

# SPACE

1<sup>st</sup> Quarter; Module 1

## PERIOD 5

(PERIOD 4 was "g" Experiment)

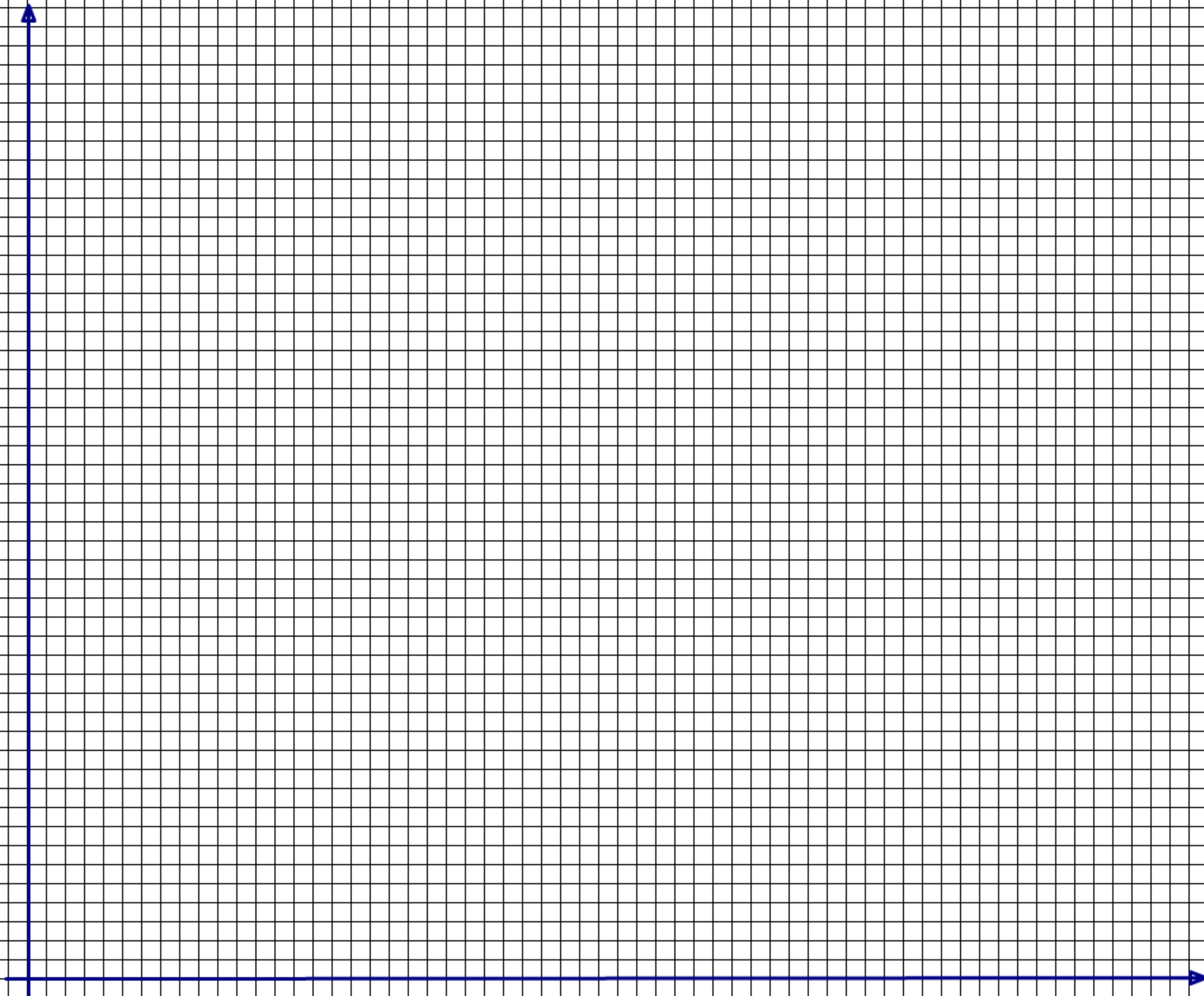
Physics Skills, Gravitational Potential Energy

H S C P H Y S I C S																		
SPACE				MOTORS and GENERATORS					From IDEAS to IMPLEMENTATION									
1	2	3	4	1	2	3	4	5	1	2	3	4	1	2	3	4	5	6



## GRAPHING SKILLS





The Earth has a gravitational field that exerts a force on objects both on it and around it

*Students learn to:*

- define weight as the force on an object due to a gravitational field
- explain that a change in gravitational potential energy is related to work done
- define gravitational potential energy as the work done to move an object from a very large distance away to a point in a gravitational field

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

*Students:*

- perform an investigation and gather information to determine a value for acceleration due to gravity using pendulum motion or computer-assisted technology and identify reasons for possible variations from the value  $9.8 \text{ m s}^{-2}$
- gather secondary information to predict the value of acceleration due to gravity on other planets
- analyse information using the expression  $F = mg$  to determine the weight force for a body on Earth and for the same body on other planets

## Gravitational potential energy: $E_p$

Gravitational potential energy is defined as the work done to move an object from infinity (or some point very far away) to a point within a gravitational field.

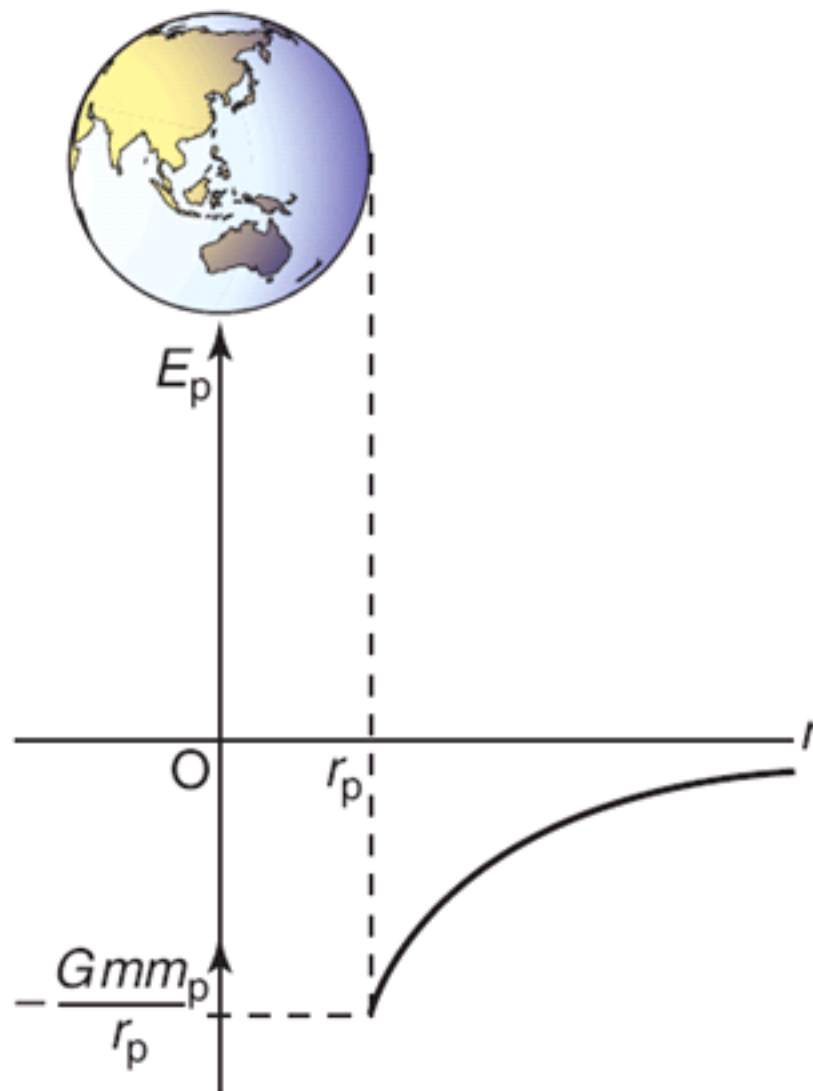
- ✓  $E_p$  is the energy of a mass due to its position within a gravitational field.
- ✓  $E_p$  increases as distance from the planet increases
- ✓  $E_p$  is zero at infinity

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

$m_1$  = mass of planet (kg)

$m_2$  = mass of object (kg)

$r$  = distance separating masses (m)



## WORK and Ep

Work changes the amount of energy an object has.

Work = Change in Energy

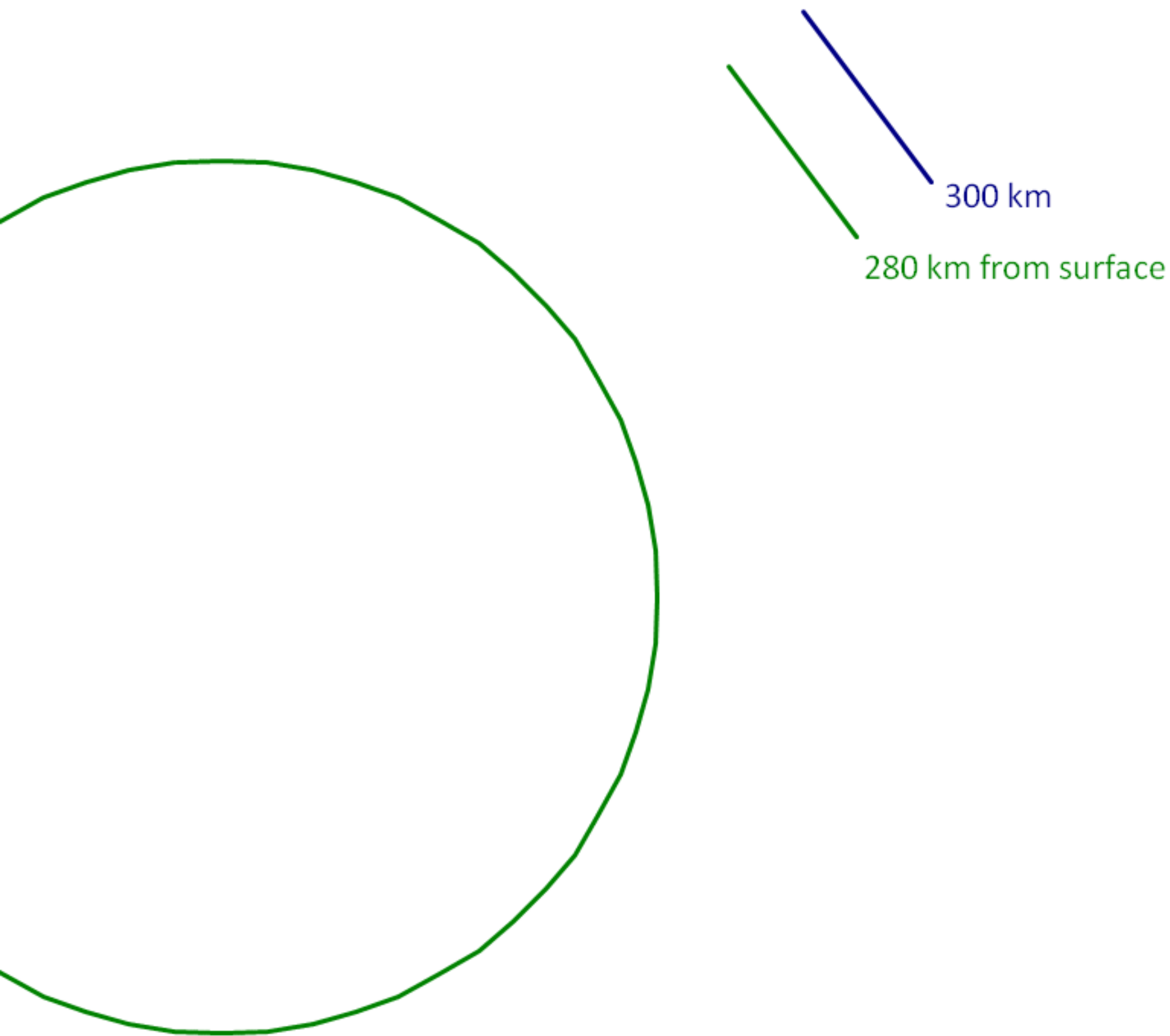
$W > 0$  if work is done on the object (object gains energy)

$W < 0$  if work is done by the object (object loses energy)



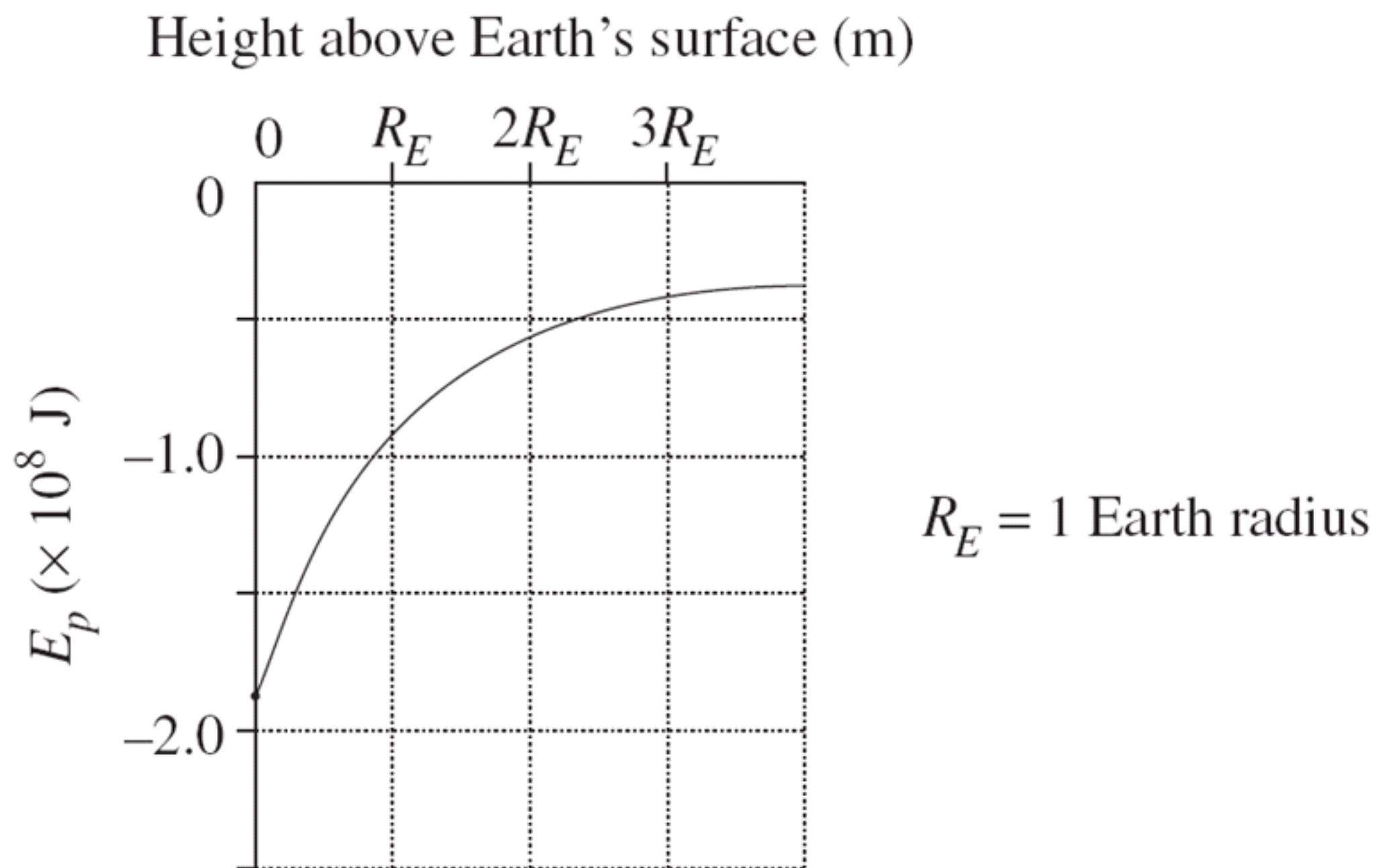
International Space Station - ISS, launch pad to space!

- a) Find the GPE of ISS (25 tonnes), positioned 280 km from the surface of the Earth.
- b) How much work needs to be done to increase its orbital radius by 20 km?



**Question 17** (5 marks)

The graph below represents the gravitational potential energy ( $E_p$ ) of a mass as it is raised above Earth's surface.



- (a) From the graph, what is the gravitational potential energy of the mass when it is one Earth radius above Earth's surface?



# 2006 HSC PAPER

## Question 18 (3 marks)

An object is stationary in space and located at a distance 10 000 km from the centre of a certain planet. It is found that 1.0 MJ of work needs to be done to move the object to a stationary point 20 000 km from the centre of the planet. **3**

Calculate how much more work needs to be done to move the object to a stationary point 80 000 km from the centre of the planet.

## 2003 HSC PAPER

### Question 17 (6 marks)

A satellite of mass 150 kg is launched from Earth's surface into a uniform circular orbit of radius  $7.5 \times 10^6$  m.

- (b) From this uniform circular orbit, the satellite can escape Earth's gravitational field when its kinetic energy is equal to the magnitude of the gravitational potential energy.

**3**

Use this relationship to calculate the escape velocity of the satellite.

## 2 QUESTIONS FOR TONIGHT!

### *Question 1*

An air gun is fired horizontally at a target 81 m away and the bullet takes just 0.35 s to strike it. What was the velocity of the bullet?

### *Question 2*

A ball is thrown directly upwards with a velocity of 30m/s. Ignoring air resistance, determine:

- (a) its peak height
- (b) its time of flight
- (c) its velocity after 0.5 s
- (d) its velocity after 1.5 s.

# HOMEWORK

- ✦ Homework is an integral part of your "Learning Curve", take it seriously!
- ✦ Target minimum 1 hour of Physics everyday
- ✦ Divide your physics home study in three segments:
  - ✓ Revision (past)
  - ✓ Homework (present)
  - ✓ Tomorrow (future)
- ✦ Homework is due next period, unless otherwise stated
- ✦ If you cannot do all, at least do a few from each piece

*Apart from **reading the relevant pages from the textbook and solving the rest of the questions in this booklet** your homework is:*

1. 2 questions in this booklet
2. Revise the 2 investigations in the practical booklet
3. Space 1 Booklet
4. Examine
  - "[http://phet.colorado.edu/simulations/sims.php?sim=Projectile\\_Motion](http://phet.colorado.edu/simulations/sims.php?sim=Projectile_Motion)
5. Find "g of Planet X" in
  - "[http://phet.colorado.edu/simulations/sims.php?sim=Pendulum\\_Lab](http://phet.colorado.edu/simulations/sims.php?sim=Pendulum_Lab)"

## NEXT PERIOD >

PROJECTILE MOTION - the topic which can make a difference

