

The Solar System is held together by gravity

2004

- 3 A spaceship at a distance  $r$  metres from the centre of a star experiences a gravitational force of  $x$  newtons. The spaceship moves a distance  $\frac{r}{2}$  towards the star.
- What is the gravitational force acting on the spaceship when it is at this new location?
- (A)  $\frac{x}{2}$  newtons  
(B)  $x$  newtons  
(C)  $2x$  newtons  
(D)  $4x$  newtons

2005

Question 19 (4 marks)

In 1970 NASA launched Apollo 13, their third mission planned to land humans on the Moon. Half-way to the Moon a huge explosion crippled the spacecraft. The only way home for the astronauts was to fly around the back of the Moon and then fire the rocket engine to take the craft out of lunar orbit and put it into an Earth-bound trajectory.

At the completion of the rocket engine burn, mission leader Jim Lovell was heard to say, ‘We just put Isaac Newton in the driver’s seat’.

Given that the spacecraft returned safely to Earth, justify Jim Lovell’s statement.

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Assessors report & Marking criteria

In better responses, candidates were able to describe and relate two or more of Newton’s Laws of Motion in words and/or equations to the return trip of Apollo 13, ie the period after leaving the lunar orbit.

In weaker responses, candidates incorrectly applied the ‘slingshot effect’ to the motion of the rocket around the moon.

MARKING GUIDELINES	
Criteria	Marks
• Presents a logical, coherent argument to support Jim Lovell’s statement, for the period after the rocket burn including correct, relevant description of Newton’s laws	4
• Describes and explains the relevance of Newton’s laws to the solution of the astronaut’s problem for the period after the rocket burn	3
• Correctly identifies and relates one of Newton’s laws to the situation for the periods either before or after the rocket burn	2
OR	
• States two of Newton’s laws	1
• Correctly states one of Newton’s laws	