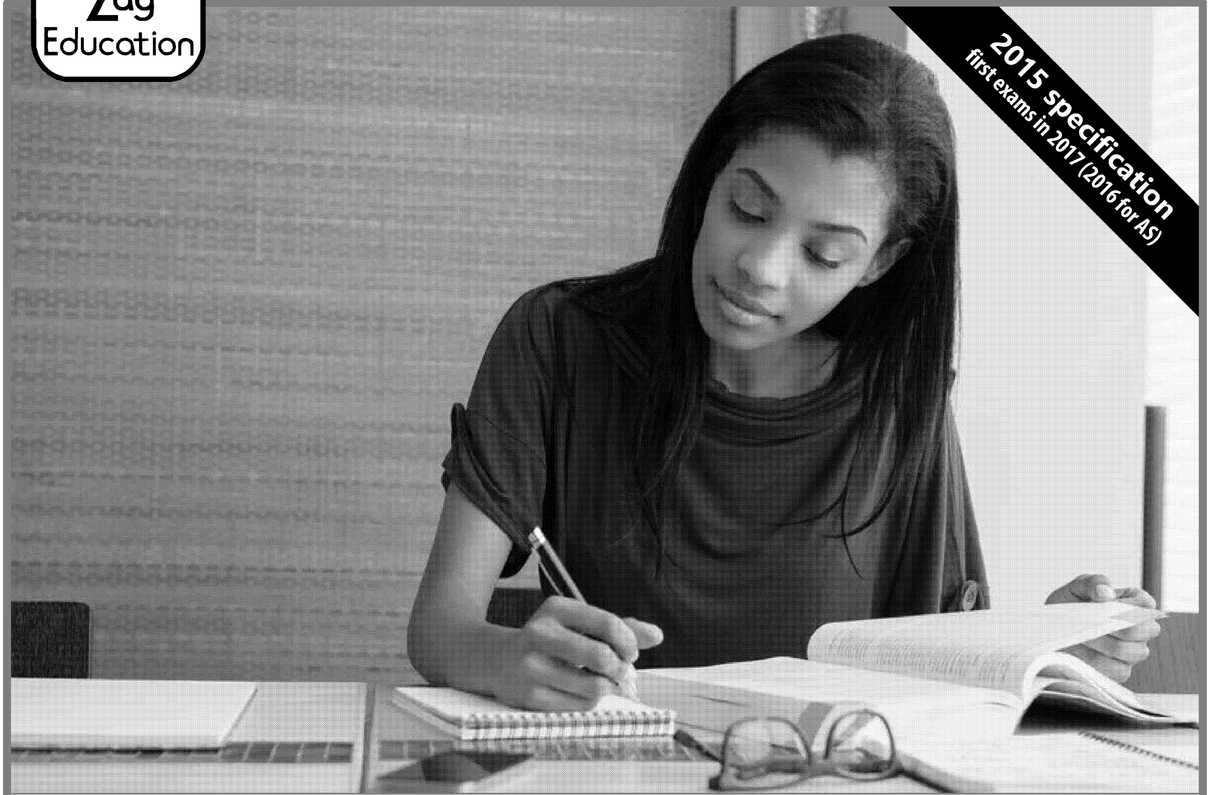
Zig Zag Education

Physics

A Level | OCR A | H556



Practice Exams for A Level OCR A Physics

Paper 1: Modelling Physics

zigzageducation.co.uk

POD 8269

Contents

Teacher's Introduction

These practice examinations support the OCR A Level specification for Physics A (H556). This specification is new, and the first examinations began in 2017. This means that students have very limited access to past papers.

Although they can work through many relevant questions from text books and old syllabuses, they are unable to get a proper feel for the format, scope and length of the three papers that they will have to sit in the real examination period.

Al
we
in
sp
as

These practice examinations have, therefore, been written so that teachers can gi
in doing whole 'past papers'. Each paper follows the exact same format and mark
examination. The whole specification is addressed, and the papers meet the mini
mathematical skills and 15% practical skills required by the exam board. The mark
same format as the real mark schemes and use the same language, so that studen
understanding of how mark schemes work and what the examiners are expecting

These papers are best used in their entirety, either as a mock paper sat under exa
homework exercise set in the last weeks before the examination period. This give
learn how to pace themselves correctly. They will also be less anxious as the exam
since they know better what to expect.

Questions marked with an asterisk (*) are level of response questions, which will t
communication skills.

Note regarding non-write-on section
Set 3: Paper 1 contains some content that requires drawing on a graph or table. A
this test which should be handed out to students before beginning the paper.

Specification Cross-Reference Table

	Pa[illegible]				Paper 2		
	Set 1	Se[illegible]	Set 3	Set 4	Set 1	Set 2	Se
Module 2: Foundations of physics							
2.1 Physical quantities and units	2, 4	2	1, 4, 21	1, 2, 3		1, 10	1
2.2 Making measurements and analysing data	3, 20	1, 17, 18, 19, 21	2, 8, 18, 19	1, 7, 18, 19, 21	18	4, 17, 18, 19	17, 1
2.3 Nature of quantities	1, 8, 16, 18	2, 3, 5, 16		4, 6, 17		5	
Module 3: Forces and motion							
3.1 Motion	5, 21	5, 16, 17, 18	5, 1[illegible]	2[illegible], 20			
3.2 Forces in action	8, 16, 17, 18, 19, 2[illegible]	4, [illegible]	4, 6, 17	2, 6, 16, 17, 18			
3.3 Work, energy and power	[illegible], 18	18	3, 7	3, 9, 12, 13, 20			
3.4 Materials	6, 9	8, 19	4	2, 8, 19			
3.5 Newton's laws and momentum	10, 11, 18, 19	4, 7	4, 18	9, 16			
Module 4: Electrons, waves and photons							
4.1 Charge and current					1	16	5
4.2 Energy, power and resistance					2, 3, 6, 16	1, 16, 17	1, 2, 1
4.3 Electrical circuits					2, 3, 6, 16		2, 3
4.4 Waves					4, 5, 7, 17	3, 4, 5, 18, 19	4, 1 1
4.5 Quantum physics					8, 18	20	6,

	Paper 1				Paper 2				Paper 3			
	Set 1	Set 2	Set 3	Set 4	Set 1	Set 2	Set 3	Set 4	Set 1	Set 2	Set 3	Set 4
Module 5: Newtonian world and astrophysics												
5.1 Thermal physics	20	11, 20, 21	9, 19, 22	10, 21, 22								
5.2 Circular motion	12, 14	22		11								
5.3 Oscillations	13	12	10, [illegible]	5								
5.4 Gravitation	21	[illegible]	12, 21									
5.5 Astrophysics and cosmology	[illegible], 22	10, 13, 14, 15, 24	13, 14, 15	14, 15, 23, 24								
Module 6: Particles and medical physics												
6.1 Capacitors					19	2, 6	8, 9	1, [illegible]				
6.2 Electric fields					9, 10	21	10, 20					
6.3 Electromagnetism					12, 20	7, 8, 9, 21	11					
6.4 Nuclear and particle physics					[illegible], 11, 12, 14, 15, 21, 22	10, 11, 12, 13, 14, 22, 23	12, 13, 14, 21, 22, 23	[illegible]				
6.5 Medical physics					13, 23	15, 24	15, 23, 24	[illegible]				

ZigZag Practice Exam Papers

Supporting A Level OCR Physics A

Practice Exam Paper 1

Set 1

Name	

Time allowed

2 hours 15 minutes

Instructions

Answer **all** of the questions and use the space provided.

Information

The total number of marks available for this paper is **100**. Section A is worth 15 marks and Section B is worth 85 marks. The number of marks available for each question is shown on the right.

For this paper, you will need:

- Data, Formulae and Relationships booklet

Additional materials required

- Pencil
- Electronic calculator
- Ruler (cm/mm)

Section A

You should spend a maximum of 30 minutes on this
Write your answer to each question in the box pro
*Answer **all** the questions.*

1 Which statement is the best description of scalar quantities?

A They have no units.
B They have no magnitude.
C They have magnitude but no direction.
D They have neither magnitude nor direction.

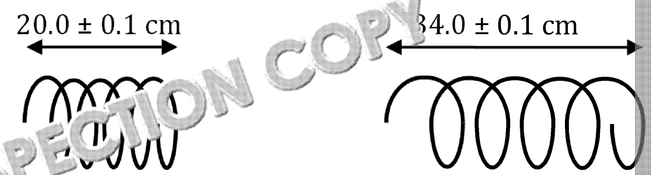
Your answer ☐

2 Which of the following units could be used for a measurement of the rate

A kg m s^{-2}
B kg m s^{-3}
C kg m^2 s^{-2}
D kg m^2 s^{-3}

Your answer ☐

3 A student stretches a spring from an initial length of 20.0 cm ± 0.1 cm to a
34.0 cm ± 0.1 cm.



What is the percentage uncertainty in the extension of the spring, given to

A 0.2 %
B 0.4 %
C 0.7 %
D 1 %

Your answer ☐

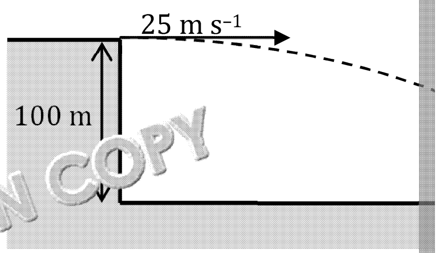
4 r and h are both measurements of length.
Which combination has no units?

A $(r/h)^{½}$
B $4/3\ \pi r^3$
C $2\pi rh$
D $\pi r^2/h$

Your answer ☐

5 A projectile is launched horizontally from a vertical height of 100 m. The projectile is $25\ m\ s^{-1}$. What is the magnitude of the projectile's velocity w

A $25\ m\ s^{-1}$
B $44\ m\ s^{-1}$
C $51\ m\ s^{-1}$
D $70\ m\ s^{-1}$



Your answer ☐

6 Which ... ip ... best fits a material that can be drawn out into a long, th

A du
B elastic
C strong
D polymeric

Your answer ☐

7 Masses of 25 kg and 60 kg hang on opposite sides of a light, inextensible s pulley. They are released from rest at the same time, and the heavier mas

By how much is the potential energy of the system reduced?

A 590 J
B 690 J
C 1200 J
D 1700 J

Your answer ☐

8 An object of mass m = 6.5 kg is moving vertically upwards, pulled by a ro at a rate of $2.0\ m\ s^{-2}$.

What is the tension T in the rope?

A 6.5 N
B 51 N
C 64 N
D 77 N

Your answer ☐

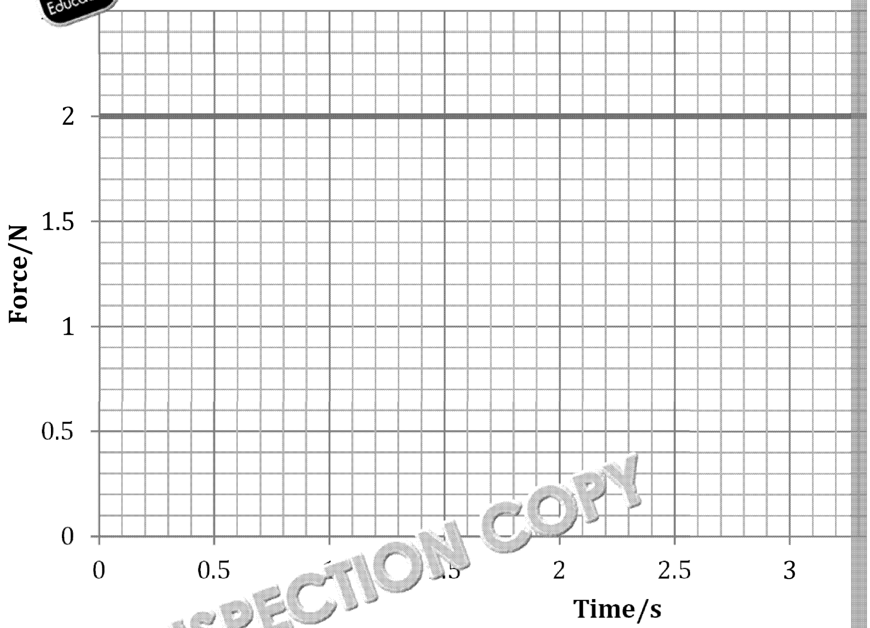
9 A cylindrical wire has a diameter of 3.2×10^{-4} m. When a force of 28 N is increases by 2 %.

What is the value of the Young modulus of the wire?

A 17 kPa
B 17 MPa
C 17 GPa
D 17 TPa

Your answer ☐

10 An object of mass 2.0 kg is initially at rest. A force then acts on the object,



What is the velocity of the object after 3.0 s?

A 3.0 m s^{-1}
B 3.5 m s^{-1}
C 6.0 m s^{-1}
D 7.0 m s^{-1}

Your answer ☐

11 A magnet of mass m travels at velocity v and collides with a stationary ma collision is perfectly inelastic.

What percentage of the initial kinetic energy is lost in this collision?

A 25 %
B 33 %
C 50 %
D 67 %

Your answer ☐

12 A particle performs 3.5 complete revolutions in 11 s.

What is the angular velocity of the particle?

A 0.32 rad s^{-1}
B 0.50 rad s^{-1}
C 2.0 rad s^{-1}
D 3.1 rad s^{-1}

Your answer ☐

13 An object oscillates with simple harmonic motion and has a total energy [illegible] object [illegible] doubles but its amplitude stays the same.

What is the total energy of the object now?

A ¼E
B ½E
C 2E
D 4E

Your answer ☐

14 An object performs circular motion at constant speed.

Which of the following statement(s) is/are **not** correct?

1 Work is done on the object as it travels
2 The velocity of the object is changing
3 The object's acceleration is perpendicular to its velocity

A 1, 2 and 3
B Only 1 and 2
C Only 2 and 3
D Only 1

Your answer ☐

15 Red giant stars occupy the top right-hand corner of the Hertzsprung–Rus

What does this tell us about their luminosity and temperature compared

	Luminosity	Temperature
A	Lower	Higher
B	Lower	Lower
C	Higher	Lower
D	Higher	Higher

Your answer ☐

Section B

*Answer **all** the questions.*

16 **(a)*** With the help of a labelled diagram, describe an experiment that you
to measure the terminal velocity in a viscous fluid of a small ball bea

Explain how you could estimate the percentage uncertainty in your r

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

(b) Fig. 16.1 shows the free body force diagram for the ball bearing whe velocity. Two of the forces have labels.

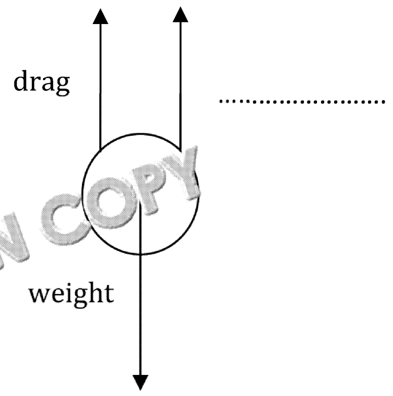


Fig. 16.1

(i) Complete the missing label on Fig. 16.1.

Fig. 16.2 shows the velocity–time graph of the ball bearing from

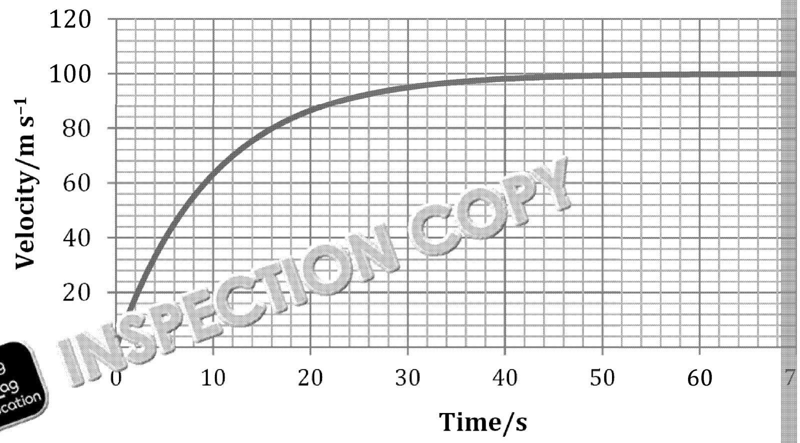


Fig. 16.2

(ii) Use the graph to estimate the total distance travelled by the ball terminal velocity at 50 s.

(iii) Stokes' law states that the drag force, F, on the ball bearing is giv
where η = coefficient of viscosity
r = radius of ball bearing
v = velocity of ball bearin

The units for η are Pa s (as . . econds).

Show that the equation F = 6πηrv is homogeneous with respect t

17 This question is about the application of Archimedes' principle.

(a) State Archimedes' principle.

....

....

A solid block has a mass of 4.0 kg in air. A student attaches a light string a
and lowers it into a container of water until it is completely submerged. T
when the block is fully submerged and at rest is 31 N.

Density of water = 1000 kg m^{-3}

(b) **(i)** Calculate the upthrust force, U, on the block.

(ii) Show that the volume V of the block is approximately 8 × 10^{-4} m^3

V

The block is made of an alloy (mixture) of aluminium and bronze.

Density of aluminium = 2700 kg m^{-3}

Density of bronze = 8100 kg m^{-3}

(c) Calculate the percentage mass of aluminium in the alloy.

percentage mass of aluminium = ...

18 A car travels down a hill at an initial speed of 22 m s^{-1}.

The hill has a constant gradient, as shown in Fig. 18. The total mass of the

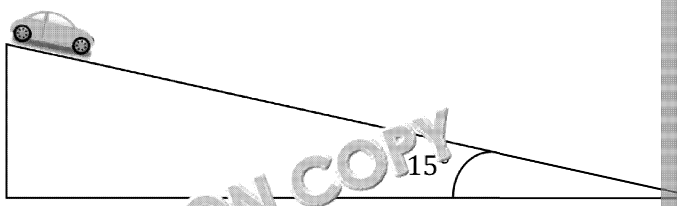


Fig. 18

(a) Show that the component of the car's weight down the slope is appro

component of w

(b) The driver applies the brakes, and the car comes to a halt in a time of reaches the bottom of the hill.

(i) Calculate the deceleration of the car.

deceleratio

(ii) Calculate the total resistive force acting on the car.

total resistive f

(iii) Calculate the work done on the car by the resistive force.

w

(iv) Calculate the loss in kinetic energy of the car.

loss in kine

(v) Explain why your answers to **(iii)** and **(iv)** are not equal.

....

....

(c) Describe and explain what would happen to the stopping distance of alone, the driver was accompanied by other passengers and their hea

....

....

....

....

19 **(a)** Newton's third law describes a pair of forces.

(i) State **two** ways in which the forces in this pair are different.

....

....

....

....

(ii) State **two** ways in which the forces in the pair are the same.

....

....

....

....

(b) Fig. 19 shows one of the forces acting on a book which rests on top of a ta

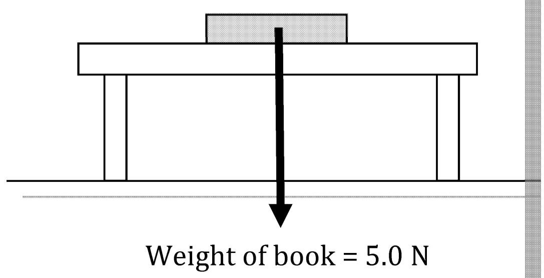


Fig. 19

(i) Describe as fully as possible the force which makes a Newton's t labelled in Fig. 19.

....

....

....

....

....

....

(ii) The book is in *equilibrium*.

One condition which must be fulfilled in order for equilibrium to … acting on the book must be balanced.

What is the other condition?

....

....

(iii) Describe as fully as possible the force which balances the weight …

1 …

....

....

....

....

....

....

20 A student introduces some smoke into a glass cell. He illuminates the cell … under a microscope. He sees the smoke particles performing *Brownian m…*

(a) Describe the motion of the smoke particles.

....

....

(b) Explain what causes this motion.

....

....

....

....

(c) A student wants to calculate the specific latent heat of fusion of wax. … granules which she melts using an electrical heater with a power of 1… 15-minute intervals the amount of wax that melts, then repeats her e… calculate an average mass and its uncertainty. The table below show…

Time t/minutes	Mass₁/g	Mass₂/g
[illegible]	0	0
15	47	59
30	85	104
45	152	163
60	204	215
75	252	268
90	318	328

(i) Complete the missing value in the table, with its uncertainty.

(ii) The student plots a graph of her results, which is shown in Fig. 2
complete the graph. Add vertical error bars to all the points.

(iii) Draw a best fit line through the points.

(iv) Use the graph to determine a value for the specific latent heat of
$J\,kg^{-1}$ assuming that there are no heat losses.

specific latent heat =

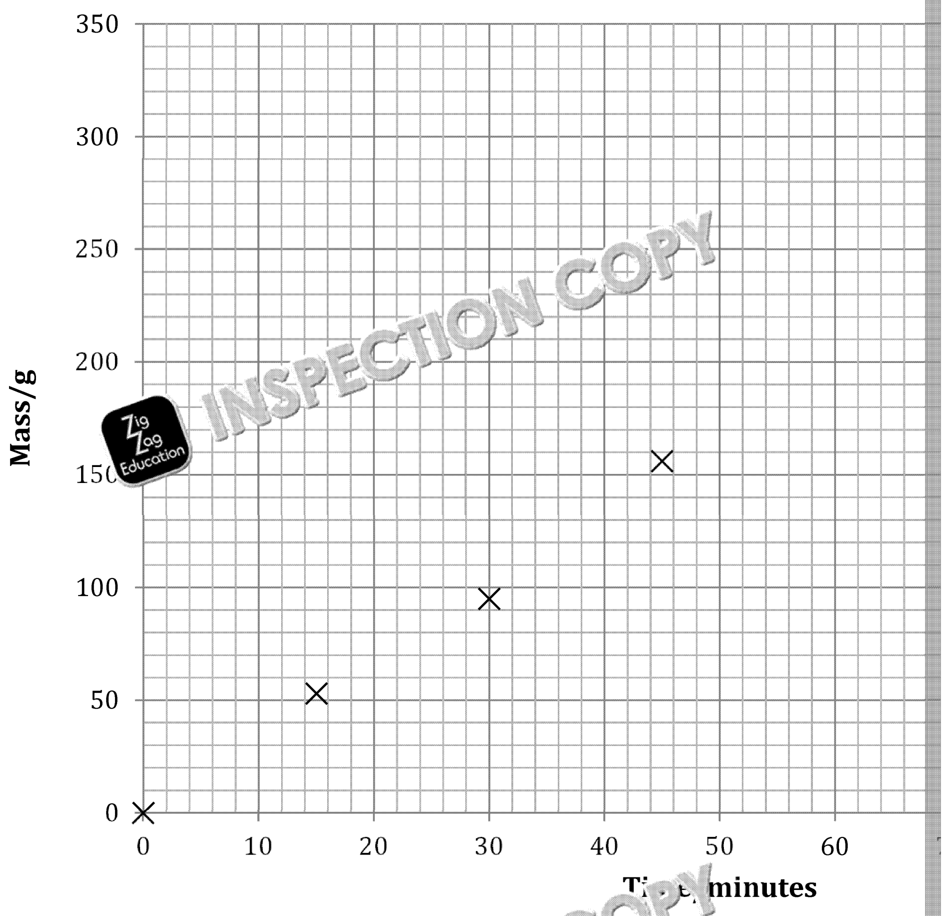


Fig. 20

(v) Draw a worst fit line through the points. Use it to calculate the p
value for the specific latent heat of wax.

percentage uncertaint

(d) Halfway through the process, solid and liquid wax are in thermal equ

State **one** similarity and **one** difference between the properties of the
solid wax and those in the molten wax.

1. **Similarity**

....

....

2. **Difference**

....

....

21 An object of mass m on the surface of the Moon has weight mg_{MOON}, where
to gravity on the Moon. The Moon has no atmosphere.

(a) On the surface of the Moon, an object takes 5.1 s to fall a vertical dista

(i) Show that g_{MOON} is 2 m s^{-2} to 1 significant figure.

(ii) The same object is now launched from the Moon's surface at a sp
of 25° to the horizontal. Calculate the time of flight of the object.

Assume that the Moon's surface is level.

(iii) If the object was launched in an identical manner on Earth, s would expect the time of flight to differ (no calculation is require

....

....

(b) Mimas is one of Saturn's moons.

(i) State Newton's law of gravitation in words.

....

....

....

(ii) Use this law to show that the acceleration due to gravity on the s calculated using the formula:

$$g_{MIMAS} = \frac{GM}{R^2}$$

where M is the mass of Mimas and R is its radius.

(iii) Calculate the value of g_{MIMAS}.

Average density of Mimas = 1.2 g cm^{-3}

Average radius of Mimas = 200 km

g_{MIM}

(iv) Hence, calculate the ratio $\dfrac{\text{weight of object on Moon}}{\text{weight of object on Mimas}}$

22 (a)* Describe as fully as possible the major events that occurred during th
from the Big Bang until the formation of the first galaxies. Include ap
after the Big Bang at which these events happened.

(b) The furthest galaxies that we can see in our universe are approximat
Earth.

(i) Describe **two** differences you would expect to find between the s
the structure of the galaxies that are nearest to us.

....

....

....

....

(ii) The most massive observed galaxy has a red shift of 0.1. Explain

....

....

....

....

(iii) The nearest galaxy to Earth is the Andromeda Galaxy, which is 0
smallest parallax angle we can measure from Earth is 0.001 arc s
or not we would be able to measure the distance to the Androme
methods.

END OF QUESTION PAPER

Set 4: Paper 1 Mark Scheme

Section A

1. B
2. C
3. C
4. A
5. A
6. C
7. D
8. C
9. A
10. D
11. B
12. D
13. C
14. B
15. C

Section B

Question	Answer	Marks
16 (a)	F = ma gives W – T = 280 × 3.25 = 910 N	C1
	So T = (280 × 9.81) – 910 = 1840 (N)	A1
(b)	No, because they are different types of force / act on the same body	B1
(c) (i)	$v^2 - u^2 = 2as$ gives $a = -u^2 / 2s$	C1
	a = -64 /(2 × 12.5) = (-)2.56 (m s^{-2})	A1
(ii)	F = ma gives T – W = 280 × 2.56 = 716.8 N	C1
	So T = 716.8 + (280 × 9.81) = 3460 (N)	A1
(d)	More likely to break when accelerating upwards	B1
	because accelerating T = W + ma constant speed T = W descending T = W – ma	B1
	Total	**9**

Question	Answer	Marks
17 (a) (i)	W = mg = 50 × 9.81 = 490 (N)	B1
(ii)	Arrow drawn vertically downwards at centre of plank	B1
(b) (i)	1. Resultant force = 0 (in any direction)	B1
	2. Resultant moment = 0 (about any point)	B1
(ii)	Taking moments around L $d_{(L\text{-}CoM)}W = d_{(L-R)}R$	
	4 × 490 = R × 6	C1
	R = 330 (N)	A1
(c)	Plank most likely to tip at furthest RH end	B1
	Taking moments about RH support: L × 6 = 2 × 490 – 3 × 700 gives L negative	M1
	Yes, plank will definitely tip at some point	A1
	Total	**9**

Question	Answer	Marks	
18 (a)*	**Level 3 (5–6 marks)** A clear description of all equipment required, and a detailed description of the method, leading to a clear method of analysis and method of measuring density. *The answer shows strong understanding and is in a reasonable order and structure. The answer includes appropriate details, with evidence where applicable.* **Level 2 (3–4 marks)** A description of most of the equipment required, and a description of the method, leading to an appropriate method of analysis and attempt at measuring density. *The answer shows some understanding and is ordered in a somewhat logical structure. The answer includes details that are largely appropriate, with some evidence where applicable.* **Level 1 (1–2 marks)** A description of some of the equipment required, and a description of the method, leading to a limited attempt at analysis and measurement of density. *The answer shows limited understanding and is unordered. The answer includes details and evidence that are inappropriate to answer the question.*	B1 × 6	Some poi **Equipme** 1. Forc 2. Clan 3. Meti mea 4. Verr 5. Clea 6. Top **Method (** 1. Mea calc 2. Mea halv 3. Low first 4. Uptl read 5. Volu 6. Incr com Accuracy 1. Clan set s outs scal 2. Eye 3. Rea 4. Poss to m **Analysis** 1. Plot 2. Exp 3. Mea 4. Calc 5. Alte case
(b) (i)	F = W – U = W – weight of displaced fluid	C1	
	$= \mu V g - \rho V g$	C1	
	$= \mu V g(1 - \frac{\rho}{\mu})$	C1	
	$= W(1 - \frac{\rho}{\mu})$	A1	
(ii)	$F = ma = mg(1 - \frac{1000}{8960})$	C1	
	$a = 0.888\ g = 8.7\ (ms^{-2})$	A1	
(iii)	Correctly labelled axis and graph starts at the origin	B1	
	Positive gradient that gradually decreases to zero	B1	
	Total	**14**	

Question	Answer	Ma
19 (a)	**Limitations** **1.** The extension is very small **2.** The diameter of the wire is very small and may not be constant along the wire **3.** The wire's diameter may change when stretching **4.** Hard to measure initial length without stretching the wire **5.** Calibration errors in instruments **Improvement** **1.** Use [illegible] on the wire / Vernier scale **2.** Measure at many different points and orientations along wire using micrometer **3.** Measure d before and after experiment **4.** Load wire initially to straighten it **5.** Check calibration / recalibrate all instruments	B B
(b)	Up to stress of approx. 150 MPa, behaviour is elastic / Hooke's law is obeyed / force is proportional to extension After the elastic limit and up to 184 MPa, wire shows plastic behaviour / the extension decreases for the same additional load / the wire becomes harder to stretch After 184 MPa (yield point) the wire extends rapidly / necks	B B B
(c) (i)	UTS = highest point on graph UTS = 1.84×10^8 (Pa)	B
(ii)	E = gradient of linear portion of graph $= (132 \times 10^6)/(0.12 \times 10^{-2})$ $= 1.1 \times 10^{11}$ (Pa)	C A
	Total	1

Question	Answer	Ma
20 (a)	$v^2 = u^2 + 2as$ $v = \sqrt{u^2 + 2as}$ $v = \sqrt{2.5^2 + 2 \times 9.81 \times 1.4}$ = 5.8 (m s^{-1})	C C A
(b)	$½m\Delta(v^2) = ½ \times 58 \times 10^{-3} \times (5.8^2 - 4.0^2)$ $\Delta E_K = 0.51$ (J)	C A
(c)	Dissipated as heat energy in the ball (plus floor and surroundings)	C
(d)	$F = \frac{\Delta p}{\Delta t}$ $F = \frac{m\Delta v}{\Delta t}$ $F = \frac{58 \times 10^{-3} \times (5.8 + 4.0)}{40 \times 10^{-3}}$ F = 14 N	C C A
	Total	9

Question	Answer
21 (a)	$m = \rho V = 2.7 \times 2 \times 2 \times 2$ $= 22$ g
(b)	Energy lost by iron = energy gained by aluminium and water $m_{Fe} \times c_{Fe} \times (300 - 23) = m_{al} \times c_{Al} \times (23 - 20) + m_W + c_W \times (23 - 20)$ $0.022c_{Fe} \times 277 = 0.1 \times 900 \times 3 + 0.25 \times 4200 \times 3$ $c_{Fe} = 3420/6.09$ $c_{Fe} = 560$ (J kg^{-1} K^{-1}) answer to 2 s.f.
(c)	Method to give larger temperature rise So this would lead to a smaller percentage error in measurement of temperature
(d)	It can absorb a large amount of heat energy from the car engine without raising its temperature significantly / coming to the boil
	Total

Question	Answer
22 (a)	1 *kelvin* is defined as the fraction $^{1}/_{273}$ of the thermodynamic temperature of the triple point of water At 0 K, molecules have minimum kinetic energy/ minimum motion
(b)	pV is only proportional to T if T is measured in kelvin
(c) (i)	Total volume $V = 3.00 + 4.50 = 7.50$ m^3 $n = pV/RT = 1.10 \times 10^5 \times 7.50/(8.31 \times 293)$ $= 339$
(ii)	Number of moles remains constant $(p \times 3.00) / (8.31 \times 253) + (p \times 4.50) / (8.31 \times 313) = 339$ $p \times (0.0119 + 0.0144) = 339 \times 8.31$ $p = 1.07 \times 10^5$ (Pa)
	Total

Question	Answer	Marks	
23*	**Level 3 (5–6 marks)** A clear and logical description of star evolution for both low and high mass stars, with clear explanation of what provides stability at each stage. *The answer shows strong understanding and is in a reasonable order and structure. The answer includes appropriate details, with evidence where applicable.* **Level 2 (3–4 marks)** A description of star evolution for both low and high mass stars plus an idea of what provides stability at some of the stages. *The answer shows some understanding and is ordered in a somewhat logical structure. The answer includes details that are largely appropriate, with some evidence where applicable.* **Level 1 (1–2 marks)** A jumbled description of star evolution for either low or high mass stars but little idea of what provides stability at most of the stages. *The answer shows limited understanding and is unordered. The answer includes details and evidence that are inappropriate to answer the question.*	B1 × 6	Example **Main se** 1. Fus 2. Rad gra **Low ma** 1. Bet 2. Hyd 3. Gra 4. Inc 5. cau 6. Out red 7. Pla 8. Wh 9. Ele gra 10. but sola **High ma** 1. Red hyd 2. Fus 3. in s 4. Sta 5. lea 6. Neu 7. Neu gra 8. but sola 9. Oth
	Total	**6**	

Question	Answer	Marks	
24 (a)	The displacement of a line in the spectrum of a star/galaxy towards longer wavelengths / the red end of the spectrum <u>because the star/galaxy is receding</u>	B1	
(b) (i)	Away from us	B1	
(ii)	$\Delta\lambda/\lambda = v/c$ gives $v = (\Delta\lambda \times c)/\lambda$ $= 1.1 \times 3 \times 10^8/656.4$ $v = 5.03 \times 10^5$ (m s^{-1})	C1 A1	
(iii)	68 km s^{-1} Mpc^{-1} = 68 000/($10^6 \times 3.1 \times 10^{16}$) $= 2.2 \times 10^{-18}$ (s^{-1})	C1 A1	
(iv)	$v = H_0d$ gives $d = 5.03 \times 10^5 / 2.2 \times 10^{-18}$ (m) $d = 2.29 \times 10^{23}/9.5 \times 10^{15}$ $d = 2.4 \times 10^7$ (ly)	C1 C1 A1	ECF (b)
	Total	**9**	