Q17 Which of the following statements is *false*? Pencil across *no more than three* cells in row 17.

KEY for Q17

A The relation now written as $m = \mu$ was tested for a range of materials by Isaac Newton using long pendulums.

B Baron Roland von Eötvös showed that the relation $m = \mu$ was true to within a few parts in 10^9.

C The accuracy of the original Eötvös experiment would have been improved if it could have been carried out at the North Pole where it would not have been affected by centrifugal forces.

D The gravitational binding energy of the Earth–Moon system causes the gravitational mass of that system to exceed the inertial mass by about one part in a thousand.

E There is no rigorous test of the equivalence principle that is independent of the weak equivalence principle.

Q18 Which of the following statements is *false*? Pencil across *no more than three* cells in row 18.

KEY for Q18

A Due to gravitational redshift, the frequency of electromagnetic radiation will *decrease* by more than one part in 10^{11} when the radiation rises through a distance of 100 km in a uniform gravitational field of strength $g = 10\,\mathrm{m\,s^{-2}}$.

B Pound and Rebka, using a discovery made by R. Mössbauer, were able to detect the redshift of γ-rays travelling up a 22.5 m tower.

C Gravitational redshift of radiation from a rocket-borne microwave generator has been used to verify the weak equivalence principle to within 2 parts in 10^4.

D Due to gravitational redshift the frequency of electromagnetic radiation will *increase* by more than one part in 10^{11} when the radiation rises through a distance of 100 km in a uniform gravitational field of strength $g = 10\,\mathrm{m\,s^{-2}}$.

E The experiment of Hay, Schiffer, Cranshaw and Egelstaff tests the weak principle of equivalence.

Q19 Three data takers, A, B and C, are respectively located in the nose, mid-point, and tail of a rocket that is undergoing uniform acceleration with respect to an inertial frame of reference. Each data taker is equipped with a clock that is identical with the clocks being used by the other two data takers. Which *three* of the statements A–G in the key are *true*? Pencil across *three* cells in row 19.

KEY for Q19

A A's clock is running slow according to C.

B C's clock is running slow according to A.

C Clocks A and C are running at the same rate.

D According to B, the clocks being used by A and C are both running at the same rate.

E According to B, the clocks being used by A and C are running at different rates.

F According to an inertial observer, instantaneously moving with the same velocity as the rocket, the clocks being used by A and C are both running at the same rate.

G According to an inertial observer, instantaneously moving with the same velocity as the rocket, the clocks being used by A and C are running at different rates.

$\frac{\Delta f}{f} = \frac{gH}{c^2} = \frac{10\times10^5}{9\times10^{16}} = 10^6$

$= \frac{1}{9\times10^{10}} = 1.1E{-}11$

C B A E

D acc.