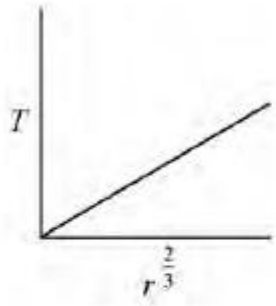
Practice Question Set For A-Level
Subject : Physics
Paper-2 Topic: Fields And Their Consequences(Gravitational Field)

Name of the Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

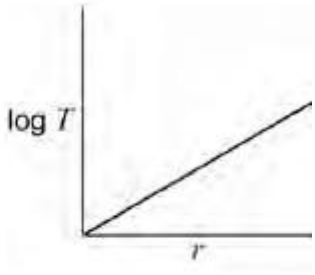
Q1.

Which graph shows the relationship between the time period T and the orbital radius r of a planet in orbit around the Sun?

A



B



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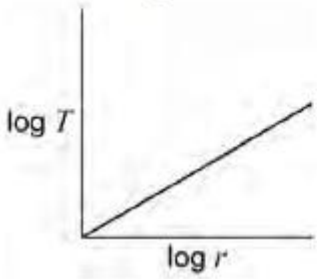
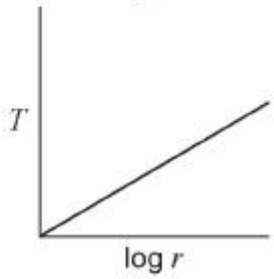


D



A ⬭

B ⬭

C ⬭

D ⬭

(Total 1 mark)

Q2.

The Earth can be assumed to be a uniform sphere of radius R.

What is the mean density of the Earth?

A $\frac{3g}{4\pi RG}$ ⬭

B $\frac{3RG}{4\pi g}$ ⬭

C $\frac{3G}{4\pi Rg}$ ⬭

D $\frac{3Rg}{4\pi G}$ ⬭

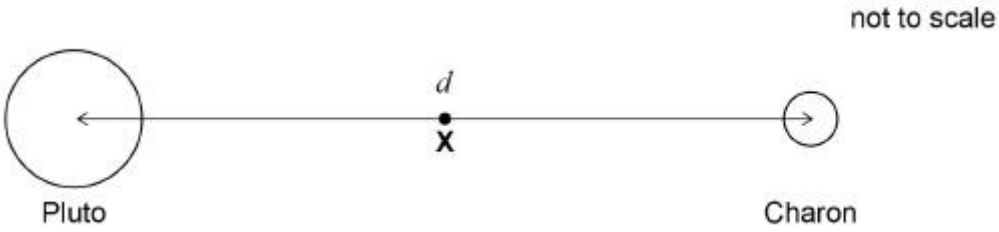
(Total 1 mark)

Q3.

Charon is a moon of Pluto that has a mass equal to $\frac{1}{9}$ that of Pluto.

The distance between the centre of Pluto and the centre of Charon is *d*.

X is the point at which the resultant gravitational field due to Pluto and Charon is zero.



What is the distance of **X** from the centre of Pluto?

A $\frac{2}{9}d$ ⬭

B $\frac{2}{3}d$ ⬭

C $\frac{3}{4}d$ ⬭

D $\frac{8}{9}d$ ⬭

(Total 1 mark)

Q4.

The distance between the Sun and Mars varies from 2.1×10^{11} m to 2.5×10^{11} m.
When Mars is closest to the Sun, the force of gravitational attraction between them is F.

What is the force of gravitational attraction between them when they are furthest apart?

A $0.71F$ ⬭

B $0.84F$ ⬭

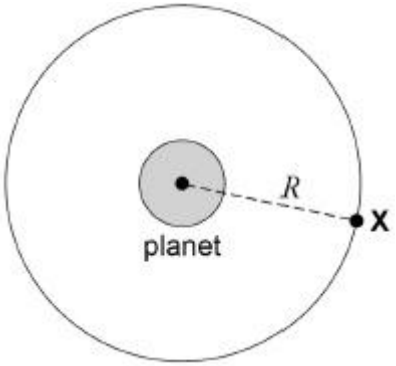
C $1.2F$ ⬭

D $1.4F$ ⬭

(Total 1 mark)

Q5.

A satellite **X** of mass *m* is in a concentric circular orbit of radius R about a planet of mass M.



What is the kinetic energy of **X**?

A $\frac{GMm}{2R}$ ⬭

B $\frac{GMm}{R}$ ⬭

C $\frac{2GMm}{R}$ ⬭

D $\frac{4GMm}{R}$ ⬭

(Total 1 mark)

Q6.

The distance between the centres of the Earth and the Moon is 3.8×10^8 m. The mass of the Earth is 6.0×10^{24} kg and the mass of the Moon is 7.4×10^{22} kg.

A spacecraft of mass 10×10^3 kg is moving along a line joining their centres.

At what distance from the centre of the Earth would the spacecraft experience no resultant force due to the Earth and the Moon?

A 3.8×10^7 m ⬭

B 4.8×10^7 m ⬭

C 3.4×10^8 m ⬭

D 3.8×10^8 m ⬭

(Total 1 mark)

Q7.

The radius of a planet is R. The gravitational potential at the surface of the planet due to its mass is −4000 J kg^{-1}.

What is the gravitational potential at a distance $2R$ from the centre of the planet?

A −1000 J kg^{-1} ⬭

B −2000 J kg^{-1} ⬭

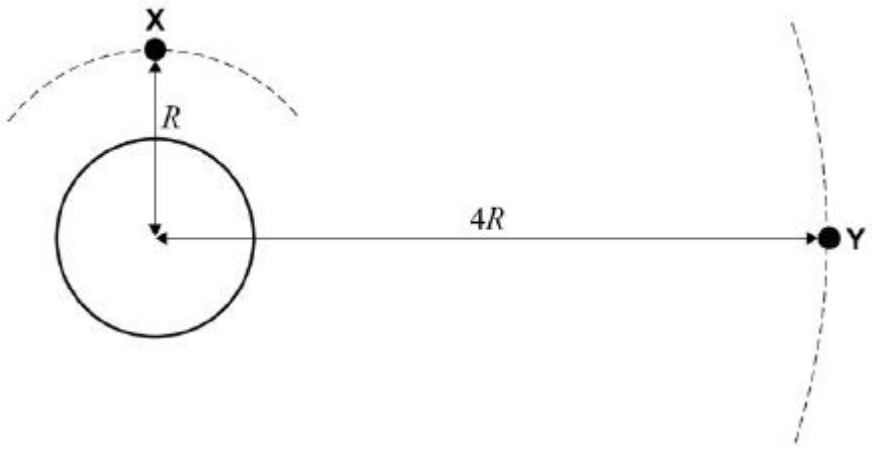
C −4000 J kg^{-1} ⬭

D −8000 J kg^{-1} ⬭

(Total 1 mark)

Q8.

Satellites **X** and **Y** orbit the Earth at distances R and $4R$ respectively, as shown in the diagram.



Which statement is **incorrect**?

A The speed of **Y** is greater than the speed of **X** ⬭

B The time period of **Y** is greater than the time period of **X**. ⬭

C The potential energy of **Y** is greater than the potential energy of **X**. ⬭

D The gravitational force acting on **Y** is less than the gravitational force acting on **X**. ⬭

(Total 1 mark)

Q9.

A planet has a radius half the Earth's radius and a mass a quarter of the Earth's mass. What is the approximate gravitational field strength on the surface of the planet?

A 1.6 N kg^{-1} ⬭

B 5.0 N kg^{-1} ⬭

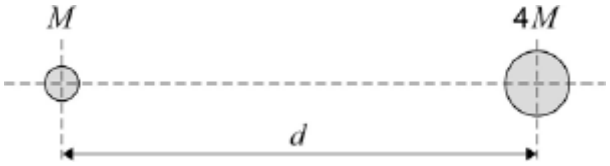
C 10 N kg^{-1} ⬭

D 20 N kg^{-1} ⬭

(Total 1 mark)

Q10.

Two stars of mass M and $4M$ are at a distance d between their centres.



The resultant gravitational field strength is zero along the line between their centres at a distance y from the centre of the star of mass M.

What is the value of the ratio $\frac{y}{d}$?

A $\frac{1}{2}$ ⬭

B $\frac{1}{3}$ ⬭

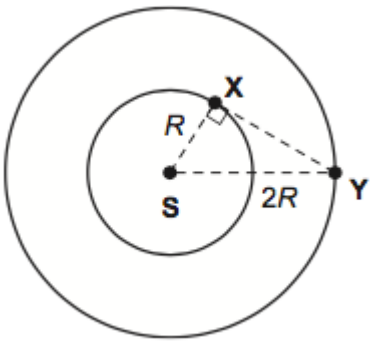
C $\frac{2}{3}$ ⬭

D $\frac{3}{4}$ ⬭

(Total 1 mark)

Q11.

Two planets **X** and **Y** are in concentric circular orbits about a star **S**. The radius of the orbit of **X** is *R* and the radius of orbit of **Y** is 2*R* .



The gravitational force between **X** and **Y** is F when angle **SXY** is 90°, as shown in the diagram.

What is the gravitational force between **X** and **Y** when they are nearest to each other?

A $2F$
B $3F$
C $4F$
D $5F$

(Total 1 mark)

Q12.

A geosynchronous satellite is in a constant radius orbit around the Earth. The Earth has a mass of 6.0×10^{24} kg and a radius of 6.4×10^{6} m.

What is the height of the satellite above the Earth's surface?

A 1.3×10^{7} m
B 3.6×10^{7} m
C 4.2×10^{7} m
D 4.8×10^{7} m

(Total 1 mark)

Q13.

The gravitational constant, G, is a constant of proportionality in Newton's law of gravitation. The permittivity of free space, ε_0, is a constant of proportionality in Coulomb's law.

When comparing the electrostatic force acting on a pair of charged particles to the gravitational force between them, the product $\varepsilon_0 G$ can appear in the calculation.

Which is a unit for $\varepsilon_0 G$?

A $C^2\ kg^{-2}$
B $C^2\ m^{-2}$
C $F\ kg^2\ N^{-1}\ m^{-2}$
D it has no unit

(Total 1 mark)

Q14.

Two identical uniform spheres each of radius R are placed in contact. The gravitational force between them is F.

The spheres are now separated until the force of attraction is $\frac{F}{9}$.

What is the distance between the **surfaces** of the spheres after they have been separated?

A $2R$

B $4R$

C $8R$

D $12R$

(Total 1 mark)

Q15.

A satellite of mass m is in a circular orbit at height R above the surface of a uniform spherical planet of radius R and density ρ.

What is the force of gravitational attraction between the satellite and the planet?

A $\frac{\pi\rho GmR}{3}$

B $\frac{2\pi\rho GmR}{3}$

C $\frac{\pi\rho GmR^2}{3}$

D $\frac{2\pi\rho GmR^2}{3}$

(Total 1 mark)

Q16.

The following data refers to two planets, P and Q.

	Radius / km	Density / kg m^{-3}
planet P	8000	6000
planet Q	16 000	3000

The gravitational field strength at the surface of P is 13.4 N kg^{-1}.
What is the gravitational field strength at the surface of Q?

A 3.4 N kg^{-1}

B 13.4 N kg^{-1}

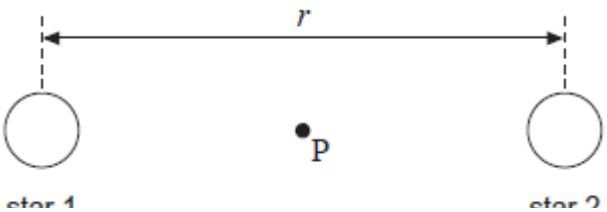
C 53.6 N kg^{-1}

D 80.4 N kg^{-1}

(Total 1 mark)

Q17.

The diagram shows an isolated binary star system. The two stars have equal masses, M, and the distance between their centres is r.



The point P is half-way between the two stars.
What is the gravitational field strength at P?

A zero

B $-\frac{GM}{r^2}$

C $-\frac{2GM}{r^2}$

D $-\frac{4GM}{r^2}$

(Total 1 mark)

Q18.

Which one of the following statements about gravitational potential is **incorrect**?

A It is analogous to the electric potential at a point in an electric field.

B It is equal to the gravitational potential energy of a mass of 1 kg.

C It is a vector quantity.

D The difference in gravitational potential between two points at different heights above the Earth depends on the position of the points.

Q19.

A satellite orbiting the Earth moves to an orbit which is closer to the Earth.

Which line, **A** to **D**, in the table shows correctly what happens to the speed of the satellite and to the time it takes for one orbit of the Earth?

	Speed of satellite	**Time For One Orbit Of Earth**
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

(Total 1 mark)

Q20.

In the equation $X = \frac{ab}{r^n}$, X represents a physical variable in an electric or a gravitational field, a is a constant, b is either mass or charge and n is a number.

Which line, **A** to **D**, in the table provides a consistent representation of X, a and b according to the value of n?

The symbols E, g, V and r have their usual meanings.

	n	***X***	***a***	***b***
A	1	E	$\frac{1}{4\pi\varepsilon_0}$	charge
B	1	V	$\frac{1}{4\pi\varepsilon_0}$	mass
C	2	g	G	mass
D	2	V	G	charge

(Total 1 mark)