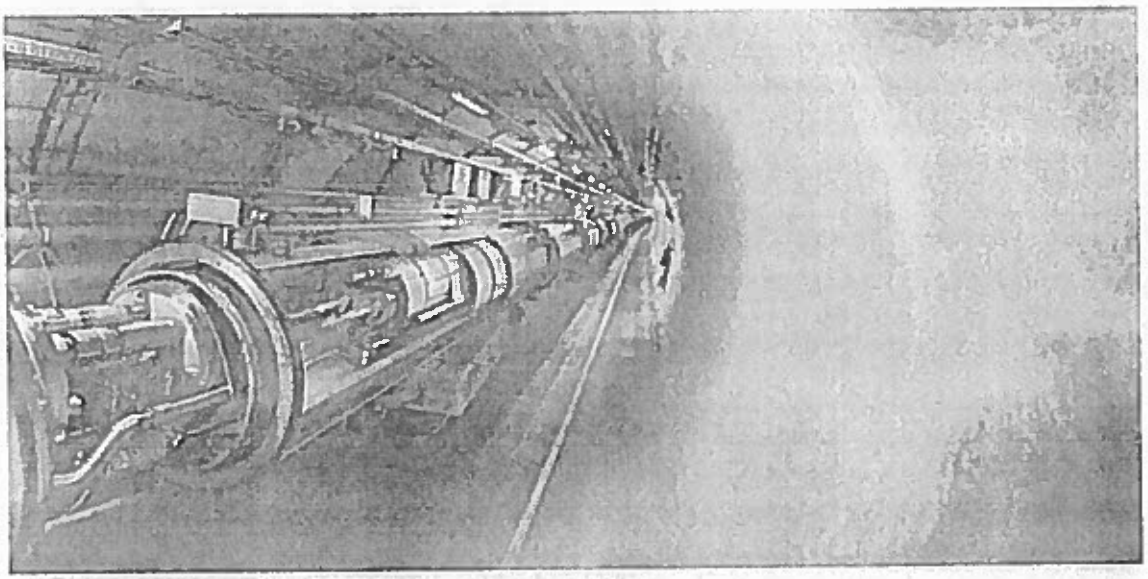
A-Level Physics Induction and Transition Pack 2019

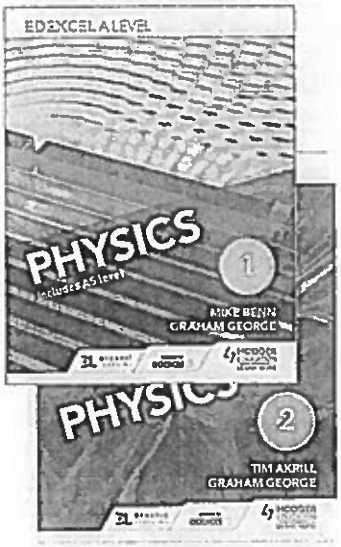


All About the course……

Specification:

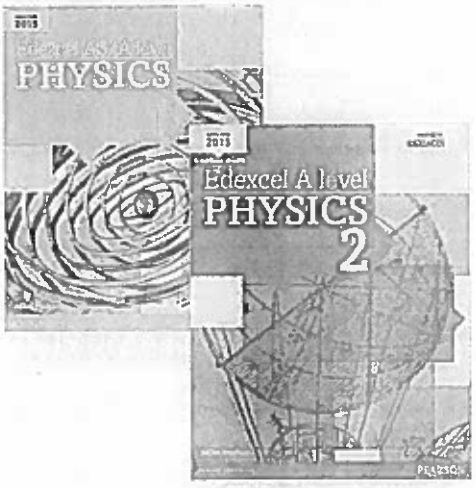
- You will be studying the Edexcel Physics Specification A course
- You can find the entire specification at www.edexcel.com

Textbooks



You will be issued with a copy of these textbooks to support your study in September – these cover content from both Y12 and Y13 – please note it is not board specific and therefore some of the topics are not relevant to our course.

You may want to buy an additional textbook to help with your wider reading, and to get a different style of explanation …..



Course Overview .....

Year	Topic	Title	Y12 Paper	Y13 Paper	Sub Topics
12	1	Mechanics	1	1	Newton's laws and momentum
					Projectile motion
					Work, energy and power
	2	Electricity	1	1	Circuits
					Potential dividers
					Electromotive force
	3	Materials	2	2	Young's modulus
					Hooke's Law
					Stokes' theorem
	4	Waves and particle nature of light	2	2	Stationary and progressive waves
					Snell's law
					Lenses
					Diffraction
					Photoelectric effect
13	5	Further Mechanics		1	Circular motion
					Momentum in 2D
	6	Electric and magnetic fields		1	Coulomb's law
					The motor effect
					Electromagnetic induction
					Capacitance
	7	Nuclear and particle physics		1	Nuclear model
					Classification of particles
					Particle accelerators
	8	Thermodynamics		2	Ideal gas equation
					Black body radiation
	9	Space		2	Life cycle of a star
					Time dilation
					Luminosity
	10	Nuclear radiation		2	$E= mc^2$
					Nuclear fusion
	11	Gravitational fields		2	Newton's laws of gravitation
					Orbital motion
	12	Oscillation		2	Simple harmonic motion
					Damping effect

Core Practicals ..... **You will have to be able to demonstrate competence in each of the following skills to pass the practical endorsement**

CPAC Skill	What is being assessed
1a	Correctly follows instructions to carry out the experimental techniques or procedures
2a	Correctly uses appropriate instrumentation, apparatus, materials (including ICT) to carry out investigative activities, experimental techniques and procedures with minimal assistance or prompting
2b	Carries out techniques or procedures methodically, in sequence and in combination, identifying practical issues, and making adjustments where necessary
2c	Identifies and controls significant quantative variables where applicable, and plans approaches to take account of variables that cannot readily be controlled
2d	Selects appropriate equipment and measurement strategies in order to ensure suitably accurate results
3a	Identifies hazards and assesses risks associated with these hazards, making safety adjustments as necessary, when carryign out experimental techniques or procedures in the lab or field
3b	Uses appropriate safety equipment and approaches to minimise risks with minimal prompting
4a	Makes accurate observations relevant to the experimental or investigative procedure
4b	Obtains accurate, precise and sufficient data for experimental and investigative procedures and records this methodically using appropriate units and conventions
5a	Uses appropriate software and/or tools to process data, carry out research and report findings
5b	Sources of information are cited demonstrating that research has taken place, supporting planning and conclusions

Core Practicals ..... You must show evidence of completing each of these – you will be assessed on them in the written exams.

	Core Practical
1	Determine the acceleration of a freely falling object
2	Determine the electrical resistivity of a material
3	Determine the e.m.f. and internal resistance of an electrical cell
4	Use a falling-ball method to determine the viscosity of a liquid
5	Determine the Young modulus of a material
6	Determine the speed of sound in air using a 2-beam oscilloscope, signal generator, speaker and microphone
7	Investigate the effects of length, tension and mass per unit length on the frequency of a vibrating string or wire
8	Determine the wavelength of light from a laser or other light source using a diffraction grating
9	Investigate the relationship between the force exerted on an object and its change of momentum
10	Use ICT to analyse collisions between small spheres, e.g. ball bearings on a table top
11	Use an oscilloscope or data logger to display and analyse the potential difference (p.d.) across a capacitor as it charges and discharges through a resistor
12	Calibrate a thermistor in a potential divider circuit as a thermostat
13	Determine the specific latent heat of a phase change
14	Investigate the relationship between pressure and volume of a gas at fixed temperature
15	Investigate the absorption of gamma radiation by lead
16	Determine the value of an unknown mass using the resonant frequencies of the oscillation of known masses

Diagnostic Test 1

1. Write the following number in standard form: 4,580,000 **(Skill 0.2)**

2. Write the following number as a whole number: 9.36×10^4 **(Skill 0.2)**

3. Convert 151° into radians **(Skill 4.7)**

4. Convert 0.15 radians into degrees **(Skill 4.7)**

5. State the equation for determining the area of the following shapes: **(Skill 4.3)**
   a) Circle
   b) Right-angled triangle

6. Write the following numbers to 4 significant figures: **(Skill 1.1)**
   a) 402,369.2
   b) 0.2048539

7. State the SI base units of the following physical quantities: **(Skill 0.1)**
   a) Mass
   b) Length
   c) Current
   d) Power

8. Evaluate x in the following equations. Assume that each equation is working in degrees.
   a) $\sin x = 0.630$
   b) $\cos 32 = x$
   c) $\tan 156 = x$ **(Skills 0.6, 2.1)**

9. The temperature of the sun is 5778 K.
   a) Write the temperature of the sun in standard form **(Skills 0.1, 0.2)**
   b) Write the value for the temperature of the sun to 3 significant figures **(Skills 0.1, 1.1)**

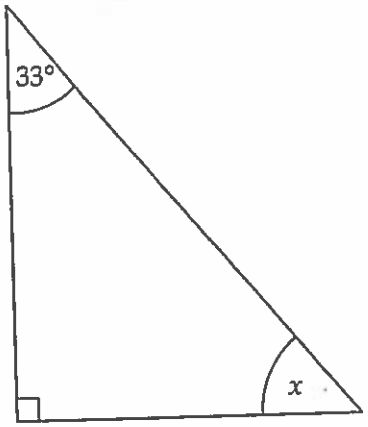
10. Explain in words the following mathematical statements: **(Skill 2.1)**
    a) $A \propto \Delta B$
    b) $C \leq D < E$
    c) $F \gg G \geq H$

11. Find the missing angle $x°$ in the following triangles.

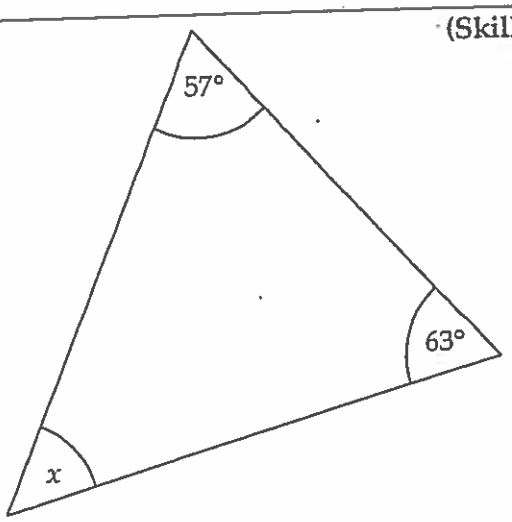
Note: the following diagrams are not to scale.

(Skills 0.1, 4.1)

a)

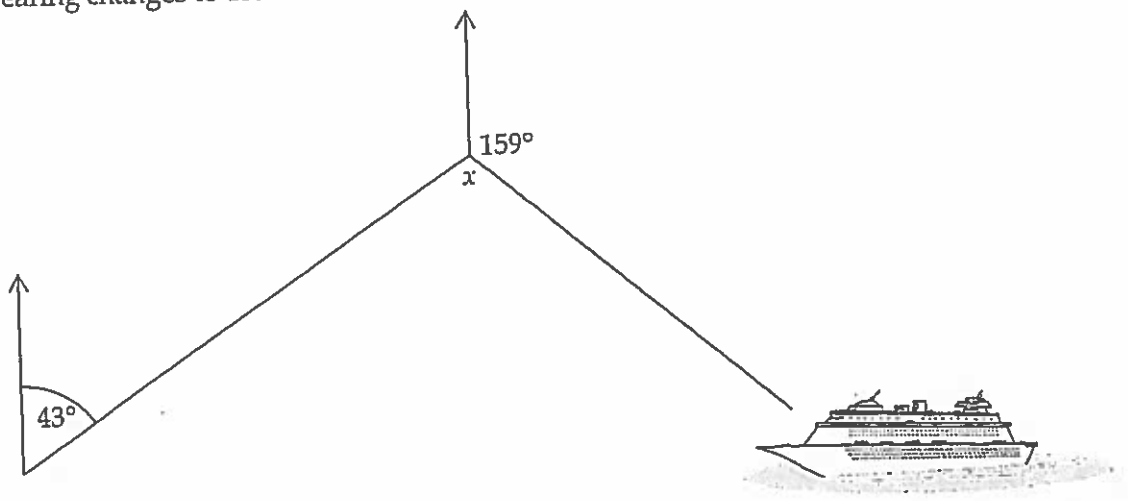


b)



12. A boat is travelling on an initial bearing of 43° and then changes course due to bad weather.

The boat bearing changes to 159°.



Determine the angle $x°$.

(Skills 0.1, 0.5, 2.4, 2.1)

13. Given that $P = I^2R$ and $I = 3$ A and $R = 14.0\ \Omega$, find P.

14. Given the following results for frequency f and wavelength λ

$$f = 2.3 \pm 0.1\ \text{Hz};\ \lambda = 0.02 \pm 0.01\ \text{m}$$

a) State the absolute uncertainty of f (Skills 0.1, 1.5)

b) State the absolute uncertainty of λ (Skills 0.1, 1.5)

c) Determine the velocity of the wave with the equation $v = f\lambda$ (Skills 2.1, 2.2, 2.3)

15. A Physics student measured value for density of a block to be $56.9 \pm 0.2\ \text{kg m}^{-3}$.

Determine the percentage uncertainty in the value for density. (Skills 0.1, 0.3, 1.5)

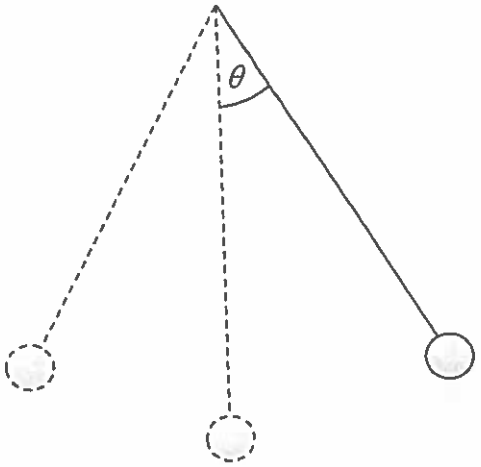
16. A lab technician measures the length of an electrical wire to be 0.21 m.

The lab technician measures the length of the wire again a few hours later and obtains 0.22 m.

Determine the percentage change in the measured value for length of the wire.

(Skills 0.1, 0.3, 0.5)

17. When we discuss a pendulum swinging, we don't discuss the distance it has swung through in metres m but through an angle θ.



The equation for determining the angle the pendulum has swung through is given by:

$$\theta = A\sin xt$$

where $A = 3.40$ m, $x = 4.60$ m and $t = 1.70$ s.

Calculate the angle the pendulum has swung through using the equation above.

(Skills 0.1, 0.6, 2.1, 2.3, 2.4)

18. In physics, we use the equations of motion to determine how an object is moving.

The equation for determining the final velocity of an object is:

$$v^2 = u^2 + 2as$$

where v is the final velocity of an object, u is the initial velocity, a is the acceleration of the object and s is the displacement travelled by the object.

If a cyclist is initially cycling at $5.8\ ms^{-1}$, and begins to accelerate at $0.80\ ms^{-2}$ for 10 m,

d) What will the final velocity (v) of the cyclist be after 10 m? **(Skills 0.1, 2.1, 2.3, 2.4)**

19. An astronomer is attempting to determine the velocity of our galaxy.

She obtains the following measurements:

Velocity (kmh^{-1})					
v_1	v_2	v_3	v_4	v_5	v_6
828×10^3	827×10^3	824×10^3	827×10^3	826×10^3	824×10^3

Calculate the mean of the astronomer's results. **(Skills 0.1, 1.2, 1.4)**

20. Using your knowledge of probability, explain how the process of throwing dice can represent the process of radioactive decay. **(Skill 1.3)**

21. A charged particle gains energy as it travels between two electrically charged plates.

The equation for the energy gained is:

$$E_k = \frac{1}{2}mv^2$$

a) State the SI base unit for energy. **(Skill 0.1)**

A charged particle of mass 1.67×10^{-27} kg travels at a velocity of 2.30×10^5 ms^{-1} between two charged plates.

b) Use the energy equation to determine the energy gained by the particle as it travels between the plates. Give your answer in standard form.

c) Write your answer to (b) using a prefix. **(Skills 0.3, 0.5, 1.4, 2.1, 2.3, 2.4)**

22. A spring with a spring constant $k = 3.0 \times 10^4$ Nm^{-1} is extended by 20 cm.
A force must have been acting on the spring in order to extend it. The force is given by the equation:

$$F = kx$$

where x is the extension length and k is the spring constant.

a) Calculate the force exerted on the spring.
b) Convert your answer to (a) into kN. **(Skills 0.1, 0.5, 2.1, 2.3, 2.4)**

23. The equation for the gravitational potential energy a planetary object possesses is given by:

$$U = -\frac{GMm}{r}$$

where M and m both represent the mass of a planetary object and r is the distance between them.

Note: G is a gravitational constant given by 6.67×10^{-11} Nm^2 kg^{-2}

a) Estimate the mass of Earth (m) and the distance between the Sun and Earth (r).
b) Using (a), estimate the gravitational potential energy Earth possesses as a result of the Sun's gravitational field.

Note: the mass of the Sun is 1.99×10^{30} kg.

c) What is your answer to (b) in kJ?
d) Write your answer to (b) to 1 significant figure.

(Skills 0.1, 0.3, 0.4, 1.1, 1.4, 2.1, 2.3, 2.4)

Diagnostic Test 2

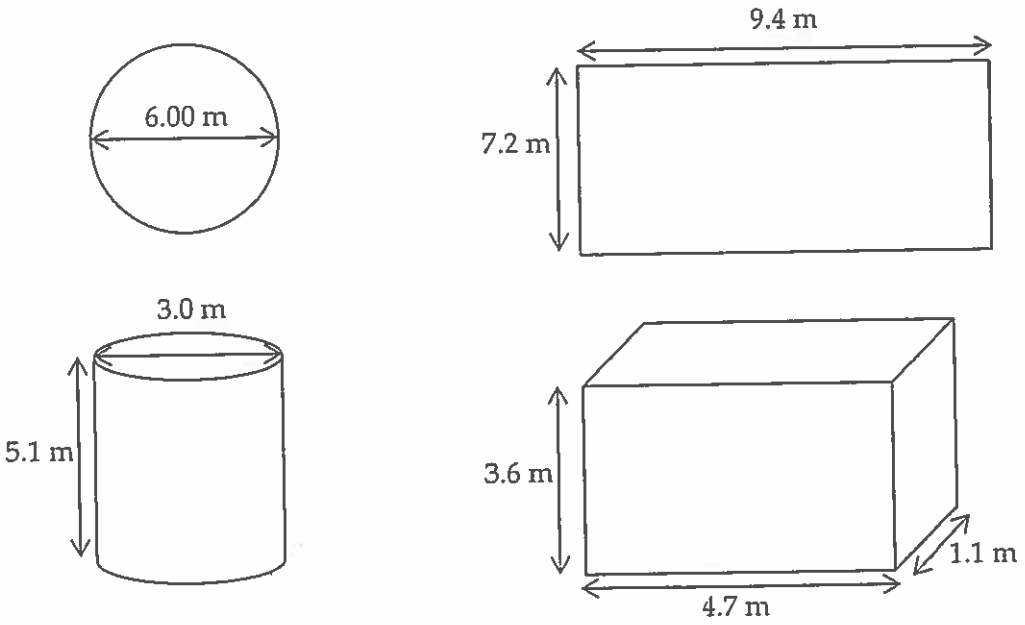
1. Write the following number in standard form: 236,900,000 **(Skill 0.2)**

2. Write the following number as a whole number: 6.31×10^{-3} **(Skill 0.2)**

3. Convert 68° into radians **(Skill 4.7)**

4. Convert 1.28 radians into degrees **(Skill 4.7)**

5. Determine the area/volume of the following shapes: **(Skills 0.1, 4.3)**



6. Write the following numbers to 6 significant figures: **(Skill 1.1)**

   a) 53021.59
   b) 0.0365821
   c) 0.00000023

7. State the SI base units of the following physical quantities: **(Skill 0.1)**

   a) Amount of a substance
   b) Resistance
   c) Volume
   d) Time

8. Evaluate x in the following equations: **(Skills 0.1, 0.6, 2.1)**

   a) $\cos x = 0.69$
   b) $\sin 89 = x$
   c) $\tan x = 0.47$

9. The universe is 13,820,000,000 years old.

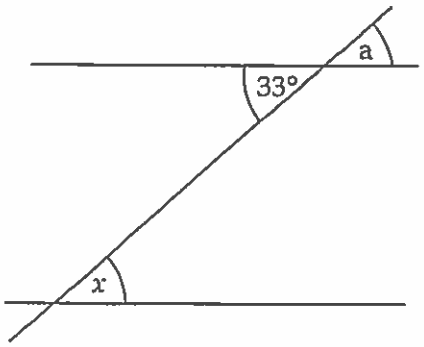
   a) Write the age of the universe in standard form. **(Skills 0.1, 0.2)**
   b) Write the value for the age of the universe to 3 significant figures **(Skills 0.1, 1.1)**

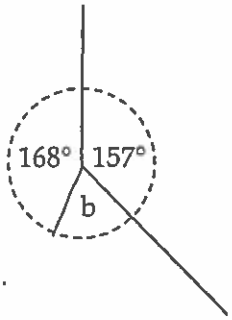
10. Explain in words the following mathematical statements:

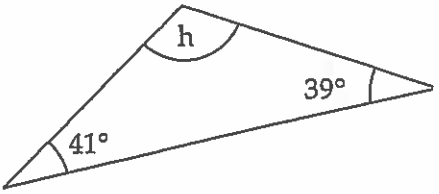
   a) $A \ll B \ll \Delta C$ **(Skill 2.1)**
   b) $C \leq \frac{\Delta D}{\Delta E}$ **(Skills 0.3, 2.1)**
   c) $F \propto x$ if $x \geq 3$ **(Skill 2.1)**

11. Find the missing angles: **(Skill 4.1)**

Note: the following diagrams are not to scale.

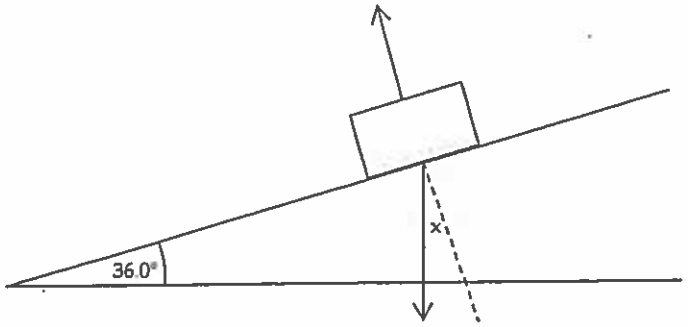






12. A rally car company draws a force diagram of the forces acting on the car as it banks a corner to assess its movement.

   The angle x is missing from the force diagram.



   a) Using your knowledge of angles, evaluate the missing angle x. **(Skills 0.1, 0.6, 2.2, 2.3, 4.2)**

   If the rally car parks on a slope without its handbrake on it will slide down the slope due to gravity. The acceleration at which is slides due to gravity is given by the equation:

$$a = g \sin x$$

   b) Using your answer to (a) determine the acceleration down the slope. **(Skills 2.3, 2.4)**

Note: You can assume that the friction between the tyres and the road is negligible.

13. Given that $s = ut + \frac{1}{2}at^2$ and $u = 2.50\ \text{ms}^{-1}$, $t = 150\ \text{s}$ and $a = 0.200\ \text{ms}^{-2}$, find s.

(Skills 0.1, 0.3, 2.1, 2.3, 2.4)

14. Given the following results for frequency F and wavelength v:

$$F = 150 \pm 1\ \text{N};\ \text{v} = 3.3 \pm 0.1\ \text{ms}^{-1}$$

a) State the absolute uncertainty of F (Skills 0.1, 0.3, 1.5)
b) State the absolute uncertainty of v (Skills 0.1, 0.3, 1.5)
c) Determine the velocity of the wave with the equation $P = Fv$ (Skills 0.1, 0.3, 2.3)

15. A Physics student obtains the following measurement for resistance: $0.02 \pm 0.005\ \Omega$

Determine the percentage uncertainty of the value for resistance. (Skills 0.1, 0.3, 1.5)

16. A research group is completing experimental tests into the correlation between pressure and force.

The group exerts a constant force on a table and measures the resulting pressure on the table as $30 \pm 2\text{Pa}$.

The group increases the force exerted and the measurement for pressure increases to $35 \pm 2\,\text{Pa}$.

Determine the percentage increase from the first reading in the measured value for pressure.

(Skills 0.1, 0.3, 1.5)

17. Charged particles accelerate between electrically charged plates.

The potential difference V between the plates is determined using the charge and velocity of the charged particle:

$$V = \frac{mv^2}{2e}$$

An electron ($m_e = 9.11 \times 10^{-31}$ kg; $e = 1.6 \times 10^{-19}$ C) travels at $2.98 \times 10^6\ \text{ms}^{-1}$ between two charged plates.

Determine the potential difference between the plates. (Skills 0.1, 0.3, 1.4, 2.1, 2.3, 2.4)

18. An energy company completes operational testing into the efficiency of one of its machines.

It repeated the test a number of times and achieved the following results:

E_1	E_2	E_3	E_4	E_5	E_6
98.6%	98.9%	98.7%	98.9%	98.2%	98.5%

Calculate the mean of the energy company's results for energy efficiency. (Skills 0.1, 0.3, 1.2)

19. Ohm's law states that, for any electrical component:

$$V \propto I$$

if the resistance of the component is constant.

a) Explain the mathematical statement $(V \propto I)$ given for Ohm's law.

The equation form of Ohm's law is:

$$V = IR$$

A bulb in an electrical circuit has 2.30 A flowing through it and has a resistance of 100 Ω.

b) Calculate the potential difference across the bulb. **(Skills 0.1, 0.2, 2.1, 2.3)**

20. A student has a set of 140 square dice. The student rolls the dice and removes any dice that land with the number 4 facing upwards. The student rolls the remaining dice and repeats the process.

Explain why this process is a useful model for representing the random behaviour of radioactive decay.

21. All masses produce a gravitational field and this field exerts a force on any other planetary objects that enter this field.

The force between can be determined using the following equation:

$$F = -\frac{GMm}{r^2}$$

where M is the mass of the larger of the two masses, m is the mass of the smaller mass, r is the distance between the two masses and G is the gravitational constant 6.67×10^{-11} $\text{Nm}^2\,\text{kg}^{-2}$.

a) Estimate the mass of the Earth (M) and the distance between the Earth and the Moon (r).
b) Use your answer to (a) and estimate the gravitational force between the Earth and the Moon ($m_M = 7.35 \times 10^{22}$ kg).
c) Give your answer to (b) in kN.
d) Write your answer to (b) to 2 significant figures.

(Skills 0.1, 0.3, 1.4, 2.1, 2.3, 2.4)

