

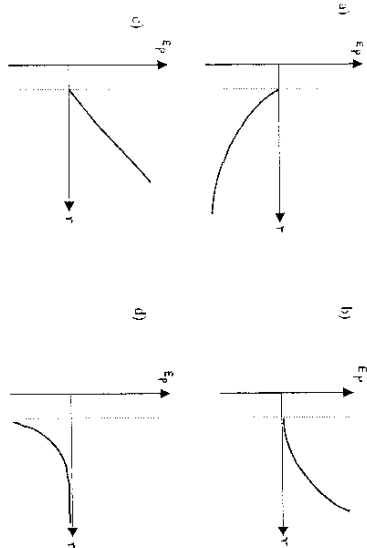
SECTION 1

PART A

(Use the multiple choice answer sheet on page 2.)

1. What is the weight of a 20 kg box of apples at Flemington markets?
a) 20 kg
b) 20 N
c) 196 kg
d) 196 N

2. Which of the graphs represents the gravitational potential energy against distance from the Earth?



3. The classic 'thought experiment' where twins are separated at birth and one is sent off into space in a very fast rocket while the other remains on Earth, finds that on return to Earth, the twin from space is much younger than the Earth-bound one. Whose work best explains this concept?
a) Michelson and Morley
b) Newton
c) Einstein
d) Galileo

1. A person descending from Sydney Tower in a lift which falls with an acceleration of 5 ms^{-2} downwards, drops one of the parcels he is carrying, which contains a video camera that is recording while the camera is falling in the lift. The camera switches off when it strikes the floor of the lift. When viewing the video later the motion of the lift would best be described as:
a) it appears stationary
b) it is descending at 4.8 ms^{-2}
c) it is moving up with acceleration of 4.8 ms^{-2}
d) from East to West because of the motion of the Earth.

5. What is the minimum initial velocity a rocket must have if it is to reach a target 200 km away? (ignore the curvature of the Earth and frictional resistance of the atmosphere)

- a) 1400 ms^{-1}
b) 2800 ms^{-1}
c) 9.8 ms^{-1}
d) 3.5 ms^{-1}

6. The mass of Jupiter is $1.9 \times 10^{27} \text{ kg}$ and the Sun is $1.99 \times 10^{30} \text{ kg}$. Given that the average Jupiter - Sun distance is $7.78 \times 10^{16} \text{ m}$, what will be the gravitational attraction between the Sun and Jupiter?

- a) $3.24 \times 10^5 \text{ N}$
b) $4.17 \times 10^{23} \text{ N}$
c) $4.76 \times 10^{26} \text{ N}$
d) $6.12 \times 10^{24} \text{ N}$

7. If an object is thrown straight upwards, at a high velocity it may escape the Earth's gravitational pull and not fall back to the Earth. The velocity required to do this is called the escape velocity. Given the mass of the Earth $5.97 \times 10^{24} \text{ kg}$ and the radius of the Earth $6.38 \times 10^6 \text{ metres}$, the escape velocity of the Earth is closest to:

- a) $1.4 \times 10^{28} \text{ ms}^{-1}$
b) $1.2 \times 10^8 \text{ ms}^{-1}$
c) $1.2 \times 10^3 \text{ ms}^{-1}$
d) 11200 ms^{-1}

8. According to the principle of relativity, the laws of physics are the same in all frames of reference.
a) at rest with respect to one another.
b) moving forward or away from one another at constant velocity.
c) moving parallel to one another at constant velocity.
d) all of the above.

9. The radius of the path of a body in uniform circular motion is doubled. What will be the centripetal force needed if its velocity remains the same?

- a) half as great as before.
- b) the same as before.
- c) twice as great as before.
- d) four times as great as before.

10. The human body can usually withstand forces of up to four times that of gravity, however astronauts have to withstand up to $10g$. To reduce the danger to astronauts on take off, spacecraft designers have

- a) made seats that face down on take off.
- b) reclined moulded seats face up on take-off.
- c) placed the astronauts at the front of the rocket away from the engine.
- d) increased pressure in the cabin to reduce black-out.

Question 11 (3 marks)

SECTION 2

A 2000 kg geostationary satellite is at an orbit altitude of 3.8×10^4 km above the surface of the Earth. Another satellite of Earth is the moon, which has a mass of 7.34×10^{22} kg, and orbits at an average radius of 3.8×10^5 km (from the Earth's centre) every 28 days.

a) Outline one major way in which a geostationary satellite is more useful than the many other satellites orbiting the Earth.

1 mark

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b) What is the period of the geostationary satellite?

1 mark

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c) Calculate the orbital speed of the geostationary satellite.

1 mark

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Question 12 (3 marks)

a) Outline the aim of the Michelson Morley experiment.

1 mark

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b) Their negative result led to two conclusions. List these two conclusions.

2 marks

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Question 13 (6 marks)

The space shuttle uses booster rockets to help leave the earth's surface. Once the fuel in these rockets is used up, the booster is released from the shuttle and falls back to the earth's surface. For the purpose of this question assume that the earth's gravity is 9.8 ms^{-2} for the entire fall of the booster, the earth is flat and assume that there is no air friction.

The shuttle releases the booster at an altitude of 10 km, when the shuttle is travelling at a speed of 300 ms^{-1} at an angle of 60° from the horizontal.



- a) Find the time that it takes for the booster to fall back to the Earth's surface

3 marks

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- b) Describe the motion of the booster as seen from the space shuttle. If the shuttle keeps travelling at constant velocity

1 mark

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- c) Calculate the final velocity of the booster rocket just before hitting the Earth.

2 marks

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Question 14 (6 marks)

This is an account of a "thought experiment". A railway carriage is moving with constant velocity along a straight track. A bolt of lightning strikes just above the carriage striking it on both ends at the same instant. This also leaves a scorch mark on the ground. This is seen by a passenger on the train in the middle of the carriage and by a stationary observer outside the train but opposite the first observer.

a) Without referring to the Special Theory of Relativity:

- i) Describe the observations by the passenger in the train explaining why the events appear not simultaneous.

2 marks

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- ii) Describe the observations by the stationary observer explaining why the events appear simultaneous.

2 marks

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b) Now explain the event as a consequence of the Special Theory of Relativity.

2 marks

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END OF TASK