Year 12 Physics Assessment Task I.D. Number: _____

Practical and Processes

Teacher: ☐ Mr Coombes ☐ Mr Pitt ☐ Mr Robson TOTAL MARKS _____/ 30

Task Weighting: 15% Time Allowed: 45 minutes

- Attempt all questions
- Show all working
- You will require a stopwatch to carry out part of this task. This may be shared between two students. Check that the stopwatch is working before the task commences and notify your teacher if there is a problem.

Data and Equations

$g = 9.81\ m\ s^{-2}$

$G = 6.67 \times 10^{-11}\ N\ m^2\ kg^{-2}$

Mass of Earth $= 5.97 \times 10^{24}$ kg

Radius of Earth = 6378 km

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$E_p = -G\frac{m_1 m_2}{r}$$

$$F = mg$$

$$v_x^2 = u_x^2$$

$$v = u + at$$

$$v_y^2 = u_y^2 + 2a_y\Delta y$$

$$\Delta x = u_x t$$

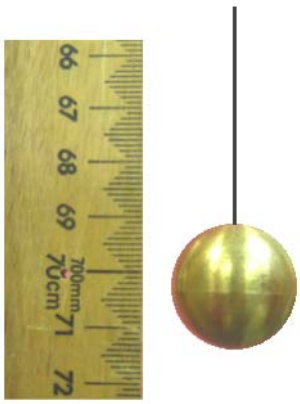
$$\Delta y = u_y t + \frac{1}{2}a_y t^2$$

$$\mathbf{E_K = \tfrac{1}{2}mv^2}$$

Question 1

(a) Two students, A and B, used pendulums to determine the acceleration due to gravity. They set up their pendulums as follows.

Student A



Student B

Identify the student who made the best choice of pendulum and justify your choice. [2M]

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(b) The equation for the period of a simple pendulum was used by one group of students to calculate the acceleration due to gravity after they carefully determined the period and length of the pendulum.

Another group of students used a movie of a falling mass and appropriate computer software to determine the acceleration due to gravity.

The students in the two groups then compared the values for "g" that they obtained and found them to be similar and both close to 9.8 m s^{-2}. The two groups concluded that **this confirmed the accuracy of their measurements**.

Assess their conclusion. [2M]

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Question 2

(a) Joshua has a mass of 70 kg.
On the moon, the gravitational field has a magnitude at the surface of 1.6 N kg^{-1}
Quantitatively compare Joshua's weight on Earth with his weight on the moon. [2M]

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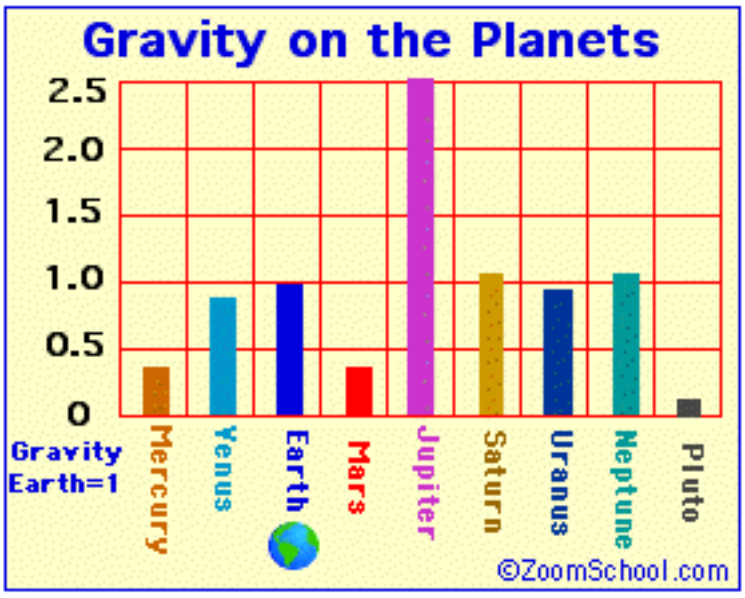
(b) Use data from this graph to help you answer the following question.



Compare the effects of gravity on a 2 kg mass released 1 m above the surface of Earth and Mars. [2M]

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Question 3

A 3000 kg satellite is in a circular orbit around the Earth at an altitude of 400 km. At this altitude it travels at 7668 m/s. Retro rockets are fired briefly, which causes it to slow down and as a result, sometime later it reaches an altitude of 300 km.

(a) Calculate the change in gravitational potential energy of the satellite. [3M]

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(b) Qualitatively state what happens to the speed of the satellite as a result of this orbital change and justify your answer using the law of conservation of energy. [3M]

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Question 4

The following diagram represents two models of the Earth's gravitational field.

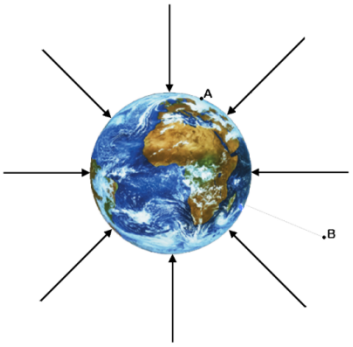

Diagram (I)

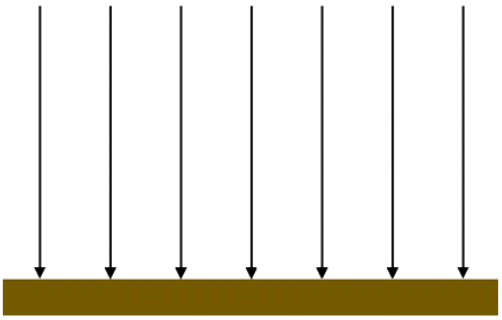

Diagram (II)

(a) Compare the Earth's gravitational field at locations A and B shown in Diagram (I) [2M]

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(b) Outline a situation where it would be appropriate to use the model shown in Diagram (II). [1M]

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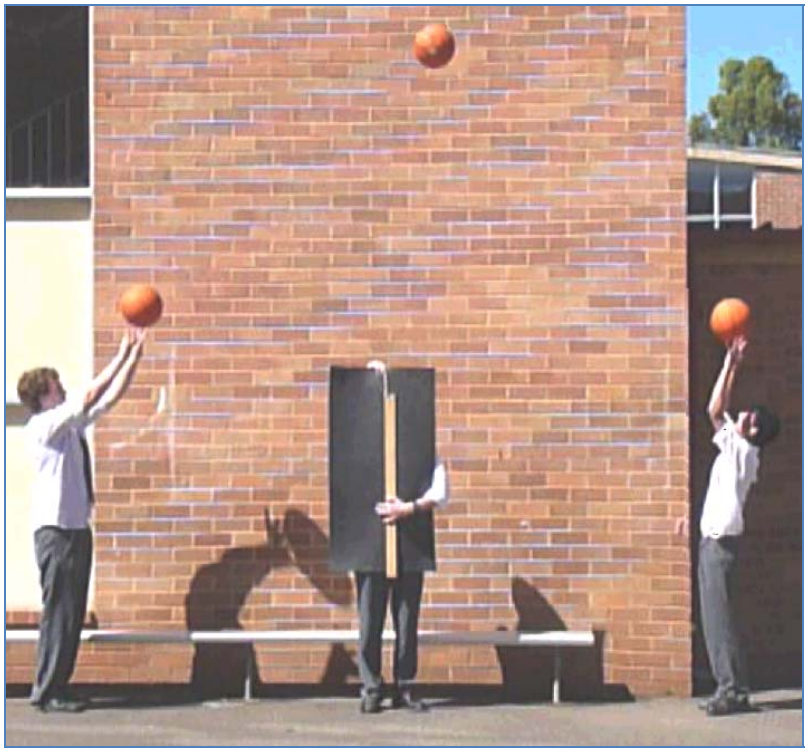
Question 5

Determine the length of the pendulum shown in the movie.
Record your measurements in a table and present your calculations clearly. [5M]

Question 6

The following composite image shows three positions of a basketball being thrown from the person on the left to the person on the right. The basketball is shown as it leaves the hands of the thrower, at its highest point and just as it is about to be caught.



(a) Draw the trajectory of the ball on this image. [1M]

(b) Use the information in the photograph to determine range of the ball. Show any measurements used in your calculation clearly on the photograph. [2M]

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(c) Propose a change which could have been made before the images were taken which would help to improve the accuracy of your calculation in part (b), assuming that the ball followed the same trajectory. [1M]

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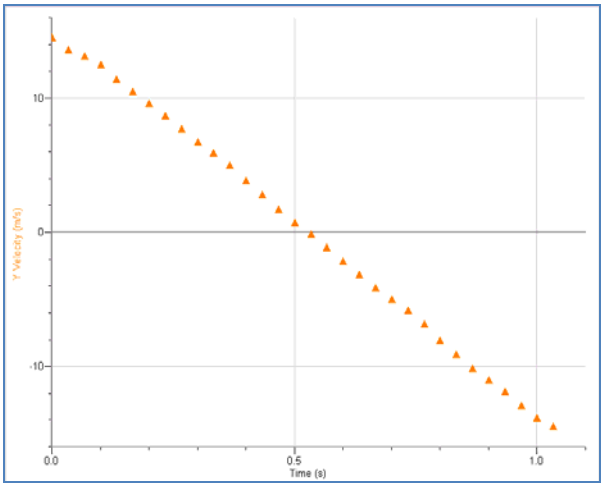
Question 7

(a) The following is a Y-velocity vs time graph for a projectile thrown on another planet. Use this graph to calculate the acceleration due to gravity on the planet. [2M]



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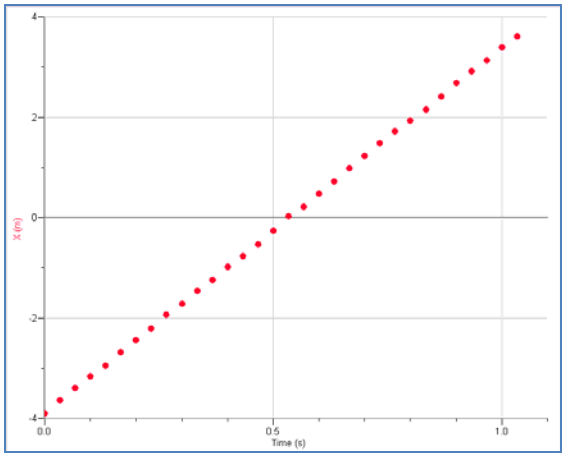
(b) The following graph shows an X-displacement vs time graph for the same projectile. Using information from both graphs, calculate the velocity of the projectile at t = 0.54 s [2M]



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End of this task

Criteria Q1a Outcome H2, H11, H14	Mark
Identifies student B and justifies this with an appropriate reason such as the ability to easily estimate the centre of mass.	2
Identifies student B but with a less significant reason.	1

Criteria Q1b Outcome H2, H14	Mark
Makes a negative judgement and demonstrates an understanding of the terms accuracy and validity	2
Makes a negative judgement and identifies that the term accuracy is incorrect.	1

Criteria Q2a Outcome H6, H12	Mark
Correct calculation of the weight force on both planets.	2
Correct calculation of the weight force on one planet.	1

Criteria Q2b Outcome H6, H12	Mark
A similar effect (eg Both masses will accelerate) and a quantitative difference(eg On Earth the acceleration is 9.8m/s2 whereas on Mars the acceleration is 3.8m/s2.)	2
One of the above.	1

NOTE : answer must include an effect of gravity. Stating the difference in gravitational force was not worth any marks.

Criteria Q3a Outcome H7, H12, H14	Mark
Correct substitution into equation for Ep AND Correct subtraction (final - initial Ep: -1.79E11 - -1.764E11) AND Correct answer with unit (-2.64E9 J) [Marks deducted for not taking Earth's radius into account, incorrect unit/s (km rather than m), wrong subtraction (leading to a positive rather than the correct negative answer)]	3
Two of the correct steps above	2
One of the correct steps above	1

Criteria Q3b Outcome H7, H14	Mark
States the law of conservation of energy AND States Ep converted to Ek hence deduces that speed increases	2
States the law of conservation of energy OR States that speed increases	1

Criteria Q4a Outcome H9, H14	Mark
States that the gravitational field strength at A is greater than that at B AND States that the direction of the field at A is perpendicular to the direction of the field at B (or that the field at both points is directed toward the Earth's centre)	2
One of the above statements	1

Criteria Q4b Outcome H9, H14	Mark
Briefly describes a specific situation in which the field can be considered uniform - such as when the motion of a projectile with a range of a few metres is being analysed or in the analysis if the motion of a simple pendulum	1

Criteria Q5 Outcome H11, H12, H13	Mark
Response must contain Appropriately displayed results (multiple results in a table) An indication that more than one oscillation was used Multiple and accurate measurements of period with a correct calculation of the average. Substitution of the average period correctly into the appropriate formula A reasonable final answer (0.16m – 0.2 m)	5
Missing one of the above	4
Missing two of the above	3
Missing three or four of the above	1-2

Criteria Q6a Outcome H12, H14	Mark
Reasonable parabolic path drawn on photograph	1

Criteria Q6b Outcome H12, H14	Mark
Measurements used clearly shown on the photograph AND Scale used to correctly calculate the range (approximately 3.4 m)	2
Scale used to correctly calculate the range (approximately 3.4 m) but Measurements used not clearly shown on the photograph OR Correct measurements shown on the photograph but calculation incorrectly performed.	1

Criteria Q6c Outcome H12, H14	Mark
Outlines a significant change (eg longer scale, camera positioned further away, greater contrast, scale in same plane as ball trajectory)	1

Criteria Q7a Outcome H11, H12	Mark
Correct calculation of the acceleration using the gradient in the range 27-31m/s2.	2
Uses gradient but doesn't calculate correct value or correct value not using gradient.	1

Criteria Q7b Outcome H12, H14	Mark
Calculates horizontal velocity using gradient of graph(range 7.1-7.3m/s) and identifies that vertical velocity is zero at this time.	2
Correct calculation of horizontal velocity or Identifies that vertical velocity is zero.	1

NOTE : some students estimated the vertical velocity as non-zero and this was acceptable if they added the two component velocities using a vector diagram.