

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

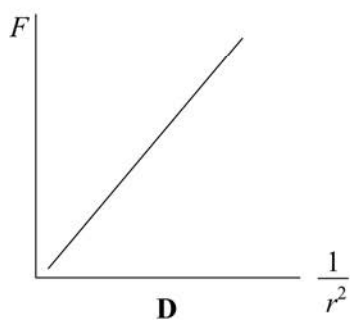
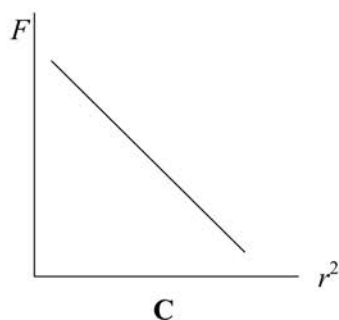
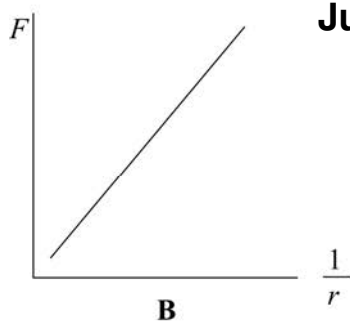
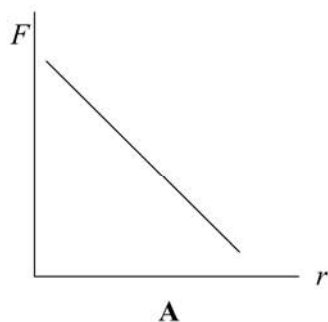
- 8 The gravitational potential difference between the surface of a planet and a point P, 10 m above the surface, is 8.0 J kg^{-1} . Assuming a uniform field, what is the value of the gravitational field strength in the region between the planet's surface and P?

Jan 2002

- A 0.80 N kg^{-1}
 B 1.25 N kg^{-1}
 C 8.0 N kg^{-1}
 D 80 N kg^{-1}

- 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



- 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 $\sqrt{\frac{GM(R+h)}{R}}$
 B $\frac{\sqrt{GM(R+h)}}{R}$
 C $\sqrt{\frac{GM}{(R+h)}}$
 D $\frac{\sqrt{GM}}{(R+h)}$

- 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 $\frac{r_1}{r_2}$?

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

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

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

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

Jan 2003

- 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

- 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?

A 1.6 N kg^{-1}

B 5.0 N kg^{-1}

C 10 N kg^{-1}

D 20 N kg^{-1}

Jan 2004

- 8 The following data refer to two planets.

	radius/km	density/kg m ⁻³
planet P	8 000	6 000
planet Q	16 000	3 000

Jun 2004

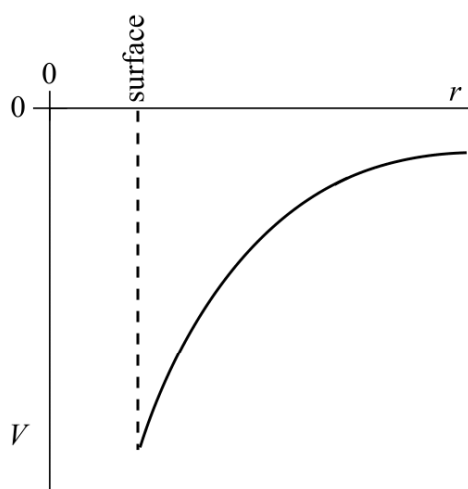
The gravitational field strength at the surface of P is 13.4 N kg^{-1} . What is the gravitational field strength at the surface of Q?

- 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.

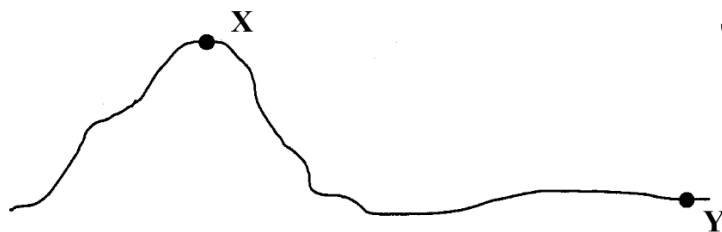


What does the gradient of the graph at any point represent?

- 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



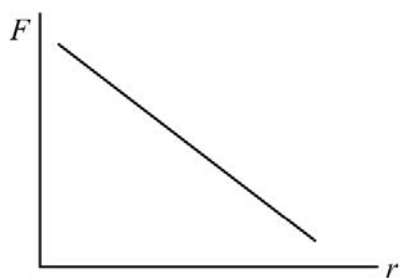
Which line, **A** to **D**, in the table gives correct comparisons at **X** and **Y** for gravitational potential and angular velocity?

	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

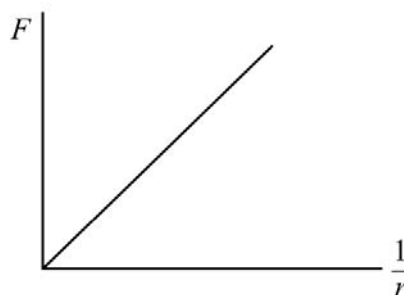
- 9 A projectile moves in a gravitational field. Which one of the following is a correct statement for the gravitational force acting on the projectile?
- A** The force is in the direction of the field.
 - B** The force is in the opposite direction to that of the field.
 - C** The force is at right angles 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 .

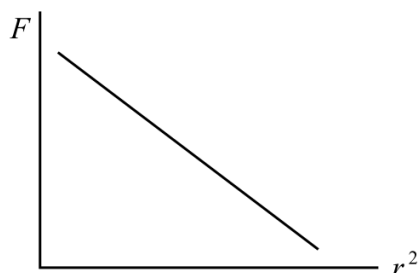
Jun 2006



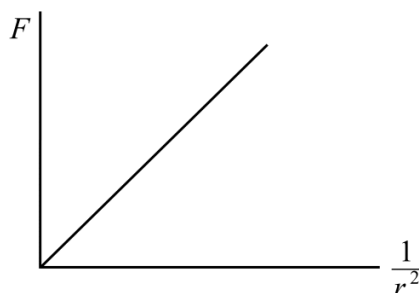
A



B



C



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

- 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 $\frac{r_1}{r_2}$?

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

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

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

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

Jun 2007

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

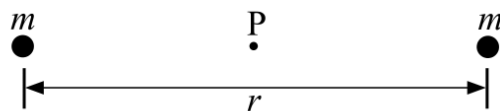
C $G = \frac{R^2}{gM}$

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}

- 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

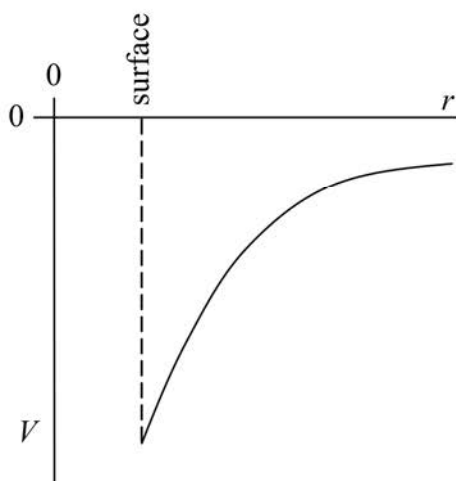
Jun 2008

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.



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

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

- 10 The following data refer to two planets, P and Q.

Jan 2010

	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}
- 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?

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