Gcse Topic 8 AQA Physics: Space Physics Mark Scheme

Q1.
(a) Mercury (1)
(b) Jupiter (1)
Total: 2 marks

Q2.
(a) Gravitational force / gravity (1)
(b) Planets naturally travel in a straight line at high speed (1)
Gravity provides centripetal force to keep them in orbit (1)
Total: 3 marks

Q3.
(a) Large ball of gas undergoing nuclear fusion, releasing energy (1)
(b) Some stars are closer to Earth (1)
Some stars are hotter / larger / more luminous (1)
Total: 3 marks

Q4.
(a) A man-made object placed in orbit around Earth or another planet (1)
(b) One use, e.g. communication / GPS / weather / spying / scientific research (1)
Total: 2 marks

Q5.
(a) Geostationary orbit stays above the same point on Earth / 24 h orbit (1)
Polar orbit passes over the poles, covering whole Earth over time (1)
(b) Advantage: allows mapping / surveillance / full Earth coverage (1)
Total: 3 marks

Q6.
(a) Gravitational force (1)
(b) Moon's gravity pulls on Earth's oceans (1)
Causes tidal bulges on near and far side of Earth (1)
Total: 3 marks

Q7.
(a) Safer / cheaper / can go where humans cannot (1)
(b) Challenge: communication delays / radiation / risk of failure / long travel time (1)
Total: 2 marks

Q8.
(a) Cloud of gas and dust (1)
(b) Star like Sun expands into red giant (1)
Outer layers ejected, leaving a cooling white dwarf (1)
Total: 3 marks

Q9.
Astronauts and spacecraft are in free fall towards Earth (1)
They accelerate at the same rate → no normal reaction force → feel weightless (1)
Total: 2 marks

Q10.
(a) Nucleus (1)
Tail (1)
(b) Tail always points away from Sun due to solar wind (1)
Not related to direction of travel (1)
Total: 4 marks

Q11.
(a) Light from distant galaxies stretched to longer wavelength (1)
Shifted towards red end of visible spectrum (1)
(b) Shows galaxies moving away → universe expanding (1)
Total: 3 marks

Q12.
(a) Evidence: red-shift of galaxies (1)
Or: cosmic microwave background radiation (1)
(b) Shows universe started hot, dense, and is expanding (1)
Total: 3 marks

Q13.
(a) Planet orbiting a star outside the Solar System (1)
(b) Detection: transit method / wobble method / radial velocity (1)
Total: 2 marks

Q14.
(a) Closer satellites experience stronger gravity (1)
So must travel faster to balance force and stay in orbit (1)
(b) Geostationary satellites stay above same point → useful for constant communication (1)
Total: 3 marks

Q15.
(a) Planets reflect light / stars produce their own light by fusion (1)
(b) Brightness depends on distance from Earth (1)
Also depends on star's size / temperature / luminosity (1)
(c) Brightness changes due to eclipses / orbiting planets / variable star output (1)
Or due to movement of star relative to Earth (1)
Total: 5 marks

Q16.
(a) Gravitational force (1)
(b) Force acts towards the Sun (1)
Provides centripetal force so planet moves in a near circle (1)
Total: 3 marks

Q17.
(a) Geostationary: stays above same point on Earth (1)
Low Earth orbit: much lower altitude and moves quickly around Earth (1)
(b) Gives higher resolution images (1)
Total: 3 marks

Q18.
(a) Tail forms because of solar radiation / solar wind pushing dust and gas away (1)
Always points away from the Sun (1)
(b) Nucleus (1)
Coma / tail (1)
Total: 4 marks

Q19.
(a) Wavelength of light increases (1)
Shifted towards the red end of the spectrum (1)
(b) Shows galaxies are moving away (1)
The greater the red-shift, the faster the galaxy is moving (1)
Total: 4 marks

Q20.
(a) Stars nearer to Earth appear brighter (1)
Stars with higher luminosity appear brighter (1)
(b) Surface temperature / size (any one) (1)
Total: 3 marks

Q21.
(a) Nebula forms a protostar (1)
Nuclear fusion produces a main-sequence star (1)
Outer layers ejected, leaving a white dwarf (1)
(b) Black hole / neutron star (1)
Total: 4 marks

Q22.
(a) Core collapses after fusion stops (1)
Infalling material rebounds, creating a shock wave (1)
(b) Neutron star or black hole (1)
Total: 3 marks

Q23.
(a) Gravity provides the centripetal force (1)
Balanced by satellite's forward motion (1)
(b) Speed decreases with altitude (1)
Total: 3 marks

Q24.
(a) Communications / broadcasting (1)
(b) Equatorial orbit keeps satellite fixed above same point on Earth (1)

Needed for constant communication (1)
Total: 3 marks

Q25.
(a) Radio interference is weaker in remote areas (1)
Avoids man-made signals from towns (1)
(b) No atmospheric absorption of signals (1)
Total: 3 marks

Q26.
(a) Planet orbiting a star other than the Sun (1)
(b) Transit method – dimming of starlight (1)
Or Doppler wobble – change in star's spectrum (1)
Total: 3 marks

Q27.
(a) Red-shift of galaxies / cosmic microwave background radiation (1)
(b) Shows universe expanded from a small hot dense point (1)
Expansion still continuing today (1)
Total: 3 marks

Q28.
(a) Wavelength increases / light is stretched (1)
Moves towards red end of spectrum (1)
(b) Red has the longest wavelength (1)
Total: 3 marks

Q29.
(a) Both astronaut and spacecraft are in free fall (1)
No normal reaction force on the astronaut (1)
(b) Gravitational force (1)
Total: 3 marks

Q30.
(a) Gravitational force is stronger nearer the Sun (1)
So orbital speed must be higher to balance the force (1)
(b) Kepler's laws (1)
Total: 3 marks

Q31.
(a) Safer, cheaper, or no life support needed (1)
(b) Long travel time / radiation damage / communication delays (1)
Total: 2 marks

Q32.
(a) Larger aperture collects more light (1)
Higher resolution so more detail visible (1)
(b) Atmospheric distortion / pollution / absorption (1)
Total: 3 marks

Q33.
(a) Gravitational attraction to the planet is stronger than that of the Sun (1)
Planet keeps the moon in orbit (1)
(b) e.g. Moon orbits Earth (1)
Total: 3 marks

Q34.
(a) Brightness as seen from Earth (1)
(b) Total power output of the star (1)
(c) Distance from Earth (1)
Total: 3 marks

Q35.
(a) Orbital motion of binary stars allows calculation of their masses (1)
By using Newton's law of gravitation (1)
(b) Distance light travels in one year (1)
Total: 3 marks

Q36.
(a) Core runs out of hydrogen fuel (1)
Outer layers expand and cool, forming a red giant (1)
(b) Red giant is large and cool, white dwarf is small and hot (1)
Total: 3 marks

Q37.
(a) Depends on planet's mass (1)
And its radius / distance from centre (1)
(b) N/kg (1)
Total: 3 marks

Q38.
(a) More massive planets give stronger gravitational pull (1)
Satellite moves faster, shorter orbital period (1)
(b) Larger orbital radius means weaker gravitational pull (1)
Slower speed, longer orbital period (1)
Total: 4 marks

Q39.
(a) Suggests universe is expanding (1)
From a single point in the past (1)
(b) Only shows galaxies moving apart – doesn't explain why (1)
Total: 3 marks

Q40.
(a) Radiation left over from the Big Bang, now stretched into microwaves (1)
(b) Shows universe was once hot and dense (1)
Supports Big Bang theory (1)
Total: 3 marks

Q41.
(a) Work done = force × distance (1)
Force = mg (1)
So, Ep = mgh (1)
Total: 3 marks

Q42.
(a) Centripetal force = gravitational force (1)
$mv^2/r = GMm/r^2$ (1)
Orbital speed: $v = \sqrt{(GM/r)}$ (1)
Total: 3 marks

Q43.
(a) $v / c = \Delta\lambda / \lambda$ (1)
(b) $\Delta\lambda = 660 - 656 = 4$ nm (1)
$v = (4 / 656) \times 3 \times 10^8 = 1.83 \times 10^6$ m/s (1)
Total: 3 marks

Q44.
(a) Escape when KE = GPE (1)
$\frac{1}{2}mv^2 = GMm/r$ (1)
$v = \sqrt{(2GM/r)}$ (1)
Total: 3 marks

Q45.
(a) Use orbital period and radius to find centripetal force (1)
Apply Newton's law of gravitation to calculate masses (1)
(b) Assume circular orbits (1)
Total: 3 marks

Q46.
(a) $\theta = \lambda/D$ (1)
Derived from diffraction at circular aperture (1)
Smaller λ or larger D improves resolution (1)
Total: 3 marks

Q47.
(a) Boundary around a black hole from which not even light can escape (1)
(b) Escape velocity > speed of light (1)
Nothing can travel faster than light (1)
Total: 3 marks

Q48.
(a) $F = Gm_1m_2 / r^2$ (1)
(b) Gravitational force weakens as distance increases (1)
Because force $\propto 1/r^2$ (1)
Total: 3 marks

Q49.
(a) Observations show galaxies further away move faster (1)
Implies expansion is uniform (1)
(b) $v = H_0 d = 70 \times 200 = 14{,}000$ km/s (1)
Convert if needed: 1.4×10^7 m/s (1)
Total: 4 marks

Q50.
(a) Centripetal force = mv^2/r (1)
Gravitational force = GMm/r^2 (1)
Therefore $mv^2/r = GMm/r^2$ (1)
Total: 3 marks

Q51.
(a) CMB is uniform radiation detected in all directions (1)
Matches predictions of cooled radiation from early hot dense universe (1)
(b) Cannot explain small-scale variations or dark energy (1)
Total: 3 marks

Q52.
(a) $Ep = -GMm/r$ (1)
r = Earth's radius + height = $6.37 \times 10^6 + 3 \times 10^5$ (1)
Substitution gives value ≈ -3.1×10^{10} J (1)
Total: 3 marks

Q53.
(a) To leave Earth permanently (1)
Must overcome gravitational pull (1)
(b) $v = \sqrt{(2GM/R)}$ (1)
Substitution: $v = \sqrt{[(2 \times 6.67 \times 10^{-11} \times 5.97 \times 10^{24}) / 6.37 \times 10^6]}$ (1)
v ≈ 11,200 m/s (1)
Total: 5 marks

Q54.
(a) $T^2 \propto r^3$ (1)
(b) $T^2 = (4\pi^2/GM) \times r^3$ (1)
Substitution gives $T^2 \approx 1.3 \times 10^7$ s² (1)
Total: 3 marks

Q55.
(a) Ripples in spacetime (1)
Caused by accelerating massive objects like merging black holes (1)
(b) Detected by laser interferometers (e.g. LIGO) (1)
Total: 3 marks