5 2024 NHT Question 2b, 2 marks

Show that the period of Himawari-8 is 24 hours. Show your working.

6 2024 NHT Question 2c, 2 marks

Juan calculates the gravitational potential energy, Eg , of the Himawari-8 satellite in orbit and uses the working:

$$E_g = mgh = (1300 \text{ kg})(9.81 \text{ m s}^{-2})(4.22 \times 10^7 \text{ m})$$

Analyse Juan's use of the gravitational potential energy formula for the Himawari-8 satellite in orbit.

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7 2023 Question 3, 1 mark

Space scientists want to place a satellite into a circular orbit where the gravitational field strength of Earth is half of its value at Earth's surface.

Which one of the following expressions best represents the altitude of this orbit above Earth's surface, where R is the radius of Earth?

A. $\dfrac{\sqrt{2}R}{2} - R$

B. $\sqrt{2}R$

C. $(\sqrt{2}R) - R$

D. $2R - \sqrt{2}R$

Ganymede has a mass of 1.5×10^{23} kg and a radius of 2.6×10^{6} m.

33 2020 Question 2, 1 mark

Which one of the following is closest to the magnitude of Ganymede's surface gravity?

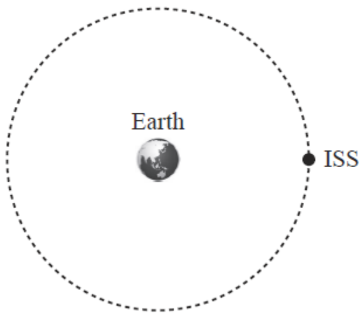
A. 0.8 m s^{-2}

B. 1.5 m s^{-2}

C. 3.8 m s^{-2}

D. 9.8 m s^{-2}

The International Space Station (ISS) is travelling around Earth in a stable circular orbit, as shown in the diagram below.



34 2020 Question 11, 1 mark

Which one of the following statements concerning the momentum and the kinetic energy of the ISS is correct?

A. Both the momentum and the kinetic energy vary along the orbital path.

B. Both the momentum and the kinetic energy are constant along the orbital path.

C. The momentum is constant, but the kinetic energy changes throughout the orbital path.

D. The momentum changes, but the kinetic energy remains constant throughout the orbital path.

Satellite move to widen reach of mobile phones

The headline and picture appeared in a recent edition of The Age newspaper it describes the use of Low Earth-Orbiting (LEO) satellites for the mobile phone network.

A LEO orbits at a height of 2000 km above the Earth's surface.

128 1996 Question 4, 1 mark

Calculate the period of the orbit of the LEO, clearly showing your working.

Data: Universal gravitational constant $G = 6.7 \times 10^{-11}$ Nm^2 kg^{-2}

mass of the Earth = 6.0×10^{24} kg

radius of the Earth = 6.4×10^6 m

Information for the next two questions.

$$\frac{\text{mass of Jupiter}}{\text{mass of Mars}} = 3000 \qquad \frac{\text{radius of Jupiter}}{\text{radius of Mars}} = 20$$

198 1972 Question 20, 1 mark

What is the value of the ratio $\dfrac{\text{average density of Jupiter}}{\text{average density of Mars}}$?

199 1972 Question 21, 1 mark

What is the value of the ratio $\dfrac{\text{period of a satellite just above the surface of Jupiter}}{\text{period of a satellite just above the surface of Mars}}$?

213 1969 Question 27, 1 mark

At P the kinetic energy of the spacecraft was

A. momentarily zero

B. less than at any other part of the translunar flight but not zero.

C. greater than at any other part of the translunar flight.

D. the same as at any other part of the translunar flight because energy is conserved.

Consider a satellite of mass *m* moving in a circular orbit around the earth at an altitude *h* above the earth's surface.
Let *M* and *R* be the mass and radius of the earth, respectively, and *G* be the gravitational constant.

214 1968 Question 59, 1 mark

In terms of the symbols given, write an expression for the period of the orbit, *T.*

215 1968 Question 60, 1 mark

The orbit is to be such that the satellite always appears, to an observer on the earth, to be in the same place-i.e. on a fixed compass bearing and at a fixed angle of elevation above the horizon. (Such an orbit is called a *synchronous orbit.)* In what plane(s) can the orbit be?

A. In the plane of any meridian of longitude.

B. In the plane of any parallel of latitude.

C. In the plane of one particular meridian of longitude.

D. In any plane through both the centre of the earth and the point at which the observer is located.

E. In the plane of the equator only.

216 1968 Question 61, 1 mark

The period of a satellite in a synchronous orbit would be

A. about 90 minutes.

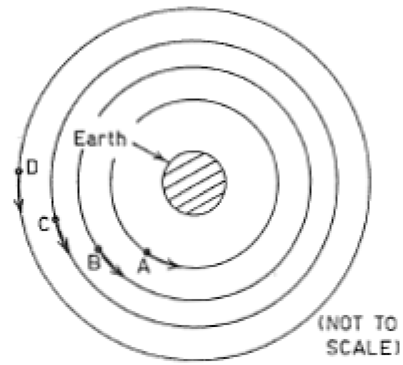
B. 12 hours

C. 1 day.

D. 1 month.

E. 1 year.

Four satellites, A, B, C, and D, are put into circular orbits about the earth.



222 1966 Question 47, 1 mark

Kepler's Third Law relates the period of revolution *T* of a planet to *R* the radius of its orbit. The law states that $T^2 = kR^3$ where *k* is a constant. If *T* were measured in days and *R* in kilometres, what would be the corresponding unit for *k?*

223 1966 Question 48a, b, c, d, 4 marks

The Table below shows certain measured and calculated quantities relating to the satellites. In some cases the units used are arbitrary. Calculate the values of the "missing" quantities, M_C, R_D, F_B and T_C. (The answers may be left in fractional or surd form.)

Satellite	Mass (arbitrary units)	Radius of orbit (arbitrary units)	Gravitational force exerted by earth (arbitrary units)	Period of revolution (days)
A	3	1	3	$\frac{1}{8}$
B	1	4	F_B	1
C	M_C	$\frac{25}{4}$	$\frac{16}{25}$	T_C
D	1,024	R_D	4	8

229 1966 Question 61, 1 mark

What is the total work done (in newton-km) against the aggravational force in lifting a 1-kg mass from the surface of the lapnet to a height of 2,000 km?

Questions 62 *and* 63 *relate to the following additional information.*

The inhabitants of the lapnet try to establish a series of satellites moving in circular orbits at various heights around the lapnet. They find three possibilities, set out in the following Key.

KEY

A. A circular orbital motion is possible. (The lapnet has no atmosphere.)

B. A satellite can remain at a fixed height but not orbiting.

C. A satellite cannot remain at the height at which it is placed.

For each of the following heights indicate which of the three statements in the Key is found to be correct

230 1966 Question 62, 1 mark

1,000 km

231 1966 Question 63, 1 mark

3,000 km

232 1966 Question 64, 1 mark

The inhabitants of the lapnet observe a meteor at a height of 10,000 km. They also observe its speed. The meteor is headed directly for a head-on collision with the lapnet. The scientists calculate that the velocity of the meteor will become zero at a height of 4,000 km, where the aggravation force on 1 kg is $\frac{2}{3} \times 80$ newtons.

What was its observed speed (in km sec^{-1}) at a height of 10,000 km?
(The answer may be left in fractional or surd form.)

233 1966 Question 65, 1 mark

Which of *A, B, C,* or *D* correctly completes the following statement?
After the meteor reaches the height at which its velocity is zero, it will

A. remain stationary at this height.

B. go into a circular orbit about the lapnet.

C. reverse its motion and return on its incident path.

D. go into free fall towards the lapnet.
