Multiple Choice Gravity Fields Paper Questions
Jan 2002—Jan 2010 (old spec)

8 The gravitational potential difference between the surface of a planet and a point P, 10 m above the surface, is $8.0\,\text{J kg}^{-1}$. Assuming a uniform field, what is the value of the gravitational field strength in the region between the planet's surface and P?

Jan 2002

A $0.80\,\text{N kg}^{-1}$

B $1.25\,\text{N kg}^{-1}$

C $8.0\,\text{N kg}^{-1}$

D $80\,\text{N kg}^{-1}$

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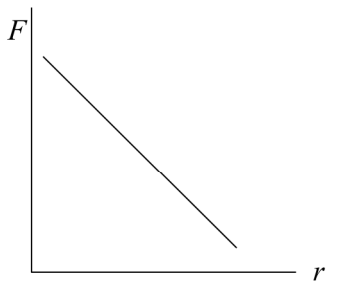
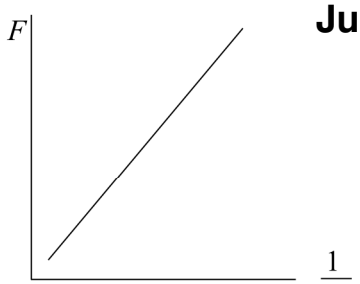
9 Which one of the following graphs correctly shows the relationship between the gravitational force, F, between two masses and the distance, r, between them?

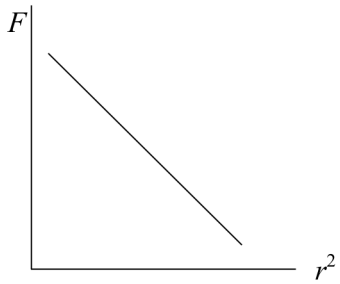
Jun 2002



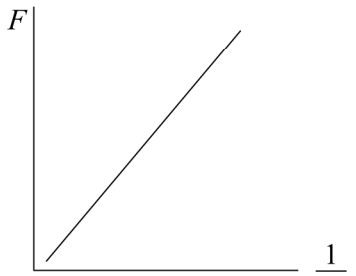
A



B



C



D

11 A satellite is in orbit at a height h above the surface of a planet of mass M and radius R. What is the velocity of the satellite?

A $\sqrt{\dfrac{GM(R+h)}{R}}$

B $\dfrac{\sqrt{GM(R+h)}}{R}$

C $\sqrt{\dfrac{GM}{(R+h)}}$

D $\dfrac{\sqrt{GM}}{(R+h)}$

10 A small mass is situated at a point on a line joining two large masses m_1 and m_2 such that it experiences no resultant gravitational force. If its distance from the mass m_1 is r_1 and its distance from the mass m_2 is r_2, what is the value of the ratio $\frac{r_1}{r_2}$?

Jan 2003

A $\frac{m_1^2}{m_2^2}$

B $\frac{m_2^2}{m_1^2}$

C $\sqrt{\frac{m_1}{m_2}}$

D $\sqrt{\frac{m_2}{m_1}}$

11 A planet of mass M and radius R rotates so rapidly that loose material at the equator just remains on the surface. What is the period of rotation of the planet?

G is the universal gravitational constant.

A $2\pi\sqrt{\frac{R}{GM}}$

B $2\pi\sqrt{\frac{R^2}{GM}}$

C $2\pi\sqrt{\frac{GM}{R^3}}$

D $2\pi\sqrt{\frac{R^3}{GM}}$

12 Which one of the following has different units to the other three?

A gravitational potential
B gravitational field strength
C force per unit mass
D gravitational potential gradient

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9 A planet has a radius half of 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?

Jan 2004

A 1.6 N kg^{-1}
B 5.0 N kg^{-1}
C 10 N kg^{-1}
D 20 N kg^{-1}

8 The following data refer to two planets.

Jun 2004

	radius/km	density/kg m^{-3}
planet P	8 000	6 000
planet Q	16 000	3 000

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}

9 Near the surface of a planet the gravitational field is uniform and for two points, 10 m apart vertically, the gravitational potential difference is 3 J kg^{-1}. How much work must be done in raising a mass of 4 kg vertically through 5 m?

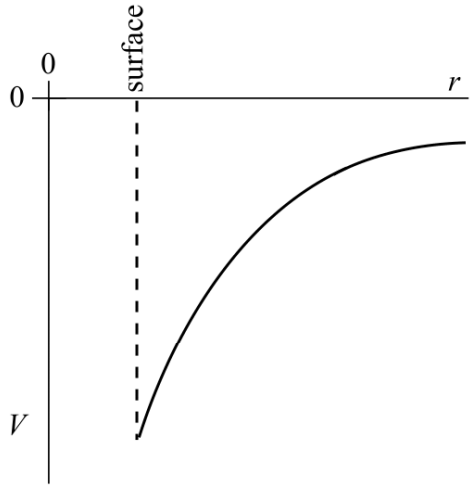
A 3 J
B 6 J
C 12 J
D 15 J

7 The Earth has density ρ and radius R. The gravitational field strength at the surface is g. What is the gravitational field strength at the surface of a planet of density 2ρ and radius $2R$?

Jun 2005

A g
B $2g$
C $4g$
D $16g$

10 The graph shows how the gravitational potential, V, varies with the distance, r, from the centre of the Earth.

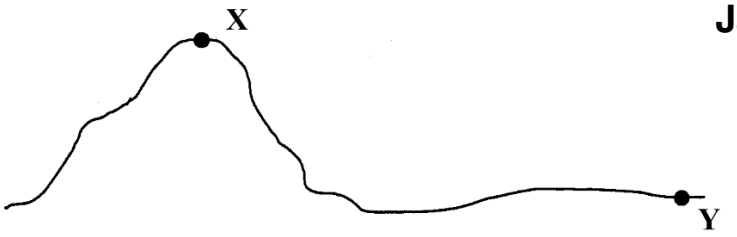


What does the gradient of the graph at any point represent?

A the magnitude of the gravitational field strength at that point
B the magnitude of the gravitational constant
C the mass of the Earth
D the potential energy at the point where the gradient is measured

8 The diagram shows two positions, **X** and **Y**, at different heights on the surface of the Earth.

Jan 2006



Which line, **A** to **D**, in the table gives correct comparisons at **X** and **Y** for gravitational potential and angular velocity?

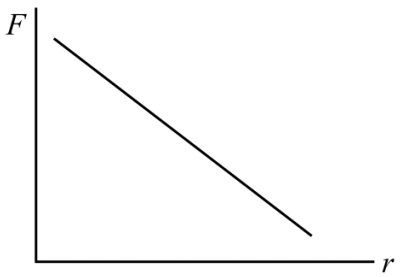
	gravitational potential at X compared with Y	**angular velocity at X compared with Y**
A	greater	greater
B	greater	same
C	greater	smaller
D	same	same

9 A projectile moves in a gravitational field. Which one of the following is a correct statement for the gravitational force acting on the projectile?

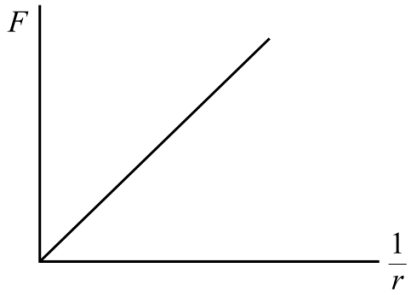
A The force is in the direction of the field.
B The force is in the opposite direction to that of the field.
C The force is at right angles to the field.
D The force is at an angle between 0° and 90° to the field.

10 Which one of the following graphs correctly shows the relationship between the gravitational force, F, between two masses and their separation r.

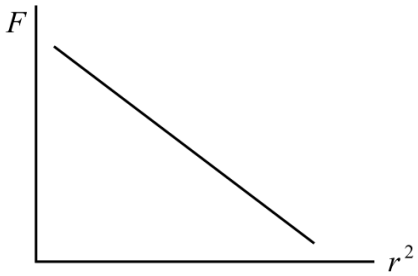
Jun 2006



A



B



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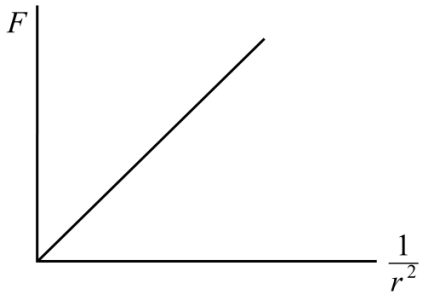

D

11 When at the surface of the Earth, a satellite has weight W and gravitational potential energy $-U$. It is projected into a circular orbit whose radius is equal to twice the radius of the Earth. Which line, **A** to **D**, in the table shows correctly what happens to the weight of the satellite and to its gravitational potential energy?

	weight	**gravitational potential energy**
A	becomes $\frac{W}{2}$	increases by $\frac{U}{2}$
B	becomes $\frac{W}{4}$	increases by $\frac{U}{2}$
C	remains W	increases by U
D	becomes $\frac{W}{4}$	increases by U

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10 A small mass is situated at a point on a line joining two large masses m_1 and m_2 such that it experiences no resultant gravitational force. If its distance from the centre of mass m_1 is r_1 and its distance from the centre of mass m_2 is r_2 , what is the value of the ratio $\frac{r_1}{r_2}$?

Jun 2007

A $\frac{m_1^{\,2}}{m_2^{\,2}}$

B $\frac{m_2^{\,2}}{m_1^{\,2}}$

C $\sqrt{\frac{m_1}{m_2}}$

D $\sqrt{\frac{m_2}{m_1}}$

11 The Earth may be considered to be a uniform sphere of mass M and radius R. Which one of the following equations correctly relates the gravitational constant, G, with the acceleration due to gravity, g, at its surface?

A $G = \frac{M}{gR^2}$

B $G = \frac{gM}{R^2}$

C $G = \frac{R^2}{gM}$

D $G = \frac{gR^2}{M}$

12 What is the unit of gravitational potential?

A J

B $J\,kg^{-1}$

C $m\,s^{-2}$

D $N\,kg^{-1}$

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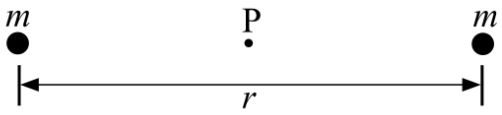
10 The diagram shows two objects of equal mass m separated by a distance r.

Jan 2008



Which line, **A** to **D**, in the table gives the correct values of the gravitational field strength and gravitational potential at the mid-point P between the two objects?

	gravitational field strength	**gravitational potential**
A	$-\frac{8Gm}{r^2}$	$-\frac{4Gm}{r}$
B	$-\frac{8Gm}{r^2}$	0
C	0	$-\frac{4Gm}{r}$
D	0	0

11 Mars has a diameter approximately 0.5 that of the Earth, and a mass of 0.1 that of the Earth. If the gravitational potential at the Earth's surface is $-63\,MJ\,kg^{-1}$, what is the approximate value of the gravitational potential at the surface of Mars?

A $-13\,MJ\,kg^{-1}$
B $-25\,MJ\,kg^{-1}$
C $-95\,MJ\,kg^{-1}$
D $-320\,MJ\,kg^{-1}$

9 Which one of the following has different units to the other three?

A gravitational potential gradient
B gravitational field strength
C force per unit mass
D gravitational potential

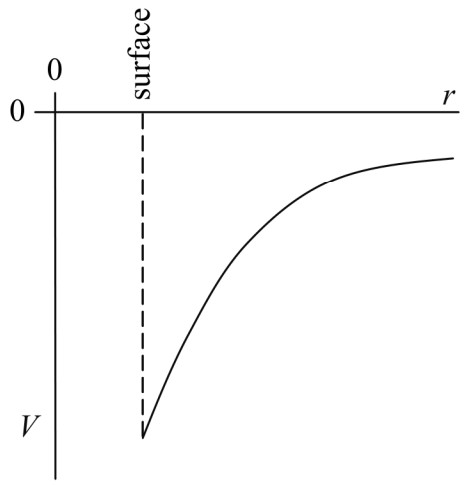
Jun 2008

8 The gravitational field strength at the surface of the Earth, of radius R, is g and the weight of an object on the surface is W. The object is now taken to a distance of $3R$ from the centre of the Earth. Which line, **A** to **D**, in the table gives the weight of the object and the gravitational field strength at this distance?

Jan 2009

	weight	**gravitational field strength**
A	$\frac{W}{9}$	$\frac{g}{9}$
B	$\frac{W}{9}$	$\frac{g}{3}$
C	$\frac{W}{4}$	$\frac{g}{4}$
D	$\frac{W}{3}$	$\frac{g}{3}$

10 The graph shows how the gravitational potential, V, varies with the distance, r, from the centre of the Earth.



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