#

# Multiple Choice Questions (MCQ) topic quiz

# Set 3 Newtonian world and astrophysics

## Instructions and answers for teachers

These instructions cover the learner activity section which can be found separately.

This Lesson Element supports OCR AS and A Level Physics A.

**When distributing the activity section to the students either as a printed copy or as a Word file you will need to remove the teacher instructions section.**

### The Activity

This Lesson Element is a teaching and learning resource containing 44 multiple choice questions (MCQs) on the theme of Newtonian world and astrophysics. Some questions might require synoptic thinking, using knowledge and ideas from various topics across the full A Level content.

This resource can be used to test and consolidate understanding at the end of a topic or to revisit and refresh knowledge at a later point in the course.

### Introduction

Multiple choice questions allow rapid coverage of a wide range of sub-topics.

Contrary to a widespread belief among students, multiple choice questions are not necessarily easy – they can be easy, moderate or difficult.

The questions are written so that the incorrect answers are plausible distractors based on common errors or misconceptions.

When the developers are writing such questions they have to provide the logic to support their answers and the reasoning for each distractor.

**For example for question 12:**

|  |  |  |
| --- | --- | --- |
|  | The temperature of a fixed volume of an ideal gas is raised from 300 K to 330 K.Which of the following statements about the gas is/are true? |  |
|  |  **1** The mean energy of the particles of the gas increases by 10%. **2** The mean square velocity of the particles of the gas increases by 10%.**3** The number of collisions per second with the walls of the container increases by 10%. |  |
| **A** | 1, 2, 3 are correct  |  |
| **B** | Only 1 and 2 are correct  |  |
| **C** | Only 2 and 3 are correct  |  |
| **D** | Only 1 is correct |  |
|  |  Your answer  |  B |

The question is a multiple completion item, requiring learners to read three statements and select the correct combination as required. In this case the rationale for the key and distractors is:

**A**  Confusing increase in pressure with increase in impulse per collision

**B** *Correct answer*

**C** See A

**D** Missing the point that c2 is proportional to energy.

**Possible techniques for completion**

For calculation questions completing the calculation before looking at the alternative answers can avoid being deflected by the distractors and ensure an impartial response.

For questions involving thinking skills and logical deduction it may be possible to eliminate at least one answer as being a distractor, thus reducing the final choice.

It is not good practice to leave any answer blank, unless the marking for the multiple choice questions includes a penalty for incorrect answers, so it is worthwhile using knowledge or intuition to select what you believe is the most likely answer.

# Topics covered

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# Multiple Choice Questions topic quiz - answers – Thermal physics

|  |  |  |  |
| --- | --- | --- | --- |
| **1** |  | The temperature of a body at 100°C is increased by Δ*θ* as measured on the Celsius scale.How is this temperature change expressed on the Kelvin scale? |  |
|  |  |  |  |  |  |
|  | **A** | Δ*θ* |  |
|  | **B** | Δ*θ +* 273 |  |
|  | **C** | Δ*θ ­­–* 273 |  |
|  | **D** | Δ*θ +* 373 |  |
|  |  |  Your answer  |  A |

|  |  |  |  |
| --- | --- | --- | --- |
| **2** |  | Two metal spheres of different radii are in continuous thermal contact in a vacuum as shown. |  |
|  |  | Two metal spheres of different radii are in continuous thermal contact in a vacuum as shown. |  |
|  |  | Which statement **must** be correct? |  |
|  |  |  |  |  |  |
|  | **A** | Each sphere has the same internal energy. |  |
|  | **B** | There is no net transfer of thermal energy between the spheres. |  |
|  | **C** | Both spheres radiate electromagnetic energy at the same rate. |  |
|  | **D** | The larger sphere has a greater mean internal energy per atom than the smaller sphere. |  |
|  |  |  |  |
|  |  |  Your answer  |  B |
|  |  |  |  |
| **3** |  | A metal mass of 100 g is heated up in a Bunsen flame to 600 °C and then dropped into 0.4 kg of water. The temperature of the water rises from 20 °C to 40 °C. The system is completely thermally isolated. What is the value of the ratio $\frac{Specific heat capacity of metal}{Specific heat capacity of water}$ ? |  |
|  | **A** |  |  |
|  | **B** |  |  |
|  | **C** |  |  |
|  | **D** |  |  |
|  |  |  Your answer  |  B |

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| --- | --- | --- | --- |
| **4** |  | The temperature of water entering a heater is 12oC. The rate of flow of water through the heater is 3.6 x 102 cm3 min-1 and the output temperature of the water is 20oC. What is the power of the heater?(Density of water = 1000 kg m-3, specific heat capacity of water 4200 J kg-1 K-1) |  |
|  | **A** | 0.20 kW |  |
|  | **B** | 0.50 kW |  |
|  | **C** | 12 kW |  |
|  | **D** | 20 kW |  |
|  |  |  |  |
|  |  |  Your answer  |  A |

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| --- | --- | --- | --- |
| **5** |  | The graph shows the variation of temperature change Δ*θ* with time *t* for 1 kg of a substance initially solid at room temperature. The substance is heated at a uniform rate of 2000 J min-1. |  |
|  |  |  Graph showing the variation of temperature change |  |
|  |  | What can be deduced from this graph? |  |
|  |  |  |  |  |  |
|  | **A** | After 4 min of heating, the substance is all liquid. |  |
|  | **B** | After 10 min of heating the substance is all gaseous. |  |
|  | **C** | The specific heat capacity of the substance is greater when liquid than when solid. |  |
|  | **D** | The specific latent heat of fusion of the substance is 6000 J kg-1 |  |
|  |  |  |  |
|  |  |  Your answer  |  D |

|  |  |  |  |
| --- | --- | --- | --- |
| **6** |  | A plastic bottle containing a litre of water at 20°C is placed inside a freezer, whose temperature is maintained at -18°C.The plastic bottle limits the transfer of energy to a mean value of 800 joule per minute for two hours and has negligible specific heat capacity.For water, the specific heat capacity is 4200 J kg-1K-1 and specific latent heat of fusion 3.3 x 104 J kg-1.What is the temperature of the water at the end of the two hours? |  |
|  | **A** | 0°C |  |
|  | **B** | -0.36 °C |  |
|  | **C** | -3.0°C |  |
|  | **D** | -18 °C |  |
|  |  |  |  |
|  |  |  Your answer  |  A |

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| **7** |  | In a heating experiment, it was noted that the temperature of a liquid in a beaker rose at 4.0 K per minute. Immediately after the 4.0 K/min measurement was made, the water began to boil, and it was observed that, 40 minutes later, it had boiled away. For this liquid what is the numerical ratio of $$\frac{specific heat capacity }{specific latent heat of vaporisation}$$ |  |
|  | **A** |  |  |
|  | **B** |  |  |
|  | **C** |  |  |
|  | **D** |  |  |
|  |  |  |  |
|  |  |  Your answer  |  C |

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| **8** |  | Cooling water enters the heat exchanger in the turbine hall of a nuclear power station at 6°C and leaves at 14°C.The specific heat capacity of water 4200 J kg-1 K-1.If the rate of heat removal by the water is 6.72 x 109 J per minute, what is the rate of water flow? |  |
|  |  |  |  |  |  |
|  | **A** | kg s-1 |  |
|  | **B** | kg s-1 |  |
|  | **C** | kg s-1 |  |
|  | **D** | kg s-1 |  |
|  |  |  |  |
|  |  |  Your answer  |  C |

# Multiple Choice Questions topic quiz - answers – Ideal gases

|  |  |  |  |
| --- | --- | --- | --- |
| **9** |  | The graphs **A** – **D** represent different relationships between variables in A level Physics. The dotted lines mark out equal intervals along the *x*- and *y*-axes. |  |
|  |  | Which graph best represents the relationship between the variables *x* and *y* where:*y* is the pressure of a fixed mass of gas in a rigid container*x* is the temperature of the gas |  |
|  |  |  |  |  |  |
|  | **A** |  The graphs A – D  represent different relationships between variables in A level Physics. The dotted lines mark out equal intervals along the x- and y-axes |  |
|  | **B** |  The graphs A – D  represent different relationships between variables in A level Physics. The dotted lines mark out equal intervals along the x- and y-axes |  |
|  | **C** |  The graphs A – D  represent different relationships between variables in A level Physics. The dotted lines mark out equal intervals along the x- and y-axes. |  |
|  | **D** |  |  |
|  |  |  |  |
|  |  |  Your answer  |  C |

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| --- | --- | --- | --- |
| **10** |  | What is the approximate number of atoms in one cubic metre of an ideal gas at a temperature of 27°C and pressure of 1x105 Pa? |  |
|  |  |  |  |  |  |
|  | **A** | 1 x 1021 |  |
|  | **B** | 1 x 1022 |  |
|  | **C** | 6 x 1023 |  |
|  | **D** | 2 x 1025 |  |
|  |  |  Your answer  |  D |

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| --- | --- | --- | --- |
| **11** |  | Here are some data about a volume of an ideal gas:volume = 0.30 x 10-3 m3pressure = 0.30 MPatemperature = 30° CWhat is the number of particles in the volume of gas? |  |
|  |  |  |  |  |  |
|  | **A** | 3.0 x 1019 |  |
|  | **B** | 2.2 x 1022 |  |
|  | **C** | 3.0 x 1023 |  |
|  | **D** | 2.2 x 1025 |  |
|  |  |  |  |
|  |  |  Your answer  |  B |

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| --- | --- | --- | --- |
| **12** |  | The temperature of a fixed volume of an ideal gas is raised from 300 K to 330 K.Which of the following statements about the gas is/are true? |  |
|  |  |  **1** The mean energy of the particles of the gas increases by 10%. **2** The mean square velocity of the particles of the gas increases by 10%.**3** The number of collisions per second with the walls of the container increases by 10%. |  |
|  | **A** | 1, 2, 3 are correct  |  |
|  | **B** | Only 1 and 2 are correct  |  |
|  | **C** | Only 2 and 3 are correct  |  |
|  | **D** | Only 1 is correct |  |
|  |  |  Your answer  |  B |

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| **13** |  | Five molecules are moving with the speeds and directions shown. |  |
|  |  |  300 m s-1 100 m s-1 100 m s-1 300 m s-1 500 m s-1 |  |
|  |  | What is the root mean square (r.m.s,) speed of these molecules? |  |
|  |  |  |  |  |  |
|  | **A** | 100 m s-1  |  |
|  | **B** | 224 m s-1   |  |
|  | **C** | 300 m s-1  |  |
|  | **D** | 500 m s-1  |  |
|  |  |  Your answer  |  C |

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| **14** |  | The pressure *p* of a gas occupying a volume *V* and containing *N* molecules of gas of mass *m* and mean square speed is given by. |  |
|  |  | The density of argon at a pressure of 1.00 x 105 Pa and at a temperature of 300 K is 1.60 kg m-3.What is the root mean square (r.m.s.) speed of argon molecules at this temperature? |  |
|  |  |  |  |  |  |
|  | **A** | 216 m s-1 |  |
|  | **B** | 250 m s-1 |  |
|  | **C** | 306 m s-1 |  |
|  | **D** | 433 m s-1 |  |
|  |  |  Your answer  |  D |

# Multiple Choice Questions topic quiz - answers – Circular motion

|  |  |  |  |
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| **15** |  | Which of the following are the appropriate units for angular velocity, ω? |  |
|  | **A** | s-1 |  |
|  | **B** | m s-1 |  |
|  | **C** | kg m s-1 |  |
|  | **D** | rad m-1 s-1 |  |
|  |  |  Your answer  |  A |

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| **16** |  | A satellite orbits the Earth in a circular orbit of at an altitude of 2.3 × 106 m above the ground.For the Earth, *GM* = 4.0 × 1014 N m2 kg-1 and *r* = 6.4 × 106 m.What is the angular velocity *ω* of the satellite? |  |
|  |  |  |  |  |  |
|  | **A** | 6.1 × 10-7 rad s-1 |  |
|  | **B** | 3.3 × 10-5 rad s-1 |  |
|  | **C** | 7.8 × 10-4 rad s-1 |  |
|  | **D** | 5.7 × 10-3 rad s-1 |  |
|  |  |  Your answer  |  C |

|  |  |  |  |
| --- | --- | --- | --- |
| **17** |  | A satellite of mass *m* moves in a circular orbit at a speed *v* and a distance *r* from the centre of a planet of mass *M*. |  |
|  |  |  A satellite of mass m moves in a circular orbit at a speed v and a distance r from the centre of a planet of mass M. |  |
|  |  | Which expression gives the total energy of the satellite? |  |
|  |  |  |  |  |  |
|  | **A** |  |  |
|  | **B** |  |  |
|  | **C** |  |  |
|  | **D** |  |  |
|  |  |  |  |
|  |  |  Your answer  |  B |

|  |  |  |  |
| --- | --- | --- | --- |
| **18** |  | If the Sun takes 250 million years to complete one orbit around the centre of the milky way, what is the angular velocity of the Sun? |  |
|  |  |  |  |  |  |
|  | **A** | 8 x 10 -16 rad s-1 |  |
|  | **B** | 3 x 10 -13 rad s-1 |  |
|  | **C** | 3 x 10-12 rad s-1 |  |
|  | **D** | 5 x 1016 rad s-1 |  |
|  |  |  Your answer  |  A |

|  |  |  |  |
| --- | --- | --- | --- |
| **19** |  | What is the centripetal acceleration of a bike travelling at a speed of 12 m s-1 around a track of radius 50m? |  |
|  |  |  |  |  |  |
|  | **A** | 0.24 m s-2 |  |
|  | **B** | 2.9 m s-2 |  |
|  | **C** | 4.5 m s-2 |  |
|  | **D** | 7200 m s-2 |  |
|  |  |  Your answer  |  B |

# Multiple Choice Questions topic quiz - answers – Oscillations

|  |  |  |  |
| --- | --- | --- | --- |
| **20** |  | A mass M oscillates in simple harmonic motion between two fixed supports.Frictional effects can be ignored. The maximum acceleration of the mass is a1. |  |
|  |  |   |  |
|  |  | The mass is replaced with a mass of 4 M **and** the amplitude of the oscillation is doubled. The maximum acceleration of the mass in the revised system is a2.Which is the correct statement? |  |
|  | **A** | *a2 =* 4*a*1 |  |
|  | **B** | *a2 =* 2*a*1 |  |
|  | **C** | *a2 = a*1 |  |
|  | **D** | *a2 =* ½ *a*1 |  |
|  |  |  Your answer  |  D |

|  |  |  |  |
| --- | --- | --- | --- |
| **21** |  | The graph shows the way the potential energy of a body varies with its displacement from a point Z.  |  |
|  |  |  The graph shows the way the potential energy of a body varies with its displacement from a point Z.  |  |
|  |  | Which feature of the graph means that the force on the body is directed towards Z? |  |
|  |  |  |  |  |  |
|  | **A** | The graph is approximately linear for large displacements. |  |
|  | **B** | The graph passes through the origin. |  |
|  | **C** | The potential energy increases as the body moves further from Z. |  |
|  | **D** | The value of potential energy, when not at Z, is always positive. |  |
|  |  |  |  |
|  |  |  Your answer  |  C |

|  |  |  |  |
| --- | --- | --- | --- |
| **22** |  | The rise and fall of water in a harbour is simple harmonic. The depth varies between 1.0 m at low tide and 3.0 m at high tide. The time between successive low tides is twelve hours.  |  |
|  |  |  The rise and fall of water in a harbour is simple harmonic. The depth varies between 1.0 m at low tide and 3.0 m at high tide. The time between successive low tides is twelve hours. |  |
|  |  | A boat which requires a minimum water depth of 1.5 m approaches the harbour at low tide.How long must it wait before being able to enter the harbour. |  |
|  |  |  |  |  |  |
|  | **A** | 1.0 hour |  |
|  | **B** | 1.5 hours |  |
|  | **C** | 2.0 hours |  |
|  | **D** | 3.0 hours |  |
|  |  |  Your answer  |  C |

|  |  |  |  |
| --- | --- | --- | --- |
| **23** |  | In which of the following lists are all three quantities constant when a particle moves in undamped simple harmonic motion? |  |
|  |  |  |  |  |  |
|  | **A** | acceleration | force | total energy |  |
|  | **B** | amplitude | force | kinetic energy |  |
|  | **C** | acceleration | period | kinetic energy |  |
|  | **D** | amplitude | period | total energy |  |
|  |  |  Your answer  |  D |

|  |  |  |  |
| --- | --- | --- | --- |
| **24** |  | A mass hanging from a spring suspended from the ceiling is pulled down and released.The mass then oscillates vertically with simple harmonic motion, period T.The graph shows how the distance from the ceiling varies with time. |  |
|  |  | A mass hanging from a spring suspended from the ceiling is pulled down and released. The mass then oscillates vertically with simple harmonic motion, period T. The graph shows how the distance from the ceiling varies with time.  |  |
|  |  | What can be deduced from this graph? |  |
|  |  |  |  |  |  |
|  | **A** | The amplitude of the oscillation is 70 cm. |  |
|  | **B** | The kinetic energy is maximum at  |  |
|  | **C** | The restoring force on the mass increases between *t* = 0 and  |  |
|  | **D** | The speed is maximum at  |  |
|  |  |  |  |
|  |  |  Your answer  |  D |

# Multiple Choice Questions topic quiz - answers – Gravitational fields

|  |  |  |  |
| --- | --- | --- | --- |
| **25** |  | Two point masses *m*1 and *m*2 are a distance *r* apart.What is the magnitude of the gravitational field strength caused by *m*1 at *m*2? |  |
|  |  |  |  |  |  |
|  | **A** |  |  |
|  | **B** |  |  |
|  | **C** |  |  |
|  | **D** |  |  |
|  |  |  Your answer  |  C |

|  |  |  |  |
| --- | --- | --- | --- |
| **26** |  | A communications satellite which takes 24 hours to orbit the Earth is replaced by a new satellite which has twice the mass of the old one.The new satellite also has an orbit time of 24 hours.What is the value of $\frac{radius of orbit of new satellite}{radius of orbit of old satellite}$ ? |  |
|  |  |  |  |  |  |
|  | **A** |  |  |
|  | **B** |  |  |
|  | **C** |  |  |
|  | **D** |  |  |
|  |  |  Your answer  |  B |

|  |  |  |  |
| --- | --- | --- | --- |
| **27** |  | The ratio of masses *M* Earth / *M* Mars ≈ 10 and the ratio of radii *R* Earth / *R* Mars ≈ 2.What is the best estimate of the ratio of gravitational fields at the surface of the two bodies *g* Earth / *g* Mars? |  |
|  | **A** | 1 |  |
|  | **B** | 3 |  |
|  | **C** | 4 |  |
|  | **D** | 5 |  |
|  |  |  Your answer  |  B |

|  |  |  |  |
| --- | --- | --- | --- |
| **28** |  | The ratio of masses *M* Earth / *M* Mars ≈ 10 and the ratio of radii *R* Earth / *R* Mars ≈ 2.What is the best estimate of the ratio of gravitational potentials at the surface of the two bodies *V*Earth / *V*Mars ? |  |
|  |  |  |  |  |  |
|  | **A** | 1 |  |
|  | **B** | 3 |  |
|  | **C** | 4 |  |
|  | **D** | 5 |  |
|  |  |  Your answer  |  D |

|  |  |  |  |
| --- | --- | --- | --- |
| **29** |  | The gravitational neutral point N between the Earth and the Moon is the position where *g*total for the two bodies is zero. N is a distance *R*1 from centre of the Earth and *R*2 from centre of the Moon. |  |
|  |  | The gravitational neutral point N between the Earth and the Moon is the position where gtotal for the two bodies is zero. |  |
|  |  | Which of the following statements is/are true? |  |
|  |  |  **1** The ratio *R*1 / *R*2 = √(*M*Earth / *M*Moon)**2** At N two gravitational attractions act on a body but they are equal and opposite **3** At N,  |  |
|  | **A** | 1, 2 and 3 are correct  |  |
|  | **B** | Only 1 and 2 are correct  |  |
|  | **C** | Only 2 and 3 are correct  |  |
|  | **D** | Only 1 is correct |  |
|  |  |  |  |
|  |  |   AYour answer  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **30** |  | The gravitational neutral point N between the Earth and the Moon is the position where *g*total for the two bodies is zero. N is a distance *R*1 from centre of the Earth and *R*2 from centre of the Moon.The ratio of masses *M* Earth / *M* Moon ≈ 80 . |  |
|  |  | The gravitational neutral point N between the Earth and the Moon is the position where gtotal for the two bodies is zero. |  |
|  |  | What is the correct value of the ratio *R*1/*R*2 |  |
|  |  |  |  |  |  |
|  | **A** | 1/ |  |
|  | **B** |  |  |
|  | **C** | 80 |  |
|  | **D** | 802 |  |
|  |  |   BYour answer  |  |

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| --- | --- | --- | --- |
| **31** |  | The diagrams below show four possible diagrams of the equipotentials near an isolated star.In each diagram, the difference in gravitational potentials between adjacent equipotentials is the same.Which is correct? |  |
|  |  |  Showing four possible diagrams of the equipotentials near an isolated star. |  |
|  |  |  |  |
|  |  |  Your answer  |  D |

# Multiple Choice Questions topic quiz - answers – Stars

|  |  |  |  |
| --- | --- | --- | --- |
| **32** |  | Two stars have identical luminosity but differing surface temperatures.Star A has a surface temperature of 4000 °C whilst star B has a surface temperature of 5000 °C.Star B has a radius of 5.0 x 105 m.What is the radius of star A? |  |
|  | **A** | 7.8 x 105 m |  |
|  | **B** | 6.3 x 105 m |  |
|  | **C** | 4.0 x 105 m |  |
|  | **D** | 3.2 x 105 m |  |
|  |  |  Your answer  |  A |

|  |  |  |  |
| --- | --- | --- | --- |
| **33** |  | When light from a star is passed through a diffraction grating it forms a spectrum.Which of the following statements is/are correct? |  |
|  |  |  **1** The sun creates a continuous spectrum of visible light.**2** Visible light received from the sun has dark lines across its spectrum which correspond to the absorption of certain wavelengths by atoms in the Earth’s atmosphere. **3** The photons in the emission spectrum are formed when electrons are moved from a lower energy level to a higher energy level within the atom. |  |
|  |  |  |  |  |  |
|  | **A** | 1, 2 and 3 are correct  |  |
|  | **B** | Only 1 and 2 are correct  |  |
|  | **C** | Only 2 and 3 are correct  |  |
|  | **D** | Only 1 is correct |  |
|  |  |  |  |
|  |  |   DYour answer  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **34** |  | A diffraction grating which has 830 lines mm-1 is illuminated with light of wavelength 530 nm.A diffraction grating which has 830 lines mm-1 is illuminated with light of wavelength 530 nm. |  |
|  |  |  What is the angle *θ*  of the second-order diffraction maximum shown in the diagram expressed to two significant figures?  |  |
|  | **A** | 0.46 rad  |  |
|  | **B** | * 1. rad
 |  |
|  | **C** | 26 rad  |  |
|  | **D** | 62 rad |  |
|  |  |  Your answer  |  B |

|  |  |  |  |
| --- | --- | --- | --- |
| **35** |  | A diffraction grating is ruled with 600 lines per mm.When monochromatic light falls normally on the grating, the first-order diffracted beams are observed on the far side of the grating, each making an angle of 15° with the normal to the grating.What is the frequency of the light? |  |
|  |  |  |  |  |  |
|  | **A** | 1.2 x 1013 Hz  |  |
|  | **B** | 4.7 x 1013 Hz |  |
|  | **C** | 3.6 x 1014 Hz  |  |
|  | **D** | 7.0 x 1014 Hz |  |
|  |  |  Your answer  |  D |

# Multiple Choice Questions topic quiz - answers – Cosmology

|  |  |  |  |
| --- | --- | --- | --- |
| **36** |  | Which of the following observations support the origin of the Universe in a ‘hot big bang’? |  |
|  |  |  **1**  Cosmological redshift as shown by Hubble’s Law**2** Cosmic microwave background radiation comes from all directions in space**3** Cosmic radiation detected contains neutrinos from distant supernovae |  |
|  |  |  |  |  |  |
|  | **A** | 1, 2 and 3 are correct  |  |
|  | **B** | Only 1 and 2 are correct  |  |
|  | **C** | Only 2 and 3 are correct  |  |
|  | **D** | Only 1 is correct |  |
|  |  |  |  |
|  |  |  Your answer  |  B |

|  |  |  |  |
| --- | --- | --- | --- |
| **37** |  | Which of the following sequences is correct for the distances to be in descending order of magnitude? |  |
|  | **A** | astronomical unit / light-year / parsec   |  |
|  | **B** | astronomical unit/ parsec / light-year |  |
|  | **C** | parsec / light-year / astronomical unit   |  |
|  | **D** | light-year / astronomical unit / parsec |  |
|  |  |  Your answer  |  C |

|  |  |  |  |
| --- | --- | --- | --- |
| **38** |  | What is the distance in light-years from the Earth to a star that makes a parallax angle of 2.0 arcseconds? |  |
|  | **A** | 0.15 light-year |  |
|  | **B** | 0.63 light-year |  |
|  | **C** | 1.6 light-year  |  |
|  | **D** | 6.5 light-year |  |
|  |  |  Your answer  |  C |

|  |  |  |  |
| --- | --- | --- | --- |
| **39** |  | Which of the following observations demonstrate Doppler shift. |  |
|  |  |  1. The sound of a train approaching an observer at high speed will be at a higher frequencythan the sound of the train travelling away from the observer.
2. The frequency of the wave remains constant, but the wavelength observed is either reduced or extended depending on whether the object is travelling towards or away from the observer.
3. Light emitted from an object travelling at high speed relative to an observer will appear to travel at a speed greater than the speed of light.
 |  |
|  |  |  |  |  |  |
|  | **A** | 1, 2 and 3 are correct  |  |
|  | **B** | Only 1 and 2 are correct  |  |
|  | **C** | Only 2 and 3 are correct  |  |
|  | **D** | Only 1 is correct |  |
|  |  |  |  |
|  |  |  Your answer  |  D |

|  |  |  |  |
| --- | --- | --- | --- |
| **40** |  | Radio waves emitted by a particular pulsar are expected to have a frequency of 500 MHz. The actual frequency of the radio waves received is 400 Hz less. How fast is this pulsar moving relative to the observer? |  |
|  |  |  |  |  |  |
|  | **A** | 240ms-1 |  |
|  | **B** | 670 ms-1 |  |
|  | **C** | 3.8 x 105 ms-1  |  |
|  | **D** | 2.4 x 108 ms-1 |  |
|  |  |  Your answer  |  A |

# Multiple Choice Questions topic quiz - answers – Synoptic

|  |  |  |  |
| --- | --- | --- | --- |
| **41** |  | The acceleration of free fall on the surface of the Earth is about six times its value on the surface of the Moon.The mean density of the Earth is about  times the mean density of the Moon.Using this data, what is the best value for the ratio of the radius of the Earth to the radius of the Moon? |  |
|  |  |  |  |  |  |
|  | **A** | 1.9 |  |
|  | **B** | 3.2 |  |
|  | **C** | 3.6  |  |
|  | **D** | 10 |  |
|  |  |  |  |
|  |  |  Your answer  |  C |

|  |  |  |  |
| --- | --- | --- | --- |
| **42** |  | A sealed U-tube contains nitrogen in one arm, and helium at pressure *p* in the other arm.The gases are separated by mercury of density *ρ* , with dimensions *x* and *y* as shown on the diagram. |  |
|  |  |  A sealed U-tube contains nitrogen in one arm, and helium at pressure p in the other arm.  |  |
|  |  | What is the pressure of the nitrogen? |  |
|  |  |  |  |  |  |
|  |  **A** | *p* |  |
|  |  **B** | *xρg* |  |
|  |  **C** | *p - xρg* |  |
|  |  **D** | *p + xρg* |  |
|  |  |  Your answer  |  D |

|  |  |  |  |
| --- | --- | --- | --- |
| **43** |  | An airgun pellet, mass *m* and specific heat capacity *c*, hits a steel plate at speed v.During the impact, 50% of the pellet’s kinetic energy is converted to thermal energy in the pellet.What is the rise in temperature of the pellet? |  |
|  | **A** |  |  |
|  | **B** |  |  |
|  | **C** |  |  |
|  | **D** |  |  |
|  |  |  Your answer  |  B |

|  |  |  |  |
| --- | --- | --- | --- |
| **44** |  | A diffraction grating is lit by a parallel beam of light from a gas discharge tube which emits monochromatic light.Which of the following will increase the spacing between the bright points in the interference pattern produced on a screen at distance *d* from the grating? |  |
|  |  |  1. Using a diffraction grating with fewer lines per mm
2. Increasing the potential difference applied to the discharge tube
3. Increase distance *d*.
 |  |
|  |  |  |  |  |  |
|  | **A** | 1, 2 and 3 are correct  |  |
|  | **B** | Only 1 and 2 are correct  |  |
|  | **C** | Only 2 and 3 are correct  |  |
|  | **D** | Only 3 is correct |  |
|  |  |  Your answer  |  D |

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##

## Learner resources

# Multiple Choice Questions topic quiz - answers – Thermal physics

|  |  |  |  |
| --- | --- | --- | --- |
| **1** |  | The temperature of a body at 100°C is increased by Δ*θ* as measured on the Celsius scale.How is this temperature change expressed on the Kelvin scale? |  |
|  |  |  |  |  |  |
|  | **A** | Δ*θ* |  |
|  | **B** | Δ*θ +* 273 |  |
|  | **C** | Δ*θ ­­–* 273 |  |
|  | **D** | Δ*θ +* 373 |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **2** |  | Two metal spheres of different radii are in continuous thermal contact in a vacuum as shown. |  |
|  |  | Two metal spheres of different radii are in continuous thermal contact in a vacuum as shown. |  |
|  |  | Which statement **must** be correct? |  |
|  |  |  |  |  |  |
|  | **A** | Each sphere has the same internal energy. |  |
|  | **B** | There is no net transfer of thermal energy between the spheres. |  |
|  | **C** | Both spheres radiate electromagnetic energy at the same rate. |  |
|  | **D** | The larger sphere has a greater mean internal energy per atom than the smaller sphere. |  |
|  |  |  |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **3** |  | A metal mass of 100 g is heated up in a Bunsen flame to 600 °C and then dropped into 0.4 kg of water. The temperature of the water rises from 20 °C to 40 °C. The system is completely thermally isolated. What is the value of the ratio $\frac{Specific heat capacity of metal}{Specific heat capacity of water}$ ? |  |
|  | **A** |  |  |
|  | **B** |  |  |
|  | **C** |  |  |
|  | **D** |  |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **4** |  | The temperature of water entering a heater is 12oC. The rate of flow of water through the heater is 3.6 x 102 cm3 min-1 and the output temperature of the water is 20oC. What is the power of the heater?(Density of water = 1000 kg m-3, specific heat capacity of water 4200 J kg-1 K-1) |  |
|  | **A** | 0.20 kW |  |
|  | **B** | 0.50 kW |  |
|  | **C** | 12 kW |  |
|  | **D** | 20 kW |  |
|  |  |  |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **5** |  | The graph shows the variation of temperature change Δ*θ* with time *t* for 1 kg of a substance initially solid at room temperature. The substance is heated at a uniform rate of 2000 J min-1. |  |
|  |  |  Graph showing the variation of temperature change |  |
|  |  | What can be deduced from this graph? |  |
|  |  |  |  |  |  |
|  | **A** | After 4 min of heating, the substance is all liquid. |  |
|  | **B** | After 10 min of heating the substance is all gaseous. |  |
|  | **C** | The specific heat capacity of the substance is greater when liquid than when solid. |  |
|  | **D** | The specific latent heat of fusion of the substance is 6000 J kg-1 |  |
|  |  |  |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **6** |  | A plastic bottle containing a litre of water at 20°C is placed inside a freezer, whose temperature is maintained at -18°C.The plastic bottle limits the transfer of energy to a mean value of 800 joule per minute for two hours and has negligible specific heat capacity.For water, the specific heat capacity is 4200 J kg-1K-1 and specific latent heat of fusion 3.3 x 104 J kg-1.What is the temperature of the water at the end of the two hours? |  |
|  | **A** | 0°C |  |
|  | **B** | -0.36 °C |  |
|  | **C** | -3.0°C |  |
|  | **D** | -18 °C |  |
|  |  |  |  |
|  |  |  Your answer  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **7** |  | In a heating experiment, it was noted that the temperature of a liquid in a beaker rose at 4.0 K per minute just before it began to boil, and that 40 minutes later it had boiled away. For this liquid what is the numerical ratio of $$\frac{specific heat capacity }{specific latent heat of vaporisation}$$ |  |
|  | **A** |  |  |
|  | **B** |  |  |
|  | **C** |  |  |
|  | **D** |  |  |
|  |  |  |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **8** |  | Cooling water enters the heat exchanger in the turbine hall of a nuclear power station at 6°C and leaves at 14°C.The specific heat capacity of water 4200 J kg-1 K-1.If the rate of heat removal by the water is 6.72 x 109 J per minute, what is the rate of water flow? |  |
|  |  |  |  |  |  |
|  | **A** | kg s-1 |  |
|  | **B** | kg s-1 |  |
|  | **C** | kg s-1 |  |
|  | **D** | kg s-1 |  |
|  |  |  |  |
|  |  |  Your answer  |   |

# Multiple Choice Questions topic quiz - answers – Ideal gases

|  |  |  |  |
| --- | --- | --- | --- |
| **9** |  | The graphs **A** – **D** represent different relationships between variables in A level Physics. The dotted lines mark out equal intervals along the *x*- and *y*-axes. |  |
|  |  | Which graph best represents the relationship between the variables *x* and *y* where:*y* is the pressure of a fixed mass of gas in a rigid container*x* is the temperature of the gas |  |
|  |  |  |  |  |  |
|  | **A** |  The graphs A – D  represent different relationships between variables in A level Physics. The dotted lines mark out equal intervals along the x- and y-axes |  |
|  | **B** |  The graphs A – D  represent different relationships between variables in A level Physics. The dotted lines mark out equal intervals along the x- and y-axes |  |
|  | **C** |  The graphs A – D  represent different relationships between variables in A level Physics. The dotted lines mark out equal intervals along the x- and y-axes. |  |
|  | **D** |  |  |
|  |  |  |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **10** |  | What is the approximate number of atoms in one cubic metre of an ideal gas at a temperature of 27°C and pressure of 1x105 Pa? |  |
|  |  |  |  |  |  |
|  | **A** | 1 x 1021 |  |
|  | **B** | 1 x 1022 |  |
|  | **C** | 6 x 1023 |  |
|  | **D** | 2 x 1025 |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **11** |  | Here are some data about a volume of an ideal gas:volume = 0.30 x 10-3 m3pressure = 0.30 MPatemperature = 30° CWhat is the number of particles in the volume of gas? |  |
|  |  |  |  |  |  |
|  | **A** | 3.0 x 1019 |  |
|  | **B** | 2.2 x 1022 |  |
|  | **C** | 3.0 x 1023 |  |
|  | **D** | 2.2 x 1025 |  |
|  |  |  |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **12** |  | The temperature of a fixed volume of an ideal gas is raised from 300 K to 330 K.Which of the following statements about the gas is/are true? |  |
|  |  |  **1** The mean energy of the particles of the gas increases by 10%. **2** The mean square velocity of the particles of the gas increases by 10%.**3** The number of collisions per second with the walls of the container increases by 10%. |  |
|  | **A** | 1, 2, 3 are correct  |  |
|  | **B** | Only 1 and 2 are correct  |  |
|  | **C** | Only 2 and 3 are correct  |  |
|  | **D** | Only 1 is correct |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **13** |  | Five molecules are moving with the speeds and directions shown. |  |
|  |  |  300 m s-1 100 m s-1 100 m s-1 300 m s-1 500 m s-1 |  |
|  |  | What is the root mean square (r.m.s,) speed of these molecules? |  |
|  |  |  |  |  |  |
|  | **A** | 100 m s-1  |  |
|  | **B** | 224 m s-1   |  |
|  | **C** | 300 m s-1  |  |
|  | **D** | 500 m s-1  |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **14** |  | The pressure *p* of a gas occupying a volume *V* and containing *N* molecules of gas of mass *m* and mean square speed is given by. |  |
|  |  | The density of argon at a pressure of 1.00 x 105 Pa and at a temperature of 300 K is 1.60 kg m-3.What is the root mean square (r.m.s.) speed of argon molecules at this temperature? |  |
|  |  |  |  |  |  |
|  | **A** | 216 m s-1 |  |
|  | **B** | 250 m s-1 |  |
|  | **C** | 306 m s-1 |  |
|  | **D** | 433 m s-1 |  |
|  |  |  Your answer  |   |

# Multiple Choice Questions topic quiz - answers – Circular motion

|  |  |  |  |
| --- | --- | --- | --- |
| **15** |  | Which of the following are the appropriate units for angular velocity, ω? |  |
|  | **A** | s-1 |  |
|  | **B** | m s-1 |  |
|  | **C** | kg m s-1 |  |
|  | **D** | rad m-1 s-1 |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **16** |  | A satellite orbits the Earth in a circular orbit of at an altitude of 2.3 × 106 m above the ground.For the Earth, *GM* = 4.0 × 1014 N m2 kg-1 and *r* = 6.4 × 106 m.What is the angular velocity *ω* of the satellite? |  |
|  |  |  |  |  |  |
|  | **A** | 6.1 × 10-7 rad s-1 |  |
|  | **B** | 3.3 × 10-5 rad s-1 |  |
|  | **C** | 7.8 × 10-4 rad s-1 |  |
|  | **D** | 5.7 × 10-3 rad s-1 |  |
|  |  |  Your answer  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **17** |  | A satellite of mass *m* moves in a circular orbit at a speed *v* and a distance *r* from the centre of a planet of mass *M*. |  |
|  |  |  A satellite of mass m moves in a circular orbit at a speed v and a distance r from the centre of a planet of mass M. |  |
|  |  | Which expression gives the total energy of the satellite? |  |
|  |  |  |  |  |  |
|  | **A** |  |  |
|  | **B** |  |  |
|  | **C** |  |  |
|  | **D** |  |  |
|  |  |  |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **18** |  | If the sun takes 250 million years to complete one orbit around the centre of the milky way, what is the angular velocity of the milky way? |  |
|  |  |  |  |  |  |
|  | **A** | 8 x 10 -16 rad s-1 |  |
|  | **B** | 3 x 10 -13 rad s-1 |  |
|  | **C** | 3 x 10-12 rad s-1 |  |
|  | **D** | 5 x 1016 rad s-1 |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **19** |  | What is the centripetal acceleration of a bike travelling at a speed of 12 m s-1 around a track of radius 50m? |  |
|  |  |  |  |  |  |
|  | **A** | 0.24 m s-2 |  |
|  | **B** | 2.9 m s-2 |  |
|  | **C** | 4.5 m s-2 |  |
|  | **D** | 7200 m s-2 |  |
|  |  |  Your answer  |   |

# Multiple Choice Questions topic quiz - answers – Oscillations

|  |  |  |  |
| --- | --- | --- | --- |
| **20** |  | A mass M oscillates in simple harmonic motion between two fixed supports.Frictional effects can be ignored. The maximum acceleration of the mass is a1. |  |
|  |  |   |  |
|  |  | The mass is replaced with a mass of 4 M **and** the amplitude of the oscillation is doubled. The maximum acceleration of the mass in the revised system is a2.Which is the correct statement? |  |
|  | **A** | *a2 =* 4*a*1 |  |
|  | **B** | *a2 =* 2*a*1 |  |
|  | **C** | *a2 = a*1 |  |
|  | **D** | *a2 =* ½ *a*1 |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **21** |  | The graph shows the way the potential energy of a body varies with its displacement from a point Z.  |  |
|  |  |  The graph shows the way the potential energy of a body varies with its displacement from a point Z.  |  |
|  |  | Which feature of the graph means that the force on the body is directed towards Z? |  |
|  |  |  |  |  |  |
|  | **A** | The graph is approximately linear for large displacements. |  |
|  | **B** | The graph passes through the origin. |  |
|  | **C** | The potential energy increases as the body moves further from Z. |  |
|  | **D** | The value of potential energy, when not at Z, is always positive. |  |
|  |  |  |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **22** |  | The rise and fall of water in a harbour is simple harmonic. The depth varies between 1.0 m at low tide and 3.0 m at high tide. The time between successive low tides is twelve hours.  |  |
|  |  |  The rise and fall of water in a harbour is simple harmonic. The depth varies between 1.0 m at low tide and 3.0 m at high tide. The time between successive low tides is twelve hours. |  |
|  |  | A boat which requires a minimum water depth of 1.5 m approaches the harbour at low tide.How long must it wait before being able to enter the harbour. |  |
|  |  |  |  |  |  |
|  | **A** | 1.0 hour |  |
|  | **B** | 1.5 hours |  |
|  | **C** | 2.0 hours |  |
|  | **D** | 3.0 hours |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **23** |  | In which of the following lists are all three quantities constant when a particle moves in undamped simple harmonic motion? |  |
|  |  |  |  |  |  |
|  | **A** | acceleration | force | total energy |  |
|  | **B** | amplitude | force | kinetic energy |  |
|  | **C** | acceleration | period | kinetic energy |  |
|  | **D** | amplitude | period | total energy |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **24** |  | A mass hanging from a spring suspended from the ceiling is pulled down and released.The mass then oscillates vertically with simple harmonic motion, period T.The graph shows how the distance from the ceiling varies with time. |  |
|  |  | A mass hanging from a spring suspended from the ceiling is pulled down and released. The mass then oscillates vertically with simple harmonic motion, period T. The graph shows how the distance from the ceiling varies with time.  |  |
|  |  | What can be deduced from this graph? |  |
|  |  |  |  |  |  |
|  | **A** | The amplitude of the oscillation is 70 cm. |  |
|  | **B** | The kinetic energy is maximum at  |  |
|  | **C** | The restoring force on the mass increases between *t* = 0 and  |  |
|  | **D** | The speed is maximum at  |  |
|  |  |  |  |
|  |  |  Your answer  |   |

# Multiple Choice Questions topic quiz - answers – Gravitational fields

|  |  |  |  |
| --- | --- | --- | --- |
| **25** |  | Two point masses *m*1 and *m*2 are a distance *r* apart.What is the magnitude of the gravitational field strength caused by *m*1 at *m*2? |  |
|  |  |  |  |  |  |
|  | **A** |  |  |
|  | **B** |  |  |
|  | **C** |  |  |
|  | **D** |  |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **26** |  | A communications satellite which takes 24 hours to orbit the Earth is replaced by a new satellite which has twice the mass of the old one.The new satellite also has an orbit time of 24 hours.What is the value of $\frac{radius of orbit of new satellite}{radius of orbit of old satellite}$ ? |  |
|  |  |  |  |  |  |
|  | **A** |  |  |
|  | **B** |  |  |
|  | **C** |  |  |
|  | **D** |  |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **27** |  | The ratio of masses *M* Earth / *M* Mars ≈ 10 and the ratio of radii *R* Earth / *R* Mars ≈ 2.What is the best estimate of the ratio of gravitational fields at the surface of the two bodies *g* Earth / *g* Mars? |  |
|  | **A** | 1 |  |
|  | **B** | 3 |  |
|  | **C** | 4 |  |
|  | **D** | 5 |  |
|  |  |  Your answer  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **28** |  | The ratio of masses *M* Earth / *M* Mars ≈ 10 and the ratio of radii *R* Earth / *R* Mars ≈ 2.What is the best estimate of the ratio of gravitational potentials at the surface of the two bodies *V*Earth / *V*Mars ? |  |
|  |  |  |  |  |  |
|  | **A** | 1 |  |
|  | **B** | 3 |  |
|  | **C** | 4 |  |
|  | **D** | 5 |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **29** |  | The gravitational neutral point N between the Earth and the Moon is the position where *g*total for the two bodies is zero. N is a distance *R*1 from centre of the Earth and *R*2 from centre of the Moon. |  |
|  |  | The gravitational neutral point N between the Earth and the Moon is the position where gtotal for the two bodies is zero. |  |
|  |  | Which of the following statements is/are true? |  |
|  |  |  **1** The ratio *R*1 / *R*2 = √(*M*Earth / *M*Moon)**2** At N two gravitational attractions act on a body but they are equal and opposite **3** At N,  |  |
|  | **A** | 1, 2 and 3 are correct  |  |
|  | **B** | Only 1 and 2 are correct  |  |
|  | **C** | Only 2 and 3 are correct  |  |
|  | **D** | Only 1 is correct |  |
|  |  |  |  |
|  |  |   Your answer  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **30** |  | The gravitational neutral point N between the Earth and the Moon is the position where *g*total for the two bodies is zero. N is a distance *R*1 from centre of the Earth and *R*2 from centre of the Moon.The ratio of masses *M* Earth / *M* Moon ≈ 80 . |  |
|  |  | The gravitational neutral point N between the Earth and the Moon is the position where gtotal for the two bodies is zero. |  |
|  |  | What is the correct value of the ratio *R*1/*R*2 |  |
|  |  |  |  |  |  |
|  | **A** | 1/ |  |
|  | **B** |  |  |
|  | **C** | 80 |  |
|  | **D** | 802 |  |
|  |  |   Your answer  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **31** |  | The diagrams below show four possible diagrams of the equipotentials near an isolated star.In each diagram, the difference in gravitational potentials between adjacent equipotentials is the same.Which is correct? |  |
|  |  |  Showing four possible diagrams of the equipotentials near an isolated star. |  |
|  |  |  |  |
|  |  |  Your answer  |   |

# Multiple Choice Questions topic quiz - answers – Stars

|  |  |  |  |
| --- | --- | --- | --- |
| **32** |  | Two stars have identical luminosity but differing surface temperatures.Star A has a surface temperature of 4000 °C whilst star B has a surface temperature of 5000 °C.Star B has a radius of 5.0 x 105 m.What is the radius of star A? |  |
|  | **A** | 7.8 x 105 m |  |
|  | **B** | 6.3 x 105 m |  |
|  | **C** | 4.0 x 105 m |  |
|  | **D** | 3.2 x 105 m |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **33** |  | When light from a star is passed through a diffraction grating it forms a spectrum.Which of the following statements is/are correct? |  |
|  |  |  **1** The sun creates a continuous spectrum of visible light.**2** Visible light received from the sun has dark lines across its spectrum which correspond to the absorption of certain wavelengths by atoms in the Earth’s atmosphere. **3** The photons in the emission spectrum are formed when electrons are moved from a lower energy level to a higher energy level within the atom. |  |
|  |  |  |  |  |  |
|  | **A** | 1, 2 and 3 are correct  |  |
|  | **B** | Only 1 and 2 are correct  |  |
|  | **C** | Only 2 and 3 are correct  |  |
|  | **D** | Only 1 is correct |  |
|  |  |  |  |
|  |  |   Your answer  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **34** |  | A diffraction grating which has 830 lines mm-1 is illuminated with light of wavelength 530 nm.A diffraction grating which has 830 lines mm-1 is illuminated with light of wavelength 530 nm. |  |
|  |  |  What is the angle *θ*  of the second-order diffraction maximum shown in the diagram expressed to two significant figures?  |  |
|  | **A** | 0.46 rad  |  |
|  | **B** | * 1. rad
 |  |
|  | **C** | 26 rad  |  |
|  | **D** | 62 rad |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **35** |  | A diffraction grating is ruled with 600 lines per mm.When monochromatic light falls normally on the grating, the first-order diffracted beams are observed on the far side of the grating, each making an angle of 15° with the normal to the grating.What is the frequency of the light? |  |
|  |  |  |  |  |  |
|  | **A** | 1.2 x 1013 Hz  |  |
|  | **B** | 4.7 x 1013 Hz |  |
|  | **C** | 3.6 x 1014 Hz  |  |
|  | **D** | 7.0 x 1014 Hz |  |
|  |  |  Your answer  |   |

# Multiple Choice Questions topic quiz - answers – Cosmology

|  |  |  |  |
| --- | --- | --- | --- |
| **36** |  | Which of the following observations support the origin of the Universe in a ‘hot big bang’? |  |
|  |  |  **1**  Cosmological redshift as shown by Hubble’s Law**2** Cosmic microwave background radiation comes from all directions in space**3** Cosmic radiation detected contains neutrinos from distant supernovae |  |
|  |  |  |  |  |  |
|  | **A** | 1, 2 and 3 are correct  |  |
|  | **B** | Only 1 and 2 are correct  |  |
|  | **C** | Only 2 and 3 are correct  |  |
|  | **D** | Only 1 is correct |  |
|  |  |  |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **37** |  | Which of the following sequences is correct for the distances to be in descending order of magnitude? |  |
|  | **A** | astronomical unit / light-year / parsec   |  |
|  | **B** | astronomical unit/ parsec / light-year |  |
|  | **C** | parsec / light-year / astronomical unit   |  |
|  | **D** | light-year / astronomical unit / parsec |  |
|  |  |  Your answer  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **38** |  | What is the distance in light-years from the Earth to a star that makes a parallax angle of 2.0 arcseconds? |  |
|  | **A** | 0.15 light-year |  |
|  | **B** | 0.63 light-year |  |
|  | **C** | 1.6 light-year  |  |
|  | **D** | 6.5 light-year |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **39** |  | Which of the following observations demonstrate Doppler shift. |  |
|  |  |  1. The sound of a train approaching an observer at high speed will be at a higher frequencythan the sound of the train travelling away from the observer.
2. The frequency of the wave remains constant, but the wavelength observed is either reduced or extended depending on whether the object is travelling towards or away from the observer.
3. Light emitted from an object travelling at high speed relative to an observer will appear to travel at a speed greater than the speed of light.
 |  |
|  |  |  |  |  |  |
|  | **A** | 1, 2 and 3 are correct  |  |
|  | **B** | Only 1 and 2 are correct  |  |
|  | **C** | Only 2 and 3 are correct  |  |
|  | **D** | Only 1 is correct |  |
|  |  |  |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **40** |  | Radio waves emitted by a particular pulsar are expected to have a frequency of 500 MHz. The actual frequency of the radio waves received is 400 Hz less. How fast is this pulsar moving relative to the observer? |  |
|  |  |  |  |  |  |
|  | **A** | 240ms-1 |  |
|  | **B** | 670 ms-1 |  |
|  | **C** | 3.8 x 105 ms-1  |  |
|  | **D** | 2.4 x 108 ms-1 |  |
|  |  |  Your answer  |  |

# Multiple Choice Questions topic quiz - answers – Synoptic

|  |  |  |  |
| --- | --- | --- | --- |
| **41** |  | The acceleration of free fall on the surface of the Earth is about six times its value on the surface of the Moon.The mean density of the Earth is about  times the mean density of the Moon.Using this data, what is the best value for the ratio of the radius of the Earth to the radius of the Moon? |  |
|  |  |  |  |  |  |
|  | **A** | 1.9 |  |
|  | **B** | 3.2 |  |
|  | **C** | 3.6  |  |
|  | **D** | 10 |  |
|  |  |  |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **42** |  | A sealed U-tube contains nitrogen in one arm, and helium at pressure *p* in the other arm.The gases are separated by mercury of density *ρ* , with dimensions *x* and *y* as shown on the diagram. |  |
|  |  |  A sealed U-tube contains nitrogen in one arm, and helium at pressure p in the other arm.  |  |
|  |  | What is the pressure of the nitrogen? |  |
|  |  |  |  |  |  |
|  |  **A** | *p* |  |
|  |  **B** | *xρg* |  |
|  |  **C** | *p - xρg* |  |
|  |  **D** | *p + xρg* |  |
|  |  |  Your answer  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **43** |  | An airgun pellet, mass *m* and specific heat capacity *c*, hits a steel plate at speed v.During the impact, 50% of the pellet’s kinetic energy is converted to thermal energy in the pellet.What is the rise in temperature of the pellet? |  |
|  | **A** |  |  |
|  | **B** |  |  |
|  | **C** |  |  |
|  | **D** |  |  |
|  |  |  Your answer  |   |

|  |  |  |  |
| --- | --- | --- | --- |
| **44** |  | A diffraction grating is lit by a parallel beam of light from a gas discharge tube which emits monochromatic light.Which of the following will increase the spacing between the bright points in the interference pattern produced on a screen at distance *d* from the grating? |  |
|  |  |  1. Using a diffraction grating with fewer lines per mm
2. Increasing the potential difference applied to the discharge tube
3. Increase distance *d*.
 |  |
|  |  |  |  |  |  |
|  | **A** | 1, 2 and 3 are correct  |  |
|  | **B** | Only 1 and 2 are correct  |  |
|  | **C** | Only 2 and 3 are correct  |  |
|  | **D** | Only 3 is correct |  |
|  |  |  Your answer  |  |