3.24 The Solar System, Orbital Motion and Satellites: 30-minute Pack

AQA 8463 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A low polar orbit satellite is used to monitor the Earth's whole surface for weather forecasting.

(a) State one feature of the orbit that makes it a low polar orbit. **(1)**

(b) State how the orbital period of a low polar orbit satellite compares with that of a geostationary satellite. **(1)**

(c) Explain why a low polar orbit is useful for monitoring the whole of the Earth's surface over time. **(1)**

(Total for Question 1 is 3 marks)

2 The Solar System, including the Sun and the planets, formed billions of years ago from a cloud of dust and gas.

(a) Name this initial cloud of dust and gas. **(1)**

(b) Name the force that causes the cloud to collapse and be pulled together. **(1)**

(c) Explain what happens to the material at the centre of the collapsing cloud, and what this eventually becomes. **(2)**

(Total for Question 2 is 4 marks)

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3 The life cycle of a star depends on its mass.

(a) State one similarity between the life cycle of a star similar in mass to the Sun and a star with a much greater mass than the Sun. **(1)**

(b) State one key difference between the two life cycles, after the main sequence stage. **(2)**

(Total for Question 3 is 3 marks)

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4 A star with a much greater mass than the Sun follows a different path after the main sequence.

(a) State the stage that a very massive star enters after leaving the main sequence, before it explodes. **(1)**

(b) Name the explosive event that ends the life of a red super giant. **(1)**

(c) State the two objects that a supernova can leave behind, and identify the factor that determines which one forms. **(3)**

(Total for Question 4 is 5 marks)

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5 A small satellite orbits the Earth at an orbital radius of 7.0×10^6 m, with a time period of 5800 s. Use the Physics Equations Sheet. Use the equation: orbital speed = (2 x π x orbital radius) / time period.

(a) Calculate the orbital speed of the satellite. **(3)**

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(Total for Question 5 is 3 marks)

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6 Satellite P orbits at a smaller radius than satellite Q, and both are in stable circular orbits around the Earth.

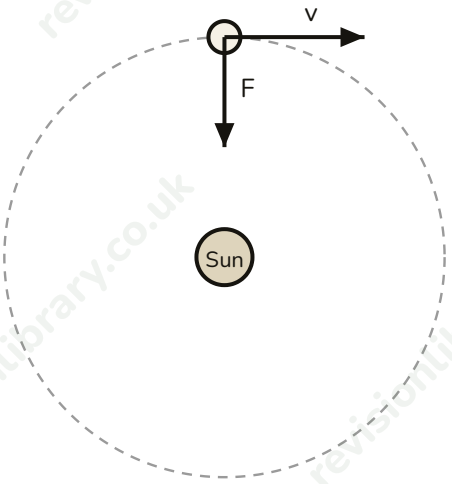
(a) State which satellite, P or Q, has the greater orbital speed. **(1)**

(b) State which satellite, P or Q, has the longer time period for one orbit. **(1)**

(Total for Question 6 is 2 marks)

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7 A planet orbits the Sun in a stable, roughly circular orbit.



(a) Name the force that keeps the planet in its orbit. **(1)**

(b) State the direction of this force, relative to the centre of the orbit. **(1)**

(c) The planet moves at a constant speed around its orbit. Explain why the planet is still accelerating, even though its speed does not change. **(2)**

(Total for Question 7 is 4 marks)

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Mark scheme · 3.24 The Solar System, Orbital Motion and Satellites: 30-minute Pack

Question 1

(a) it orbits at a low altitude, close to the Earth's surface, passing near/over the North and South poles on each orbit, oe **B1**

(a) Answer: It orbits close to the Earth, passing near the poles.

(b) it is much shorter (much less than 24 hours) **B1**

(b) Answer: It is much shorter.

(c) the satellite passes over a different strip of the Earth's surface on each orbit, as the Earth rotates beneath it, so given enough time it can image/monitor the whole surface, oe **B1**

(c) Answer: It passes over a different strip of the Earth each orbit as the Earth turns, eventually covering the whole surface.

Question 2

(a) nebula **B1**

(a) Answer: Nebula.

(b) gravity (gravitational attraction) **B1**

(b) Answer: Gravity.

(c) the material at the centre becomes increasingly hot, dense and compressed as more material is pulled in by gravity **B1**

(c) eventually this becomes hot and dense enough for nuclear fusion to begin, forming a new star, oe **B1**

(c) Answer: The material at the centre becomes hotter and denser until nuclear fusion begins, forming a new star.

Question 3

(a) e.g. both begin as a nebula and pass through a main sequence stage powered by nuclear fusion, oe **B1**

(a) Answer: E.g. both pass through a main sequence stage.

(b) a Sun-sized star ends as a white dwarf (then a black dwarf), while a massive star explodes as a supernova **B1**

(b) a massive star can leave behind a neutron star or black hole, which a Sun-sized star's life cycle never produces, oe **B1**

(b) Answer: A Sun-sized star ends as a white/black dwarf; a massive star explodes as a supernova, leaving a neutron star or black hole.

Question 4

(a) red super giant (red supergiant) **B1**

(a) Answer: Red super giant.

(b) supernova **B1**

(b) Answer: Supernova.

(c) neutron star **B1**

(c) black hole **B1**

(c) depends on the mass of the remaining core/original star - only a sufficiently massive star leaves behind a black hole, oe **B1**

(c) Answer: A neutron star or a black hole; a black hole only forms from a sufficiently massive remaining core.

Question 5

(a) substitution: $v = (2 \times \pi \times 7.0 \times 10^6) / 5800$, oe **M1**

(a) correct evaluation of the numerator: $2 \times \pi \times 7.0 \times 10^6 = 4.398 \times 10^7$ **M1**

(a) v = 7580 m/s (3 s.f.), cao (accept awrt 7580 m/s) **A1**

(a) Answer: v = 7580 m/s

Question 6

(a) satellite P **B1**

(a) Answer: Satellite P.

(b) satellite Q **B1**

(b) Answer: Satellite Q.

Question 7

(a) gravitational force (of attraction between the Sun and the planet) **B1**

(a) Answer: Gravitational force.

(b) towards the centre of the orbit (towards the Sun) **B1**

(b) Answer: Towards the centre of the orbit.

(c) velocity depends on both speed and direction, and although the speed is constant, the direction of the planet's motion is continuously changing **B1**

(c) a change in velocity means the planet is accelerating, with the acceleration directed towards the centre of the orbit, oe **B1**

(c) Answer: Its direction keeps changing, so velocity changes, so it is accelerating towards the centre of the orbit.

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