

1. .....................................................................................................................................

2. ............................................................................................................................... [2]

**(b)** Forces *F*1 and *F*2 are applied vertically downwards at the ends of a beam resting on a

pivot P. The beam has weight *W*. The beam is shown in Fig. 5.1.

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**(i)** Complete the statements about the two requirements for the beam to be in

equilibrium.

1. There must be no resultant ..................................................

2. There must be no resultant ..................................................

**(ii)** The beam in Fig. 5.1 is in equilibrium. *F* is the force exerted on the beam by the

pivot P.

Complete the following equation about the forces on the beam.

*F* = ....................................................

**(iii)** Which one of the four forces on the beam does **not** exert a moment about P?

................................................... [4]

**3 (a)** A light vertical triangular piece of rigid plastic PQR is pivoted at corner P.

A horizontal 5N force acts at Q, as shown in Fig. 3.1.

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Describe what, if anything, will happen to the piece of plastic.

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**(b)** On another occasion, two horizontal 5N forces act on the piece of plastic, as shown in Fig. 3.2.

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1. Describe what, if anything, will happen to the piece of plastic.

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**(ii)** On Fig. 3.2, mark the force that the pivot exerts on the piece of plastic. Show the

direction of the force by means of an arrow and write the magnitude of the force

next to the arrow. [4]

**4** A piece of stiff cardboard is stuck to a plank of wood by means of two sticky-tape “hinges”. This is shown in Fig. 3.1.

 **(a)** The cardboard is lifted as shown, using a force applied either at A or B or C.

**(i)** On Fig. 3.1, draw the force in the position where its value will be as small as

possible. [2]

**(ii)** Explain why the position you have chosen in **(a)(i)** results in the smallest force.

............................................................................................................................ [1]

**(b)** Initially, the cardboard is flat on the plank of wood. A box of matches is placed on it. The cardboard is then slowly raised at the left hand edge, as shown in Fig. 3.2.

State the condition for the box of matches to fall over.

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 **(c)** The box of matches is opened, as shown in Fig. 3.3. The procedure in **(b)** is repeated.

 **(i)** Complete the sentence below, using either the words “greater than” or “the same

as” or “less than”.

In Fig. 3.3, the angle through which the cardboard can be lifted before

the box of matches falls is …………………………………………… the angle

before the box of matches falls in Fig. 3.2. [1]

**(ii)** Give a reason for your answer to **(c)(i)**.

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