Physics

A Level | AQA | 7408

Practice Exams for A Level AQA Physics

Paper 1

zigzageducation.co.uk

POD 7605

Contents

Teacher's Introduction

This collection of four practice papers has been written to support the AQA A-level physics specification 7408 (first examination 2016). The pack consists of four sets of paper 1.

Each paper consists of a Section A, with questions that require written answers totalling 60 marks, and a Section B, with multiple choice questions totalling 25 marks, for a total of 85 marks per paper.

Remember!
Always check the exam board website for new information, including changes to the specification and sample assessment material.

Each paper a similar format to the AQA papers. Every item listed in the specification is covered, with most aspects visited several times in the pack. Each set of papers matches the weightings of assessment objectives, maths skills and practical skills set out by the exam board.

The mark schemes are written in a similar format to those written by AQA. The individual marking points are on separate lines with additional guidance to clarify points and indicate alternative acceptable answers.

Suggested Uses

1. Set as a mock examination under exam conditions, marked by the teacher. This provides the most reliable summative assessment.
2. Set as a complete paper under exam conditions which is then marked by the student. This provides a good formative assessment as the student gets a good understanding of how the mark schemes work and what they need to do to score. Such a session could be reinforced by a lesson on exam technique.
3. Set as a complete paper under exam conditions which is then peer marked. This could be by the teacher assigning scripts to students to mark or by students swapping amongst themselves. Group marking can be particularly helpful as the students get the chance to develop their ideas by discussing why things do and don't score.
4. Go through a question at a time in a lesson. Get students to discuss their answers before revealing the mark scheme for that question.
5. Set a paper as a homework for the student to answer and mark. This would be an ideal activity for study leave, when the student could come to a tutorial to go through their script. They should be briefed to list questions that need addressing as a result of their marking of their script.

T Brown & S Khonji, April 2017

Specification Cross-refere

Paper:	1 (A)	1 (B)	1 (C)	1 (D)	2 (A)	2 (
1 Measurements and their errors						
1.1 Measurements and their errors						
1.1.1 Use of SI units and their prefixes			3			3
1.1.2 Limitation of physical measurements	3	3, 6		6, 27	2	
1.1.3 Estimation of physical quantities				4, 6	1, 15	1
2 Particles and radiation						
2.1 Particles						
2.1.1 Constituents of the atom	1	9	9	9	5, 6, 29	
2.1.2 Stable and unstable nuclei	1, 10					
2.1.3 Particles, antiparticles and photons	6		11	5		
2.1.4 Particle interactions	1, 6	10	8, 10	7		
2.1.5 Classifications of particles	6	5	8	29		3
2.1.6 Quarks and antiquarks	6	11		7		
2.1.7 Applications of conservation laws	6	1, 11	8, 10			
2.2 Electromagnetic radiation and quantum phenomena						
2.2.1 The photoelectric effect	7, 8	7	4			
2.2.2 Collisions of electrons with atoms		5	7			
2.2.3 Energy levels and photon emission	9	8				
2.2.4 Wave–particle duality		5,7	4	10	6	

Paper:	1 (A)	1 (B)	1 (C)	1 (D)	2 (A)	2 (
3 Waves						
3.1 Progressive and stationary waves						
3.1.1 Progressive wave	15		1	[illegible], 13		
3.1.2 Longitudinal and transverse waves	11, 12	2	1	11, 14		
3.1.3 Principle of superposition of waves and formation of stationary waves	4	2	13			
3.2 Refraction, diffraction and interference						
3.2.1 Interference	5, 13	15	5	12		
3.2.2 Diffraction	5	5, 16	5, 15	10		
3.2.3 Refraction at a plane surface		12, 13, 14	12, 14, 16	3, 15		
4 Mechanics and materials						
4.1 Force, energy and momentum						
4.1.1 Scalars and vectors	2, 16, 19	20	6, 19		7	
4.1.2 Moments	17	18	22	6		
4.1.3 Motion along a straight line	2, 19, 21	1, 6	6, 17, 20, 21	1, 17, 20, 21	21	3
4.1.4 Projectile motion	2, 20	20	6			3,
4.1.5 Newton's laws of motion	2, 16	22	6		7, 9, 10	3
4.1.6 Momentum	[illegible]	[illegible], 19	18	1, 16, 19		
4.1.7 Work, energy and power	18	1, 6, 21, 22	6	2, 18	10	
4.1.8 Conservation of energy	18, 19	1, 3, 17	4	6	3, 5	6
4.2 Materials						
4.2.1 Bulk properties of solids	3, 23, 24, 25	3, 23, 24	2, 23	2, 22, 23, 24	2	
4.2.2 The Young modulus	3	25	2, 23, 24	22		

Paper:	1 (A)	1 (B)	1 (C)	1 (D)	2 (A)	2 (
5 Electricity						
5.1 Current electricity						
5.1.1 Basics of electricity	4, 28	4, 26, [illegible]	[illegible]	4	18	
5.1.2 Current–voltage characteristics	[illegible]	4	3	25, 27		
5.1.3 Resistivity	27		3	28	2	
5.1.4 Circuits	4, 28	4, 28	25, 26	4, 26	24	1
5.1.5 Potential divider		4	28			
5.1.6 Electromotive force and internal resistance	4		27	4, 26		
6 Further mechanics and thermal physics						
6.1 Periodic motion						
6.1.1 Circular motion	29				6, 7, 8, 9, 10	
6.1.2 Simple harmonic motion	30			1	4, 17	6,
6.1.3 Simple harmonic system	31			1	4	6, 8
6.1.4 Forced vibrations and resonance					4	
6.2 Thermal physics						
6.2.1 Thermal energy transfer		1, 29			19	1
6.2.2 Ideal gases		30				6, 1 11,
6.2.3 Molecular kinetic theory model		31				12, 15

Paper:	1 (A)	1 (B)	1 (C)	1 (D)	2 (A)	2 (
7 Fields and their consequences						
7.1 Fields						
Fields					11, 15	19
7.2 Gravitational fields						
7.2.1 Newton's law			29		3	
7.2.2 Gravitatio[illegible]rength					11, 12	
7.2.3 Gravitational potential					3, 11, 12, 13	16,
7.2.4 Orbits of planets and satellites					3, 14	17,
7.3 Electric fields						
7.3.1 Coulomb's law					1, 16	3, 2
7.3.2 Electric field strength			30		1, 17	3
7.3.3 Electric potential						3, 20
7.4 Capacitance						
7.4.1 Capacitance						4
7.4.2 Parallel plat[illegible]cito						4
7.4.3 Energy st[illegible]apacitor					2	24
7.4.4 Capacitor charge and discharge					2, 18, 19, 20	23,

Paper:	1 (A)	1 (B)	1 (C)	1 (D)	2 (A)	2 (
7.5 Magnetic fields						
7.5.1 Magnetic flux density						5
7.5.2 Moving charges in a magnetic field			21	29	6	27
7.5.3 Magnetic flux and flux linkage						5
7.5.4 Electromagnetic induction					21, 22	5, 2
7.5.5 Alternating currents				*4*	23	26
7.5.6 The operation of a transformer					24, 25	
8 Nuclear physics						
8.1 Radioactivity						
8.1.1 Rutherford scattering					5	31
8.1.2 α, β and γ radiation					26, 28	2
8.1.3 Radioactive decay	1, 9		30		29	2, 2
8.1.4 Nuclear instability		8			27, 30	
8.1.5 Nuclear radius					5	
8.1.6 Mass and energy			31			
8.1.7 Induced fission					31	30
8.1.8 Safety aspects	1				31	2

ZigZag Practice Exam Papers

Supporting A Level AQA Physics

Practice Exam Paper 1

Set 2

Name	

Time allowed

2 hours

Instructions

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

Information

The total marks available for this paper is **85**. Section A is worth 60 marks and Section B is worth 25 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

*Answer **all** questions in this section.*

1. An experiment is carried out to measure the percentage of energy dissipa is dropped from a height h_1, and bounces back to a height h_2, as shown by

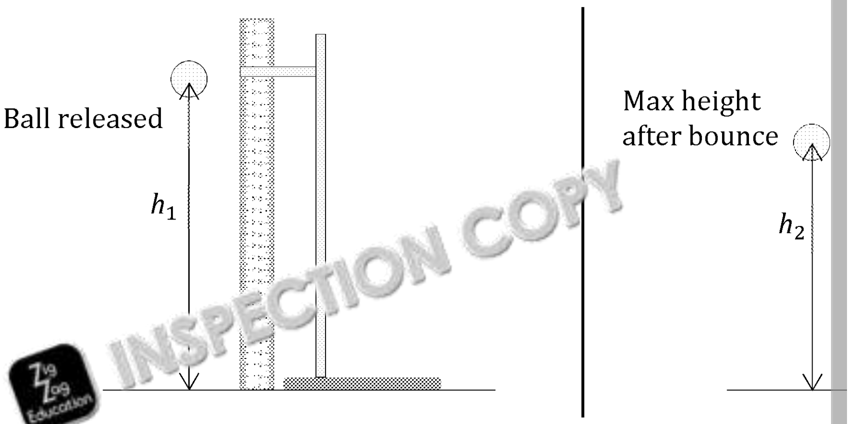


Figure 1

1.1 Outline the difference between instantaneous velocity and average v

....

....

....

....

1.2 When is the velocity of the ball at a maximum?

....

1.3 Write an expression for the percentage energy loss of the ball as it bo

1.4 When the ball hits the ground ... of thermal energy is introduced

Calculate the temperature increase of the ball.

[T... cific heat capacity of the rubber the ball is made out of is 112

1.5 On **Figure 2**, sketch the shape of a velocity–time graph for the ball if i
bounce a total of three times.

Figure 2

2. A child attaches an 8.22 m rope with a mass of 3.50 kg to a tree and shake
produce a stationary wave as shown in **Figure 3**.

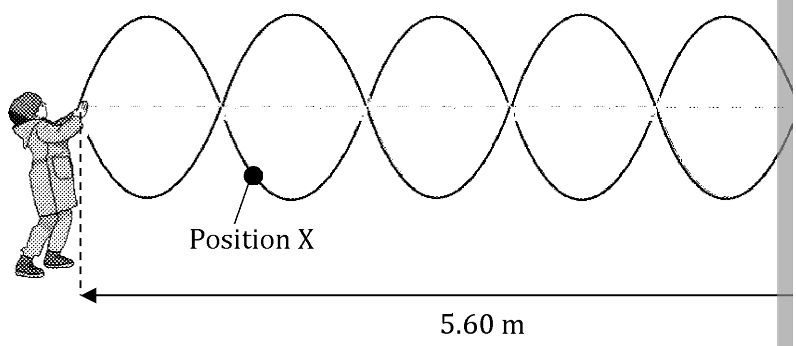


Figure 3

2.1 State the direction of movement of the segment of rope at position X
explain whether the stationary wave is transverse or longitudinal.

....

....

....

2.2 Give the number of nodes and wavelength of the stationary wave sho

Number of nodes: ....

Wavelength: ....

2.3 Explain how the stationary wave is formed and why it has this shape.

....

....

....

....

....

2.4 The child changes the rate at which they shake the rope so that the fi
produced instead.

The tension in the rope is [illegible] N

Calculate the frequency of this stationary wave.

3. A toy gun uses the elastic strain energy stored in a spring to fire a small sp
the spring and pellet provided by the manufacturer are shown in **Figure 4**

Radius of pellet = 6.25 mm
Density of pellet = 980 kg m^{-3}
Stiffness of spring = 4.50 N m^{-1}

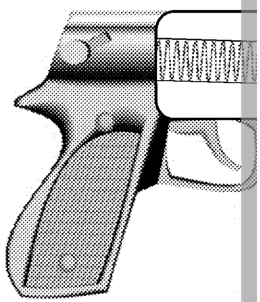


Figure 4

3.1 A lever inside the gun compresses the spring causing its length to de
the elastic strain energy stored in the spring when it is compressed.

3.2 Calculate the mass of the pellet.

3.3 When the trigger is pulled, the lever is released and the pellet is fired. the pellet leaves the spring. Assume all the energy stored in the spring

3.4 Suggest **two** ways to increase the speed the pellet leaves the toy gun the pellet.

1. ....

....

2. ....

....

3.5 The manufacturer wants to determine the Young modulus of the wire t the toy gun can be adapted. Describe an experiment to determine the Y

....

....

....

....

....

....

....

....

4. **Figure 5** shows a potential divider circuit containing a thermistor.

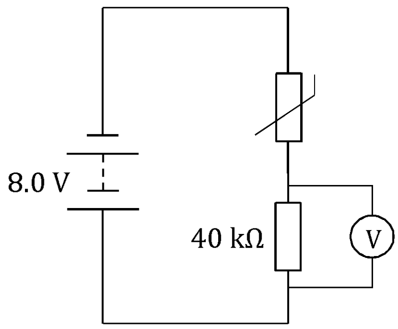


Figure 5

The internal resistance of the battery is negligible.

4.1 Explain why the resistance of the thermistor decreases as the temperat

....

....

....

....

4.2 The temperature is set so that the resistance of the thermistor is 52 k

Calculate the reading on the voltmeter.

4.3 State the resistance of the voltmeter, if it is ideal.

....

4.4 Calculate the power dissipated by the thermistor.

4.5 The temperature is increased so that the resistance of the thermistor

What effect will this have on the reading on the voltmeter?

....

....

4.6 Suggest an application of the circuit shown in **Figure 5**.

....

....

5. A beam of electrons is passed through a crystal lattice.

The electrons are diffracted by the spaces in the crystal lattice.

5.1 The space between atoms is 3.49×10^{-10} m.

The first order diffraction maximum occurs at an angle of 2.68°.

Calculate the de Broglie wavelength of the electrons in the beam.

5.2 Calculate the speed of the electrons in the beam from the de Broglie w

5.3 A muon beam travelling at the same speed is passed through the crys

Describe how the diffraction pattern produced would be different to

....

....

....

....

....

5.4 The electron beam passes through a gas before being diffracted.
The electron beam collides with atoms in the gas and the energy of th
Atoms in the gas emit photons at several specific frequencies.

Explain these effects.

....

....

....

....

....

6. **Figure 6** shows a person mowing a particular section of their lawn. Their the surface of the ground is inclined at an angle of 18 ° to the horizontal. T of 53 ° to the slope, to push their lawnmower up the hill. The lawnmower the effects of friction can be ignored.

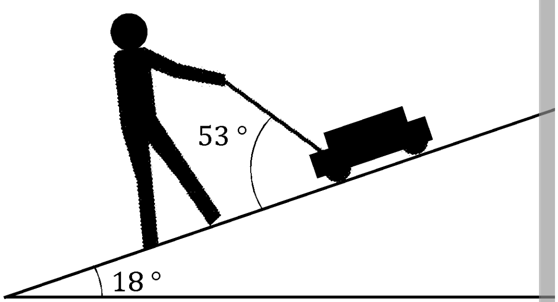


Figure 6

6.1 On the diagram below, draw the forces acting on the lawnmower.

6.2 The lawnmower is pushed up the hill and gains 205 J of gravitational
Show that the force F applied in pushing the lawnmower is around 2

6.3 The Italian physicist Galileo estimated the value of g by rolling balls d
this because he did not have timing devices that were precise enough
method.

Explain why measuring g using a free-fall method is likely to be more a

....

....

6.4 Describe how to calculate the acceleration of an object that is droppe

....

....

....

Section B

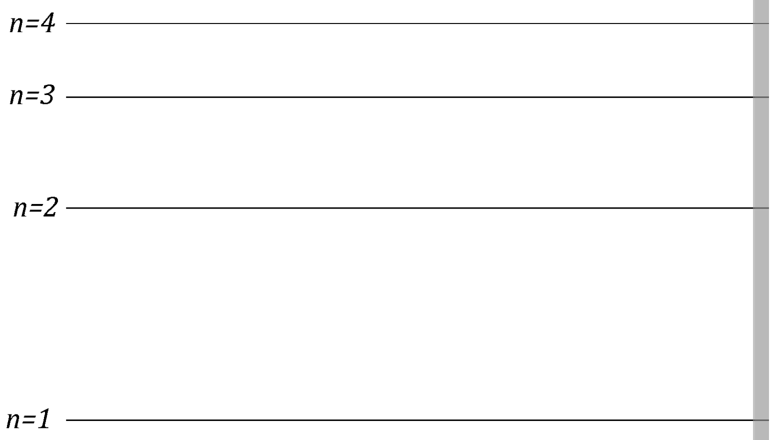
Each question in Section B is followed by four options: A, B, C and D.
For each question, select ***one*** *correct answer by shading the box alongside the a*

7. Which of the phenomena listed below are evidence of light acting as a par

   1: Photoelectric effect
   2: Refraction
   3: Reflection
   4: Electrons moving between energy levels

   A. 1 and 4 only
   B. 2 and 3 only
   C. 1 only
   D. 3 only

8. Below nergy level diagram for a hydrogen atom.



   An electron in the n=4 energy level de-excites to the n=1 energy level.

   Which of the following de-excitation paths can the electron take by only e

   1. $n = 4 \rightarrow n = 2 \rightarrow n = 3 \rightarrow n = 1$
   2. $n = 4 \rightarrow n = 1$
   3. $n = 4 \rightarrow n = 3 \rightarrow n = 1$
   4. $n = 4 \rightarrow n = 2.5 \rightarrow n = 1$

   A. 2 only
   B. 1 and 3 only
   C. 2 and 3 only
   D. 4 on

9. How many protons, neutrons and electrons are in a ${}^{79}_{35}Br^{2+}$ ion?

   A. 35 protons, 79 neutrons, 35 electrons
   B. 44 protons, 35 neutrons, 42 electrons
   C. 35 protons, 44 neutrons, 33 electrons
   D. 35 protons, 44 neutrons, 37 electrons

10. A particle decay conserves baryon number, lepton number and charge.

The decay does not conserve strangeness.

Which fundamental interaction is responsible for the decay?

A. Electromagnetic
B. Weak nuclear force
C. Strong nuclear force
D. Gravity

11. A hadron has charge $Q = 0$, baryon number $B =$ [illegible] strangeness $s = +$

What is the quark composition of the hadron?

A. $\mathrm{u\bar{d}\bar{s}}$
B. $\mathrm{\bar{d}s}$
C. d[illegible]
D. $\mathrm{\bar{u}s}$

12. The refractive index of olive oil is 1.47.

What is the speed of light in olive oil?

A. 3.00×10^8 m s^{-1}
B. 4.41×10^8 m s^{-1}
C. 2.04×10^8 m s^{-1}
D. 4.90×10^7 m s^{-1}

13. Light passes from diamond, with a refractive index of 2.42, into water, wi

The angle of refraction is 77.5°.

What is the angle of incidence?

A. 47.2°
B. 42.6°
C. 32.4°
D. 34.3°

14. What is the critical angle of an interface between water, which has a refra and amber, which has a refractive index of $n_{amber} = 1.55$?

Which direction does the light have to pass to undergo total internal refle

A. 31° Travelling from water to amber
B. 31° Travelling from amber to water
C. 59° Travelling from water to amber
D. 59° Travelling from amber to water

15. Two coherent sources emit sound with a wavelength of 2.2 m.

At what path difference will the two sound waves interfere destructively

A. 6.6 m
B. 5.5 m
C. 4.4 m
D. 3.3 m

16. In a diffraction experiment, green light is switched for red light.

What affect does this have on the width of the central maximum and the diffraction pattern produced?

	Width of central maximum	Distance bet
A.	Greater	Grea
B.	Greater	Low
C.	Lower	Grea
D.	Lower	Low

17. An object of mass m has a momentum p. Which of the following gives the kinetic energy?

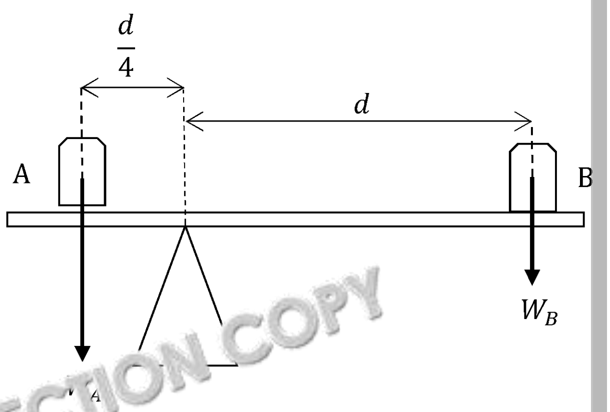
A. $\frac{p^2}{2}$

B. $\frac{2p^2}{m}$

C. $\frac{p^2}{2m}$

D. $\sqrt{\frac{2p}{m}}$

18. Two objects A and B of weight W_A and W_B respectively are placed at diffe
a horizontal plank resting on a pivot as shown below. Both objects have th
density of object A is three times more than the density of object B.



What happens to the system above?

A. More information is needed
B. It turns clockwise
C. It turns anticlockwise
D. It does not move

19. Which of the following is a perfectly elastic collision?

1: A collision between ideal gas molecules
2: A gas cylinder exploding in a room
3: The collision between two billiard balls

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

20. A bullet is fired at an angle of 20° to the horizontal. How, if at all, does air
of the bullet?

A. It does not change its trajectory
B. It only decreases the horizontal distance travelled by the bullet
C. It only decreases the vertical height reached by the bullet
D. It decreases both the horizontal distance and the vertical height of th

21. Which of the following does **not** increase when the driving force on a car i

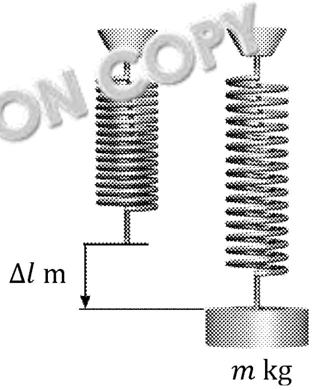
A. The air resistance experienced by the car
B. The normal reaction force experienced by the car
C. The momentum of the car
D. The distance travelled by the car in 10 s

22. An 800 kg racing car initially travelling at 27 m s^{-1} is driven forward by a
85 N of resistive forces.

What is the velocity of the car after 15 s?

A. 30 m s^{-1}
B. 74 m s^{-1}
C. 29 m s^{-1}
D. 90 m s^{-1}

23. A mass m kg is hung from the end of a spring causing an extension Δl m.



What is the extension when a mass $\frac{3}{4}m$ kg is hung from the end of the sa

A. Δl m

B. $\frac{3}{4}\Delta l$ m

C. $\frac{4}{3}\Delta l$ m

D. $\frac{9}{16}\Delta l$ m

24. Which of the following gives the equivalent units for the area under a stre

A. J m^{-3}
B. J
C. J m^3
D. J^{-1} m^3

25. A copper cable has a diameter of 8.50 mm. The Young [illegible] modulus of copper
What force is required to produce a strain of 0[illegible]% inside the cable?

A. 2.66×10^4 N
B. 1.06×10^5 N
C. 2.06×10^6 N
D. 8.[illegible]

26. 80 C of charge flow through a resistor in 15 minutes.

What is the current flowing through the resistor?

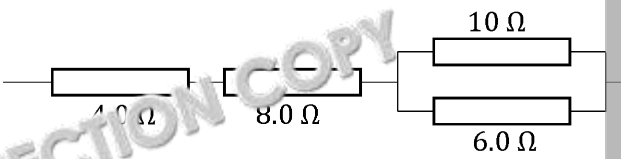
A. 0.089 A
B. 5.3 A
C. 20 A
D. 320 A

27. A resistor has a potential difference of 50 V across it.

The potential difference does work on 2.75×10^{19} electrons. What is the w

A. 220 J
B. 11 J
C. 18 J
D. 140 J

28. What is the total resistance of the resistors shown below?



A. 12 Ω
B. 1
C. 2
D. 28

29. A heater transfers 3.50 kW of heat to oxygen for one minute, causing 0.98 boiling point, -183 °C.

What is the specific latent heat of vaporisation for oxygen?

A. 1.16 kJ kg^{-1}
B. 17.4 kJ kg^{-1}
C. 104 kJ kg^{-1}
D. 213 kJ kg^{-1}

30. An aerosol canister has a pressure of 800 kPa at 20 °C and a volume of 2.5

How many moles of aerosol gas are contained in the canister?

A. 8.24×10^{-2} mol
B. 1.21 mol
C. 0.496 mol
D. 6.07×10^{-3} mol

31. A gas has a molecular weight of 16.0 g mol

What is the root mean square speed of the molecules in the gas at 25.0 °C

A. 277
B. 6
C. 19
D. 21.6 m s^{-1}

ZigZag Practice Exam Papers

Supporting A Level AQA Physics

Practice Exam Paper 1

Set 2

Name	

Time allowed

2 hours

Instructions

Answer **all** of the questions.

Information

The total marks available for this paper is **85**. Section A is worth 60 marks and Section B is worth 25 marks. The number of marks available for each question is shown on the right.

For this paper you will need:

- Data and formulae booklet

Additional materials required

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

Section A

*Answer **all** questions in this section.*

1. An experiment is carried out to measure the percentage of energy dissipa
is dropped from a height h_1, and bounces back to a height h_2, as shown b

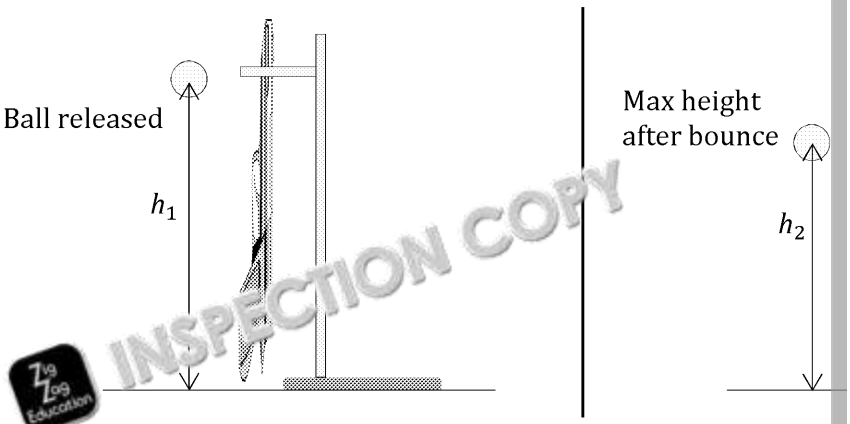


Figure 1

1.1 Outline the difference between instantaneous velocity and average v

1.2 When is the velocity of the ball at a maximum?

1.3 Write an expression for the percentage energy loss of the ball as it bo

1.4 When the ball hits the ground, 4.00 J of thermal energy is introduced

Calculate the temperature increase of the ball.

[The specific heat capacity of the rubber the ball is made out of is 11

1.5 Copy **Figure 2** and sketch the shape of a velocity–time graph for the
continue to bounce a total of three times.

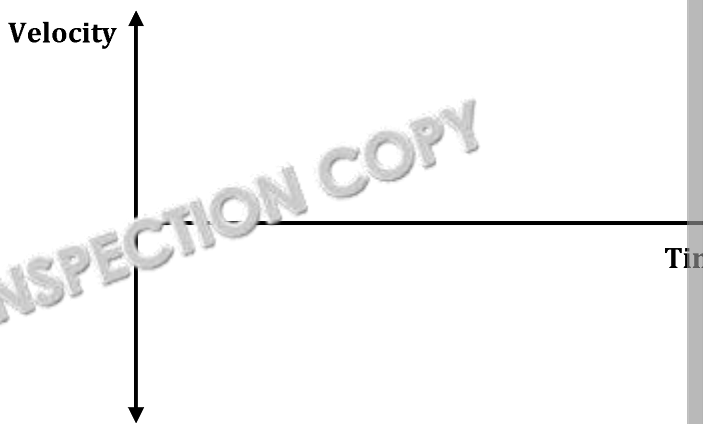


Figure 2

2. A child attaches an 8.22 m rope with a mass of 3.50 kg to a tree and shake produce a stationary wave as shown in **Figure 3**.

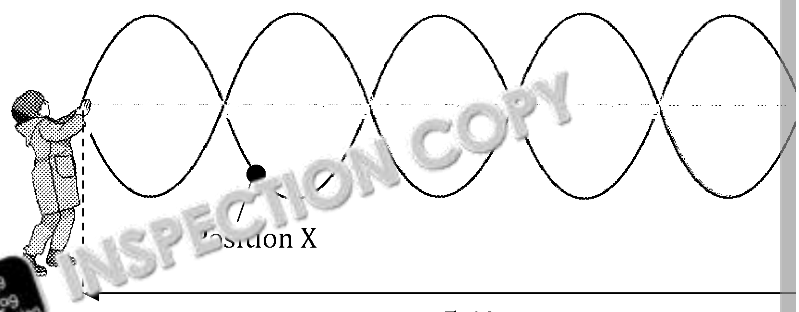


Figure 3

2.1 State the direction of movement of the segment of rope at position X explain whether the stationary wave is transverse or longitudinal.

2.2 Give the number of nodes and wavelength of the stationary wave sho

2.3 Explain how the stationary wave is formed and why it has this shape.

2.4 The child changes the rate at which they shake the rope so that the fi produced instead.

The tension in the rope is 120 N.

Calculate the frequency of this stationary wave.

3. A toy gun uses the elastic strain energy stored in a spring to fire a small s
the spring and pellet provided by the manufacturer are shown in **Figure**

Radius of pellet = 6.25 mm

Density of pellet = 980 kg m^{-3}

Stiffness of spring = 4.50 N m^{-1}

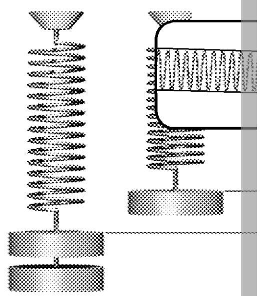


Figure 4

3.1 A lever inside the gun compresses the spring causing its length to de
the elastic strain energy stored in the spring when it is compressed.

3.2 Calculate the mass of the pellet.

3.3 When the trigger is pulled, the lever is released and the pellet is fired.
the pellet leaves the spring. Assume all the energy stored in the spring

3.4 Suggest **two** ways to increase the speed the pellet leaves the toy gun
the pellet.

3.5 The manufacturer wants to determine the Young modulus of the wire t
the toy gun can be adapted. Describe an experiment to determine the Y

4. **Figure 5** shows a potential divider circuit containing a thermistor.

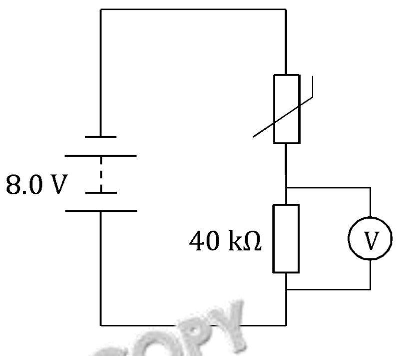


Figure 5

The internal resistance of the battery is negligible.

4.1 Explain why the resistance of the thermistor decreases as the temperat

4.2 The temperature is set so that the resistance of the thermistor is 52 k

Calculate the reading on the voltmeter.

4.3 State the resistance of the voltmeter, if it is ideal.

4.4 Calculate the power dissipated by the thermistor.

4.5 The temperature is increased so that the resistance of the thermistor

What effect will this have on the reading on the voltmeter?

4.6 Suggest an application of the circuit shown in **Figure 5**.

5. A beam of electrons is passed through a crystal lattice.

The electrons are diffracted by the spaces in the crystal lattice.

5.1 The space between atoms is 3.49×10^{-10} m.
The first order diffraction maximum occurs at an angle of 2.68°.

Calculate the de Broglie wavelength of the electrons in the beam.

5.2 Calculate the speed of the electrons in the beam from the de Broglie w

5.3 A muon beam travelling at the same speed is passed through the crys

Describe how the diffraction pattern produced would be different to

5.4 The electron beam passes through a gas before being diffracted.
The electron beam collides with atoms in the gas and the energy of th
Atoms in the gas emit photons at several specific frequencies.

Explain these effects.

6. **Figure 6** shows a person mowing a particular section of their lawn. Their
the surface of the ground is inclined at an angle of 18 ° to the horizontal. T
of 53 ° to the slope, to push their lawnmower up the hill. The lawnmower
the effects of friction can be ignored.

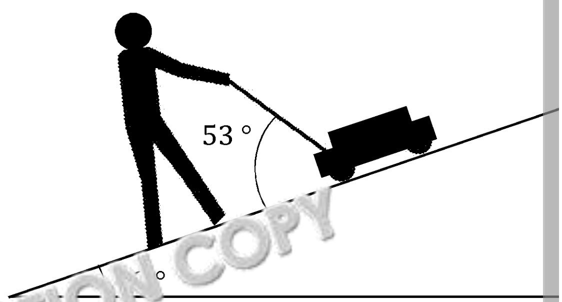
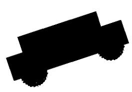


Figure 6

6.1 Copy the diagram below and draw the forces acting on the lawnmow



6.2 The lawnmower is pushed up the hill and gains 205 J of gravitational
Show that the force F applied in pushing the lawnmower is around 2

6.3 The Italian physicist Galileo estimated the value of g by rolling balls d
this because he did not have timing devices that were precise enough
method.

Explain why measuring g using a free-fall method is likely to be more a

6.4 Describe how to calculate the acceleration of an object that is droppe

Section B

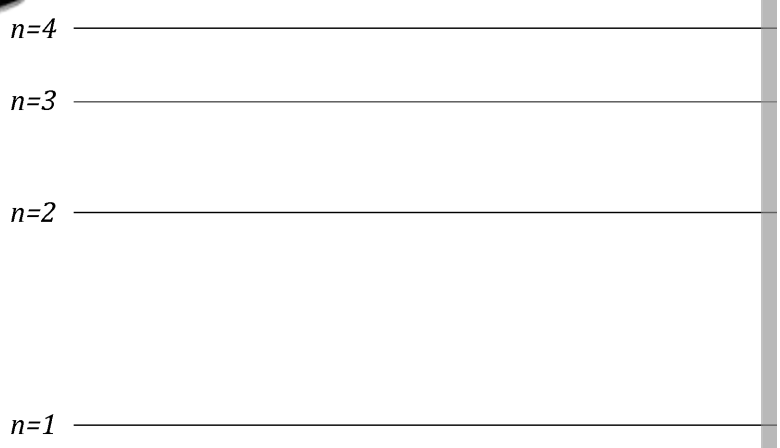
Each question in Section B is followed by four options: A, B, C and D. For each que

7. Which of the phenomena listed below are evidence of light acting as a par

   1: Photoelectric effect
   2: Refraction
   3: Reflection
   4: Electrons moving between energy levels

   A. 1 and 4 only
   B. 2 and 3 only
   C. 1 only
   D. 3 only

8. Below is an energy level diagram for a hydrogen atom.



   An electron in the n=4 energy level de-excites to the n=1 energy level.

   Which of the following de-excitation paths can the electron take by only e

   1. $n = 4 \rightarrow n = 2 \rightarrow n = 3 \rightarrow n = 1$
   2. $n = 4 \rightarrow n = 1$
   3. $n = 4 \rightarrow n = 3 \rightarrow n = 1$
   4. $n = 4 \rightarrow n = 2.5 \rightarrow n = 1$

   A. 2 only
   B. 1 and 3 only
   C. 2 and 3 only
   D. 4 only

9. How many protons, neutrons and electrons are in a $^{79}_{35}Br^{2+}$ ion?

   A. 35 protons, 79 neutrons, 35 electrons
   B. 44 protons, 35 neutrons, 42 electrons
   C. 35 protons, 44 neutrons, 33 electrons
   D. 35 protons, 44 neutrons, 37 electrons

10. A particle decay conserves baryon number, lepton number and charge.

The decay does not conserve strangeness.

Which fundamental interaction is responsible for the decay?

A. Electromagnetic
B. Weak nuclear force
C. Strong nuclear force
D. Gravity

11. A hadron has charge $Q = 0$, baryon number $B = 0$ and strangeness $s = +$

What is the quark composition of the hadron?

A. $u\bar{d}\bar{s}$
B. $\bar{d}s$
C. d[illegible]
D. $\bar{u}s$

12. The refractive index of olive oil is 1.47.

What is the speed of light in olive oil?

A. 3.00×10^8 m s^{-1}
B. 4.41×10^8 m s^{-1}
C. 2.04×10^8 m s^{-1}
D. 4.90×10^7 m s^{-1}

13. Light passes from diamond, with a refractive index of 2.42, into water, wi

The angle of refraction is 77.5°.

What is the angle of incidence?

A. 47.2°
B. 42.6°
C. 32.4°
D. 34.3°

14. What is the critical angle of an interface between water, which has a refra and amber, which has a refractive index of $n_{amber} = 1.55$?

Which direction must the light have to pass to undergo total internal refle

A. 31° Travelling from water to amber
B. 31° Travelling from amber to water
C. 59° Travelling from water to amber
D. 59° Travelling from amber to water

15. Two coherent sources emit sound with a wavelength of 2.2 m.

At what path difference will the two sound waves interfere destructively

A. 6.6 m
B. 5.5 m
C. 4.4 m
D. 3.3 m

16. In a diffraction experiment, green light is switched for red light.

What affect does this have on the width of the central maximum and the diffraction pattern produced?

	Width of central maximum	Distance bet
A.	Greater	Grea
B.	Greater	Low
C.	Lower	Grea
D.	Lower	Low

17. An object of mass m has a momentum p. Which of the following gives the kinetic energy?

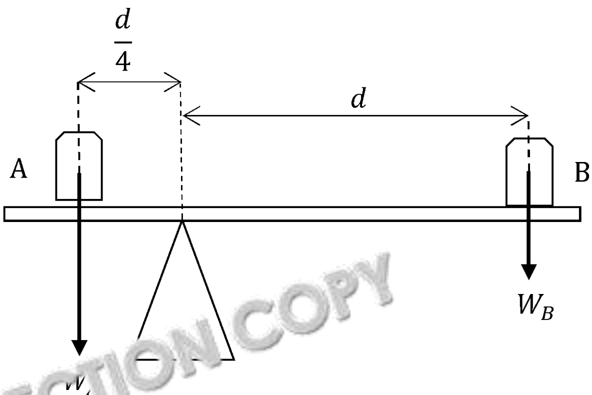
A. $\frac{p^2}{2}$

B. $\frac{2p^2}{m}$

C. $\frac{p^2}{2m}$

D. $\sqrt{\frac{2p}{m}}$

18. Two objects A and B of weight W_A and W_B respectively are placed at diffe
a horizontal plank resting on a pivot as shown below. Both objects have th
density of object A is three times more than the density of object B.



What happens to the system above?

A. More information is needed
B. It turns clockwise
C. It turns anticlockwise
D. It does not move

19. Which of the following is a perfectly elastic collision?

1: A collision between ideal gas molecules
2: A gas cylinder exploding in a room
3: The collision between two billiard balls

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

20. A bullet is fired at an angle of 20° to the horizontal. How, if at all, does air
of the bullet?

A. It does not change its trajectory
B. It only decreases the horizontal distance travelled by the bullet
C. It only decreases the vertical height reached by the bullet
D. It decreases both the horizontal distance and the vertical height of th

21. Which of the following does **not** increase when the driving force on a car i

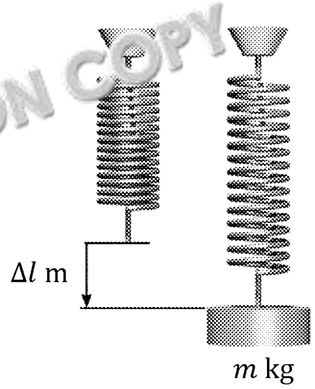
A. The resistance experienced by the car
B. The normal reaction force experienced by the car
C. The momentum of the car
D. The distance travelled by the car in 10 s

22. An 800 kg racing car initially travelling at 27 m s^{-1} is driven forward by a
85 N of resistive forces.

What is the velocity of the car after 15 s?

A. 30 m s^{-1}
B. 74 m s^{-1}
C. 29 m s^{-1}
D. 90 m s^{-1}

23. A mass m kg is hung from the end of a spring causing an extension Δl m.



What is the extension when a mass $\frac{3}{4}m$ kg is hung from the end of the sa

A. Δl m

B. $\frac{3}{4}\Delta l$ m

C. $\frac{4}{3}\Delta l$ m

D. $\frac{9}{16}\Delta l$ m

24. Which of the following gives the equivalent units for the area under a stre

A. J m^{-3}
B. J
C. J m^{3}
D. J^{-1} m^{3}

25. A copper cable has a diameter of 8.50 mm. The Young [illegible]odulus of copper
What force is required to produce a strain of 0[illegible]% inside the cable?

A. 2.66×10^{4} N
B. 1.06×10^{5} N
C. 2.06×10^{6} N
D. 8.[illegible]

26. 80 C of charge flow through a resistor in 15 minutes.

What is the current flowing through the resistor?

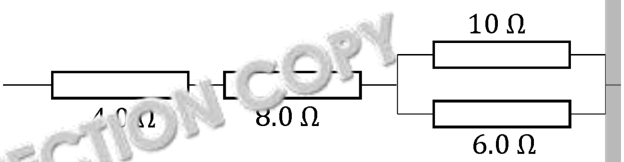
A. 0.089 A
B. 5.3 A
C. 20 A
D. 320 A

27. A resistor has a potential difference of 50 V across it.

The potential difference does work on 2.75×10^{19} electrons. What is the w

A. 220 J
B. 11 J
C. 18 J
D. 140 J

28. What is the total resistance of the resistors shown below?



A. 12 Ω
B. 1[illegible]
C. 2[illegible]
D. 28 Ω

29. A heater transfers 3.50 kW of heat to oxygen for one minute, causing 0.98 boiling point, -183 °C.

What is the specific latent heat of vaporisation for oxygen?

A. 1.16 kJ kg^{-1}
B. 17.4 kJ kg^{-1}
C. 104 kJ kg^{-1}
D. 213 kJ kg^{-1}

30. An aerosol canister has a pressure of 800 kPa at 20 °C and a volume of 2.5

How many moles of aerosol gas are contained in the canister?

A. 8.24×10^{-2} mol
B. 1.21 mol
C. 0.496 mol
D. 6.07×10^{-3} mol

31. A gas has a molecular weight of 16.0 g mol^{-1}.

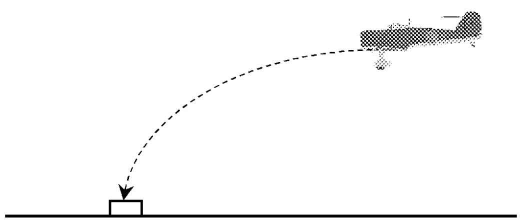
What is the root mean square speed of the molecules in the gas at 25.0 °C?

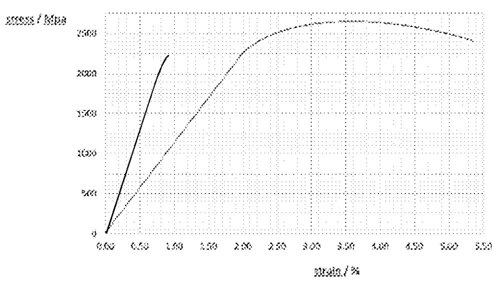
A. 277 [illegible] s^{-1}
B. 6[illegible] s^{-1}
C. 19[illegible] s^{-1}
D. 21.6 m s^{-1}

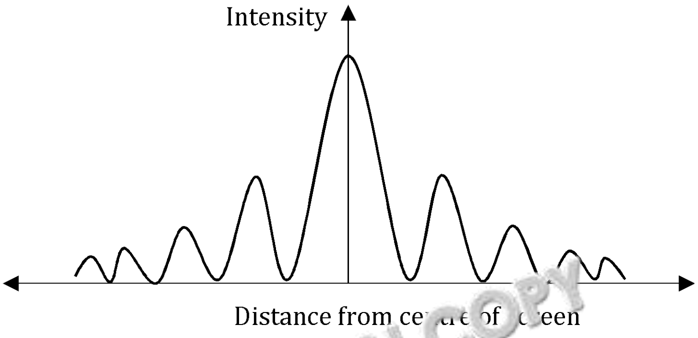
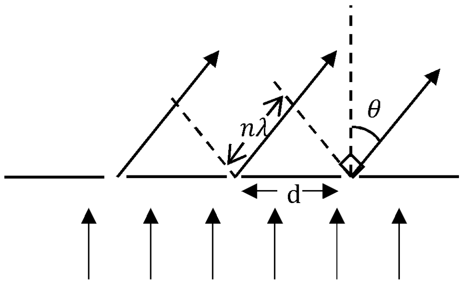
Preview of Questions Ends Here

This is a limited inspection copy. Sample of questions ends here to avoid students previewing questions before they are set. See contents page for details of the rest of the resource.

Mark Scheme: Set 1

Question	Answer	Marks
1.1	92 protons, 146 neutrons ✓	1
1.2	Specific charge $= \frac{\text{charge}}{\text{mass}}$ ✓ $= \frac{92 \times 1.60 \times 10^{-19}}{(92 \times 1.673 \times 10^{-27}) \times (146 \times 1.675 \times 10^{-27})}$ $= 3.69 \times 10^{7}$ C kg^{-1} ✓	1 1
1.3	$X = 234$ ✓ $Y = 90$ ✓	1 1
1.4	$82 = 92 - (8 \times 2) + \beta$ ✓ 6 β decays ✓	1 1
1.5	Repulsive at short distances (under 0.5 fm) ✓ Attractive at larger distances (over 0.5 fm) ✓	1 1
1.6	Any one from: ✓ Lead–lined container Reduce exposure time Use only small quantities of radioactive material Protective clothing Protective screen	1
2.1	Parabolic shape as shown ✓ 	1
2.2	$s = ut + \frac{1}{2}at^2$ $t = \sqrt{\frac{2s}{a}}$ $t = \sqrt{\frac{2 \times 400}{9.81}}$ ✓ $t = 9.03$ s ✓	 1 1
2.3	$d = vt$ $d = 68 \times 9.03$ $d = 614$ m ✓	 1
2.4	Use of $v^2 = u^2 + 2as$ ✓ $v = \sqrt{u^2 + 2as}$ $v = \sqrt{0 + 2 \times 9.81 \times 400}$ $v = 88.59$ m s^{-1} ✓ Use of $p = mv$ $p = 650 \times 88.59$ $p = 57\,600$ kg m s^{-1} ✓	1 1 1
2.5	$F = \frac{\Delta p}{\Delta t}$ $F = \frac{57{,}580 - 0}{80 \times 10^{-3}}$ ✓ $F = 720$ kN ✓	 1 1

Question	Answer	Marks
2.6	Increases the time over which the impact occurs ✓ Reduces the force on the crate and, therefore, on the food ✓	1 1
3.1	The maximum stress a material is able to withstand before it breaks ✓	1
3.2	(From graph) Breaking stress = 2350 MPa ✓ 18.1 cm² = $18.1 \times (10^{-2})^2 = 18.1 \times 10^{-4}$ m $F = stress \times area$ $= 2350 \times 10^6 \times 18.1 \times 10^{-4}$ $= 4.25 \times 10^6$ N ✓	1 1
3.3	Attempt to calculate gradient of straight line of graph ✓ Young modulus = $\frac{2250\times10^6}{0.02}$ = 1.13 × 10¹¹ Pa =113 ✓ GPa ✓	1 1 1
3.4	Strain energy density OR energy per unit volume ✓	1
3.5	Steeper gradient ✓ Fractures at 2250 MPa ✓ 	1 1
4.1	$\epsilon = IR$ ✓	1
4.2	Potential difference gained in cell is equal to potential difference drop across circuit ✓ Potential difference is energy gained per unit charge ✓	1 1
4.3	$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2}$ $\frac{1}{R_{total}} = \frac{1}{48} + \frac{1}{32}$ ✓ $\frac{1}{R_{total}} = \frac{5}{96} (= 0.052\ \Omega)$ $R_{total} = 19.2\ \Omega$ ✓	 1 1
4.4	$\varepsilon = I(R + r)$ ✓ $\varepsilon = 1.6 \times (19.2 + 0.8)$ ✓ $\varepsilon = 32$ V	1 1
4.5	$E = I^2 rt$ $E = 1.6^2 \times 0.8 \times 60 \times 60$ ✓ $E = 7400$ ✓	 1 1
4.6	(Lower internal resistance) dissipates less power ✓ Phone has longer useful battery life ✓	1 1

Question	Answer	Marks
5.1	Bright central maximum ✓ Several dimmer fringes separated by minima ✓  	1 1
5.2	Longer wavelength: Wider central spot ✓ Wider slit: Narrower central spot ✓	1 1
5.3	Wavefronts at right angle to direction of beam from diffraction grating ✓ Path difference is distance between wavefronts ✓  	1 1
5.4	Any one from: ✓ Spectroscopy Used in lasers Isolating a single wavelength of light (monochromators)	1
5.5	$n\lambda = d\sin\theta$ $\theta = \sin^{-1}\frac{n\lambda}{d}$ ✓ $\theta = \sin^{-1}\frac{2\times350\times10^{-9}}{1\times10^{-3}/100}$ ✓ $\theta = 4.01\,°$ ✓	 1 1 1
6.1	Any two from: ✓✓ (A particle made up of) three quarks Affected by the strong force Baryon number of 1	MAX 2
6.2	(Three quarks, from above) $s = -1$, one strange quark ✓ $Q_{total} = +1$, $Q_s = -\frac{1}{3}$ Charge of other two quarks in Σ^+, $Q_{total} - Q_s = 1 - -\frac{1}{3} = \frac{4}{3}$ $Q_{total} - Q_s = \frac{4}{3} = 2\times\frac{2}{3}$ i.e. charge of two up quarks ✓ Quark composition: uus / two up quarks, one strange quark✓	 1 1 1
6.3	Conserved: Two from baryon number B, charge Q, lepton number L ✓ Not conserved: s ✓	1 1
6.4	Weak (nuclear force) ✓	1
6.5	Muon neutrino, ν_μ ✓	1

7. B
8. D
9. B
10. C
11. D
12. B
13. A
14. D
15. C
16. D
17. B
18. D
19. C
20. D
21. C
22. A
23. D
24. D
25. C
26. B
27. D
28. B
29. C
30. D
31. A

Preview of Answers Ends Here