National 5

Questions by Topic

ANSWER BOOKLET

Based on Past SQA Papers 2000 - 2008

Electricity and Energy

Conservation of Energy

Source	Question	Answer
2002 Int 2	4	C
2003 Int 2	3	E
2005 Int 2	5	E
2004 Int 2	21. (a)	Ep = 2.4 J
	(b)	v = 2 ms^{-1}
2007 Int 2	21. (a)	(i) v = 0.16 ms^{-1} (ii) W = 600 N (iii) Ep = 1920 J
	(b)	(i) v = 8 ms^{-1} (ii) actual speed is less since not all Ep is converted into Ek
2008 Int 2	24. (a)	Ep = 54 000 J
	(b)	(i) 54 000 J (ii) v = 12 ms^{-1}

Electric Charge Carriers and Electric Fields

Source	Question	Answer
2002 Int 2	11	B
2005 Int 2	7	D
	9	C
2006 Int 2	26. (a)	in d.c. electrons/charges move in one direction only in a.c. direction of movement of electrons/ charges continually reverses

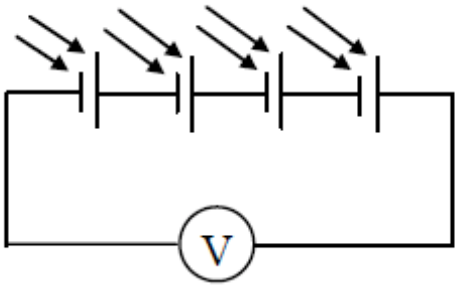
Potential Difference (Voltage)

Source	Question	Answer
2001 Int 2	9	C
2004 Int 2	11	D
2006 Int 2	7	A

Source	Question	Answer
	9	D
2007 Int 2	7	C
	14	A
2000 Int 2	27. (a)	(i) MOSFET (ii) Voltage (or potential) divider
	(b)	(i) 2.0 V (Range 2.0 - 2.1 V) (ii) R_1 = 5.71 kΩ

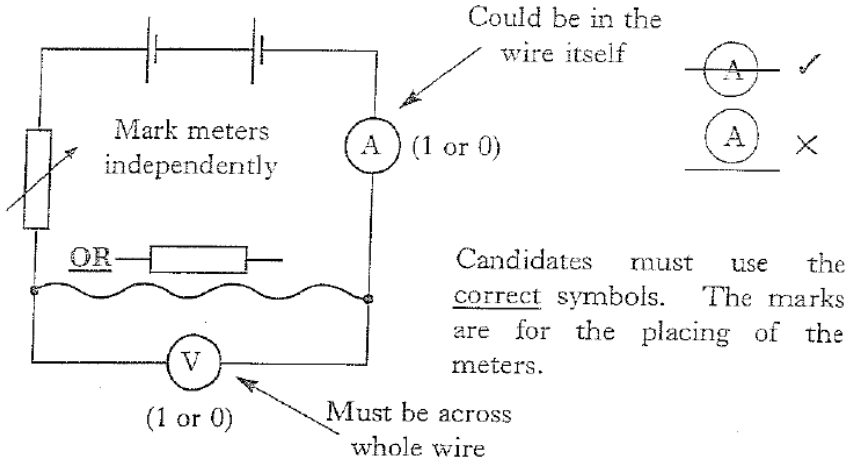
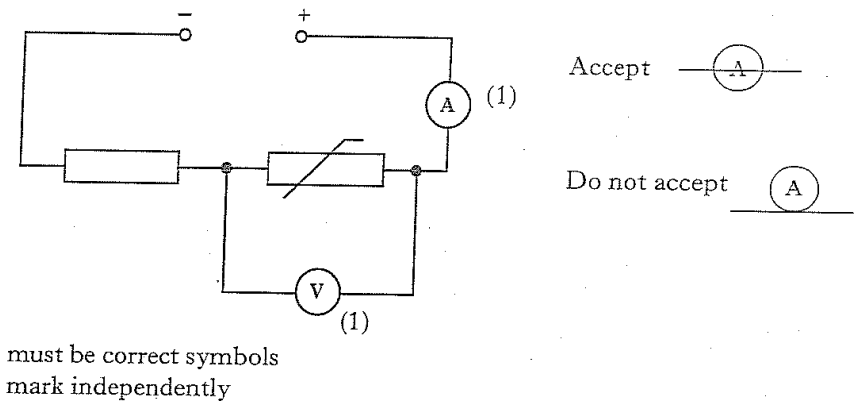
Practical Electrical and Electronic Circuits

Source	Question	Answer
2000 Int 2	11	D
2001 Int 2	13	E
	14	C
2002 Int 2	10	B
	12	A
2003 Int 2	8	E
	15	A
2004 Int 2	14	E
2005 Int 2	11	A
	13	B
2006 Int 2	8	B
	10	D
2008 Int 2	8	D
	9	C
	10	D
2000 Int 2	26. (b)	(i) Resistor (ii) R = 355 Ω
2001 Int 2	25. (a)	230 V supplied to each lamp
	(b)	R = 265 Ω

Source	Question	Answer
	(c)	I = 2.61 A
2006 Int 2	26. (d)	Q
	(e)	Q and P
	27. (a)	225 (within 220 - 230)
	(b)	so that meter measures the same brightness as the solar cell receives
	(c)	
2008 Int 2	28. (a)	(i) to limit the voltage across the LED (ii) R = 500 Ω (iii) I = 0.2 A

Ohm's Law

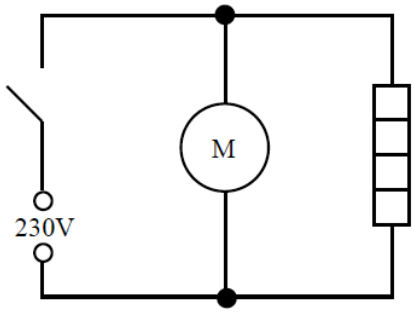
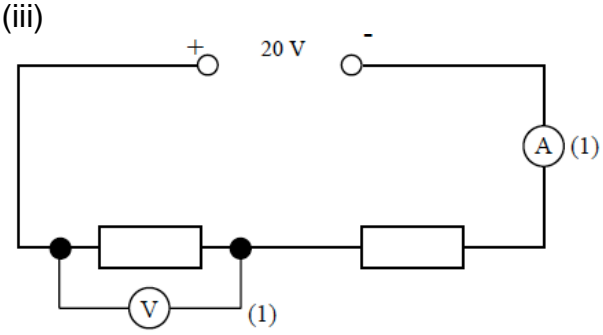
Source	Question	Answer
2000 Int 2	10	A
	14	D
2002 Int 2	15	D
2003 Int 2	11	C
2004 Int 2	8	C
	9	D
	10	C
	13	B
2006 Int 2	13	D
2007 Int 2	8	D
	9	B

Source	Question	Answer
2000 Int 2	25. (a)	
	(b)	(i) Use variable resistor (to change current in the circuit) Take voltmeter and ammeter readings For each setting of the variable resistor. (ii) R = 20 Ω
	(c)	R = 1.5 Ω
2001 Int 2	27. (a)	
	(b)	R = 120 Ω, R = 123 Ω, resistance increases when force applied
	(c)	
2002 Int 2	25. (a)	(i) V_1 = 1.8 V; V_2 = 1.2 V (ii) Vs = 3.0 V
	(b)	R = 3000 Ω
	(c)	light intensity is increasing, V_1 is increasing, resistance of LDR is increasing
	(d)	V_2 is below 0.7 V between 20 s and 50 s transistor is switched off
2003 Int 2	25. (a)	Calculations and statement that as V increases R decreases

Source	Question	Answer
	(b)	(i) 1.6 V (ii) R = 170 Ω

Electrical Power

Source	Question	Answer
2001 Int 2	8	A
	10	C
	11	C
2002 Int 2	9	A
	13	C
	14	E
2003 Int 2	9	D
2005 Int 2	14	B
2006 Int 2	11	B
2007 Int 2	13	B
2008 Int 2	11	D
2002 Int 2	26. (a)	I = 0.174 A
	(b)	R = 1322.5 Ω
	(c)	Position 1 has the maximum voltage (current) across (through) the motor
	(d)	R = 200 Ω
2003 Int 2	24. (a)	R = 46 Ω
	(b)	(i) 23 V (ii) If one lamp breaks the others go out too
	(c)	(i) R = 4.6 Ω
2004 Int 2	23. (a)	P = 4 200 W
	(b)	P = 6 400 W
	(c)	65.6%

Source	Question	Answer
	(d)	power supplied will have to be greater to give kinetic energy to wheel
	27. (a)	R = 92 Ω
	(b)	
	(c)	no effect on speed since 230V still across motor
2005 Int 2	25. (a)	(i) I = 0.5 A (ii) V = 7.5 V (iii) 
	(b)	P = 2.56 W
2008 Int 2	25. (a)	I = 0.2 A
	(b)	(i) R = 20 Ω (ii) P = 1.35 W; P = 2.7 W (iii) 30 Ω resistor will over heat
	(c)	none

Specific Heat Capacity

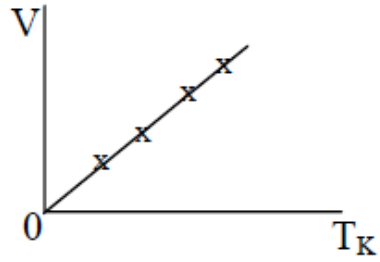
Source	Question	Answer
2000 Int 2	8	E
2002 Int 2	8	B
2008 Int 2	7	A
2000 Int 2	24. (a)	I = 2500 A

Source	Question	Answer
	(b)	$P = 2.5 \times 10^7$ W
	(c)	(i) $\Delta t = 77.9^oC$ (ii) No loss of heat (energy) to the surroundings
2001 Int 2	24. (a)	Eh = 121 kJ
	(b)	t = 1210 s
2002 Int 2	24. (b)	E = 4500 J
	(c)	Eh = 4053 J
	(d)	heat energy lost to the surroundings
	(e)	heat → electrical
2004 Int 2	24. (a)	electrical → heat
	(b)	resistance wire or resistor
	(c)	Eh = 4 800 J
	(d)	P = 20 W assuming no heat loss to surroundings
2006 Int 2	24. (a)	Eh = 376200 J
	(b)	1068 ^oC
	(c)	no heat lost to the surroundings
	(d)	greater specific heat capacity less heat required per degree temperature rise
2007 Int 2	23. (a)	(i) $Eh = 3.34 \times 10^6$ J (ii) t = 134 s (iii) some heat is lost to the surroundings
	(b)	I = 10.9 A
	(c)	$Eh = 2.71 \times 10^6$ J

Gas Laws and the Kinetic Model

Source	Question	Answer
2000 H	6	D
	7	A
2001 H	7	B

Source	Question	Answer
2002 H	7	A
2003 H	7	E
2004 H	7	A
	9	E
2005 H	6	B
2006 H	7	E
2008 H	7	D
2001 H	22. (b)	(i) $P = 2.25 \times 10^{-5}$ Pa (ii) The mass of the gas trapped is constant. (iii) Pressure is caused by the gas particles exerting a force on the walls of the container. When the volume of the container decreases there is an increase in the collision rate, meaning that more force is exerted on the container walls. This increases the pressure as pressure is a measure of force per unit area (P = F/A).
2002 H	22. (a)	P = 120.35 kPa
	(b)	As the temperature increases the nitrogen gas molecules gain kinetic energy. With increased kinetic energy the atoms are moving faster and collide with the container walls more frequently and forcefully. The pressure(force/area) therefore increases.
	(c)	(i) F = 0.7 N (ii) l = 35 mm
	(d)	The assumption in the original set up is that the temperature of the water is the same as the temperature of the gas inside the flask. Placing the thermometer inside the flask will give a more direct and accurate reading of the gas temperature.

Source	Question	Answer
2005 H	24. (a)	(i)  or calculations showing V/T = constant (ii) V = 23.3 ml (iii) As the temperature increases the particles move faster; the particles hit the wall harder; the volume increases; keeping the pressure constant
2006 H	23. (a)	(i) T = 241 K (ii) Speed of air particles decreases; collisions with walls softer and less frequent; pressure decreases
	(b)	(i) F = 360 N (ii) F = 645 N (iii) air passes into the box; pressure inside the box is the same as outside; resultant force on lid is reduced
	(c)	3 panels minimum
2007 H	23. (a)	V = 0.48 m^3
	(b)	20 balloons
2008 H	23. (a)	(i) P = 2.68×10^6 Pa
	(b)	(ii) Fewer particles inside the container so fewer collisions with the wall per second (iii) gas has reached atmospheric pressure

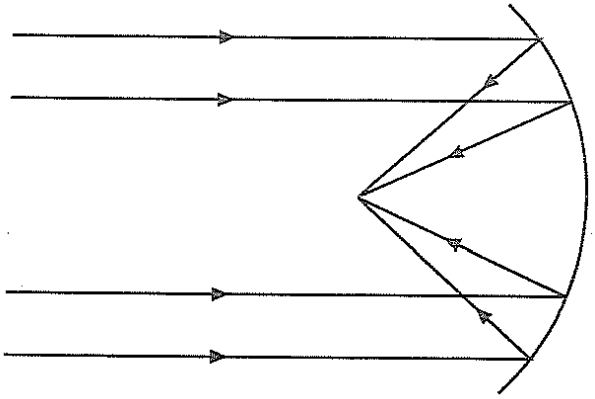
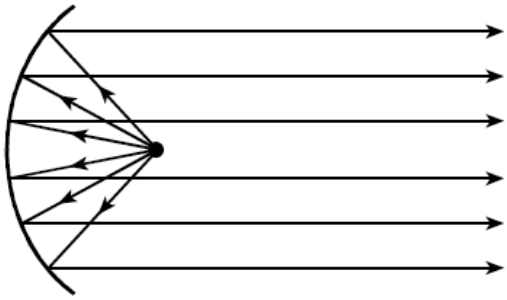
Waves and Radiation

Wave Parameters and Behaviours

Source	Question	Answer
2001 Int 2	16	C
	17	B
2002 Int 2	16	B
2003 Int 2	17	D
	18	E
2004 Int 2	16	D
2005 Int 2	12	A
	15	B
2006 Int 2	15	E
2008 Int 2	14	B
2002 Int 2	28. (a)	energy lost
	(b)	6 ms
	(c)	d = 1.02 m
	(d)	λ = 0.272 m
2005 Int 2	28. (a)	λ = 0.85 m
2006 Int 2	22. (c)	(i) f = 0.0625 Hz (ii)λ = 200 m
2007 Int 2	28. (a)	(i) Q (ii)Q
	(b)	(i) λ = 0.17 m (ii)t = 0.06 s
	(c)	wavelength decreased speed of sound slower

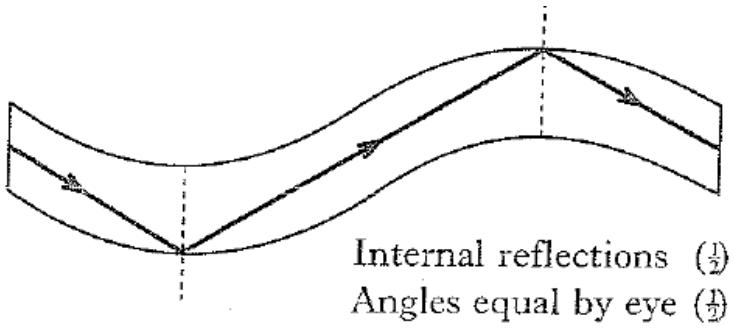
Electromagnetic Spectrum

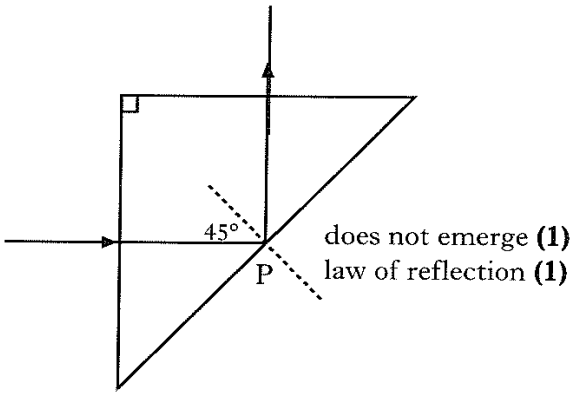
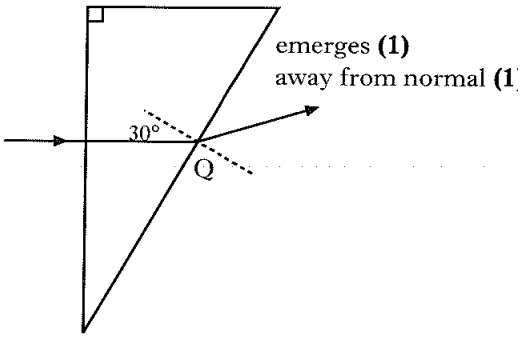
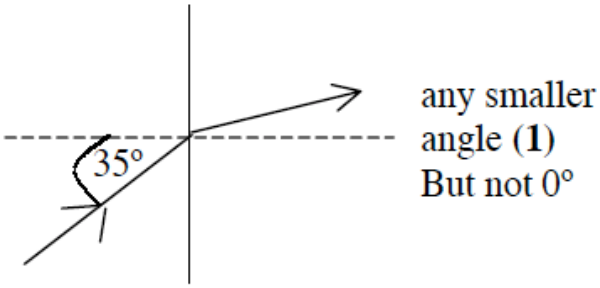
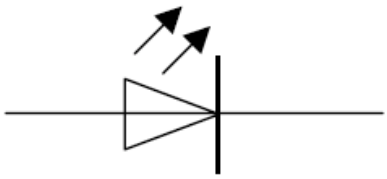
Source	Question	Answer
2002 Int 2	15	D
2004 Int 2	15	A

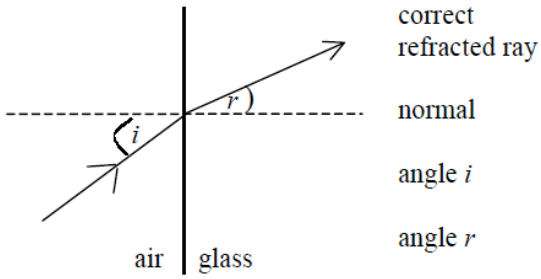
Source	Question	Answer
2006 Int 2	17	B
2007 Int 2	17	C
2000 Int 2	28. (a)	3×10^{8} ms^{-1}
	(b)	$\lambda = 6.52 \times 10^{-7}$ m, Light is red
2001 Int 2	28. (a)	
	(b)	$f = 2 \times 10^{10}$ Hz
	(c)	$t = 1 \times 10^{-4}$ s
	(d)	One of: wind power, wind generator, solar power, solar energy, solar cell, generator, battery
2003 Int 2	29. (a)	(i) Solar cell (ii) Q = 1350 C
	(b)	
	(c)	P X-rays; Q Infrared
	(d)	$\lambda = 3.75 \times 10^{-2}$ m
2004 Int 2	28. (a)	energy
	(b)	300 MHz others are reflected by ionosphere
	(c)	t = 0.24 s
2005 Int 2	29. (a)	energy

Source	Question	Answer
	(b)	t = 500 s
	(c)	(i) microwaves (ii) X-rays OR gamma rays (iii) electrons removed from or added to atom
2007 Int 2	25. (a)	(i) IR (infrared) (ii) both arrive at the same time; both travel at the same speed
	(b)	Q = 21 600 C
	(c)	R = 400 Ω

Light

Source	Question	Answer
2000 Int 2	16	A
2001 Int 2	18	E
2002 Int 2	18	E
2004 Int 2	17	C
2005 Int 2	16	B
2007 Int 2	15	C
	16	D
2008 Int 2	15	C
2000 Int 2	22. (b)	 (i) (ii) Total internal reflection

Source	Question	Answer
2002 Int 2	29. (a)	
	(b)	
2003 Int 2	28. (a)	(i) 35ºC (ii) 
	(b)	B, C, angle of incidence must be smaller than critical angle
2004 Int 2	26. (a)	(i) total internal reflection (ii)  (iii) R = 102 Ω

Source	Question	Answer
	29. (b)	
2005 Int 2	30. (a)	(i) 40° (ii) 59°
2006 Int 2	29. (a)	(i) 35° (ii) same as answer to your answer to (i)
	(b)	(i) total internal reflection (ii) any angle less than 45°, angle of incidence must be more than critical
2007 Int 2	27. (a)	(i) refraction (ii) reflection (iii) red
	(b)	air resistance and weight balanced
2008 Int 2	26. (a)	sound to electrical
	(b)	(i) none (ii) greater
	(c)	λ = 0.4 m
	(d)	(i) If light inside the prism strikes the surface at an angle greater than the critical angle it will be totally internally reflected. (ii) internal reflection; right angle - condition on internal reflection

Nuclear Radiation

Source	Question	Answer
2000 Int 2	18	D
	19	B
	20	D
2001 Int 2	19	E
	20	B

Source	Question	Answer
2002 Int 2	19	D
	20	C
2003 Int 2	19	E
	20	B
2004 Int 2	18	A
	19	B
	20	D
2005 Int 2	17	D
	18	C
	19	E
	20	D
2006 Int 2	18	C
	19	B
	20	D
2007 Int 2	18	D
	19	E
	20	C
2008 Int 2	17	B
	18	A
	19	E
	20	A
2000 Int 2	26. (a)	(i) A helium nucleus (ii) Removal or addition of electrons from or to the atom
	30. (a)	Nucleus splits releasing energy and neutrons
	(b)	Control rods absorb fewer neutrons More fissions take place Increase in temperature of coolant
	(c)	$W_r = 2.8$
2001 Int 2	30. (a)	1.11×10^9 decays per second

Source	Question	Answer
	(b)	H = 1.17 mSv
	(c)	to ensure people are kept a safe distance from the source
	31. (a)	(i) to extract the heat energy (ii) to slow down (fast) neutrons)
	(b)	some of the neutrons bombard other uranium nuclei and cause further fissions or splits fissions produce more neutrons and maintain the reaction process
	(c)	(i) 28 ± 1 year (ii) 76 ± 2 year (iii) any suitable storage method (underwater, under ground etc)
2002 Int 2	30. (a)	$N = 4.8 \times 10^{10}$
	(b)	Source R will be first
	(c)	gloves, tongs, film badge, short exposure time etc.
	31. (a)	(i) fission (ii) slow neutrons down (iii) lower control rods
	(b)	advantage: no greenhouse gas, conserves fossil fuel, lot of energy from a small mass etc. disadvantage: radioactive waste, decommissioning stations etc.
2003 Int 2	27. (a)	(i) Protons and neutrons (ii) Fission (iii) Uranium (fuel) is used up (iv) Radioactive waste
	(b)	$\Delta T = 100^{o}C$
	30. (a)	(i) the number of decays per second (ii) 1250 Bq
	(b)	gamma since beta absorbed by aluminium
	(c)	(i) $E = 2.5 \times 10^{-5}$ J (ii) $H = 1 \times 10^{-3}$ Sv
2004 Int 2	30. (a)	fission
	(b)	neutrons go on to cause further fissions OR chain reaction
	(c)	boron rods absorb neutrons

Source	Question	Answer
	(d)	H = 0.00605 Sv
	(e)	(i) no release of green house gases OR more energy from small amount of fuel OR conserves fossil fuel (ii) radioactive waste OR decommissioning power plants OR possibility of specified types of accidents
2005 Int 2	31. (a)	(i) slow neutrons (ii) absorbs neutrons
	(b)	(i) number of decays per second (ii) time taken for activity to half (iii) Activity = 5×10^{11} Bq
	(c)	(i) a measure of the radiation's biological effect (ii) E = 0.0108 J
2006 Int 2	30. (a)	(i) helium nucleus (ii) electron
	(b)	(i) removal or addition of electrons from atom (ii) alpha, increase distance and fewer alphas will reach the grid
	(c)	Q = 2×10^{-7} C
	31. (a)	Time taken for activity to half
	(b)	40.5 days
	(c)	Iodine 135, activity remains high for hours, returns to safer level by next day
	(d)	Iodine 127, not radioactive
2007 Int 2	29. (a)	E = 9.0×10^{-4} J
	(b)	lead shields leg from X-rays
	(c)	type of radiation or type of tissue
	30. (a)	(i) loss or gain of electrons from an atom (ii) alpha greatest ionisation (iii) Source Y long half life but short range
	(b)	(i) R = 300 Ω (ii) electrical to sound
	31. (a)	cosmic rays and radon gas (or other correct answers)
	(b)	A = 0.4 Bq
	(c)	4 minutes

Source	Question	Answer
2008 Int 2	30. (a)	Count rate increases, air easier to penetrate than metal
	(b)	gamma, other two would not penetrate steel
	(c)	x-rays longer/gamma shorter
	31. (a)	time taken for activity to decrease by half
	(b)	2 kBq
	(c)	Any 2 of shielding/limiting time of exposure/ increasing distance
	(d)	(i) H = 200 mSv (ii) Tissue type

Dynamics and Space

Velocity and Displacement - Vectors and Scalars

Source	Question	Answer
2000 Int 2	1	C
	2	D
	4	B
2001 Int 2	1	D
	2	C
2002 Int 2	2	D
2003 Int 2	2	D
	4	C
2005 Int 2	1	E
	2	D
2007 Int 2	2	B
2008 Int 2	1	E
	2	C

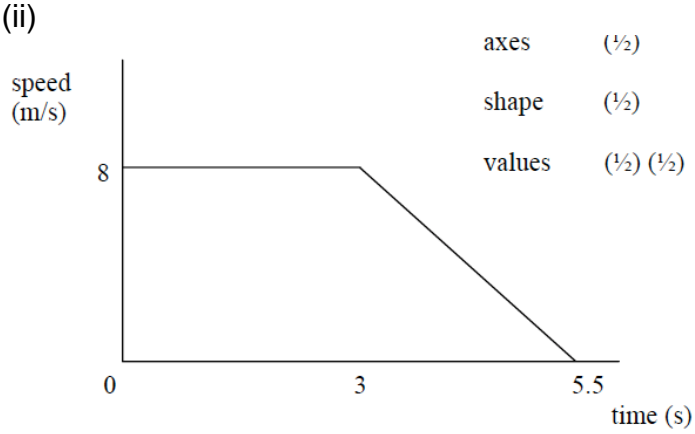
Velocity-time Graphs

Source	Question	Answer
2003 Int 2	5	A
2000 Int 2	21. (a)	(i) Constant velocity (speed) (ii) Constant deceleration (acceleration)
	(b)	$a = 0.45\ ms^{-2}$
	(c)	d = 517.5 m
	(d)	The weight is balanced by the friction
2003 Int 2	21. (a)	Ep = 420 000 J
	(b)	(i) $a = 4\ ms^{-2}$ (ii) d = 80 m (iii) Less friction

Source	Question	Answer
2004 Int 2	22. (a)	(i) 2 s (ii) The train starts to decelerate OR reaction time of driver
	(b)	a = -2.5 ms^{-2}
	(c)	d = 475 m so train is travelling at right speed
2005 Int 2	21. (d)	measure distance with tape measure time with stop watch calculate average speed using $\text{speed} = \frac{\text{distance}}{\text{time}}$
	22. (a)	(i) C or 60 s (ii) E or 110 s
	(b)	 air resistance OR air friction weight OR gravity force
	(c)	f = 900 N
2006 Int 2	21. (a)	Ep = 2 700 J
	(b)	Ek = 2 880 J
	(c)	Extra energy has been supplied by the work done peddling
	(d)	(i) decreases (ii) friction increases
2008 Int 2	21. (a)	a = 4.5 ms^{-2}
	(b)	F = 67.5 N
	(c)	d = 103.5 m

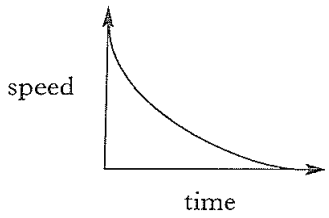
Acceleration

Source	Question	Answer
2002 Int 2	1	B
2004 Int 2	3	B
2006 Int 2	1	C

Source	Question	Answer
2007 Int 2	1	E
2008 Int 2	3	C
2006 Int 2	22. (a)	$F = 1.0 \times 10^7$ N
	(b)	$a = 0.013\ ms^{-2}$
2007 Int 2	22. (a)	measure a distance using a tape/rule/trundle wheel measure time to travel this distance with stopwatch/clock use formula d = vt to calculate average speed
	(b)	(i) $a = -3.2\ ms^{-2}$ (ii) 

Newton's Laws

Source	Question	Answer
2000 Int 2	3	D
	7	D
2001 Int 2	4	B
	7	E
2002 Int 2	3	B
2004 Int 2	2	C
	4	E
2005 Int 2	4	C
2006 Int 2	4	E
2007 Int 2	5	A
	6	B

Source	Question	Answer
2008 Int 2	4	B
2000 Int 2	22. (a)	(i) F = 680 kN (ii) f = 88 kN
	23. (a)	w = 900 N
	(b)	(i) Ep = 1.08×10^9 J (ii) P = 3×10^5 W
2001 Int 2	21. (a)	Ep = 30 J
	(b)	W = 21 J
	(c)	Work has been done due to friction
	22. (a)	(i) 800 N (ii) a = 0.17 ms^{-2} (iii) F = 867 N (iv) d = 28 m
	(b)	(i) time will be longer (ii)  (note: straight line not acceptable) Ignore any values on graph No labels on axes acceptable Wrong labels on axes not acceptable
2002 Int 2	21. (a)	Ep = 3 355 000 J
	(b)	(i) Ew = 76 600 000 J (ii) P = 42 560 W
	(c)	potential energy lost by descending capsules
	23. (a)	a = 1.5 ms^{-2}
	(b)	15 250 N
	(c)	greater air resistance on blades, frictional force will reach 15 250 N at lower speed
2005 Int 2	21. (a)	Ek = 75 J
	(b)	F = 50 N
2006 Int 2	25. (c)	F = 1.94×10^5 N
2008 Int 2	22. (a)	F = 1131 N

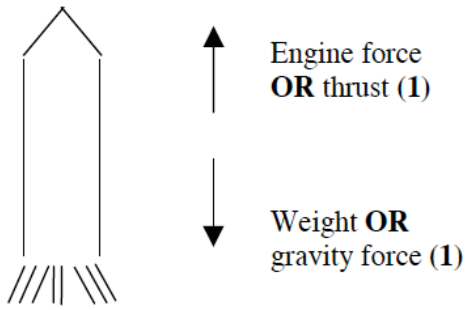
Source	Question	Answer
	(b)	(i) W = 1 800 N (ii) a = 5 ms^{-1}
	23. (a)	(i) Ew = 450 J (ii) P = 750 W
	(b)	(i) $\Delta T = 21^{o}C$ (ii) energy is lost to the surrounding air

Projectile Motion

Source	Question	Answer
2000 Int 2	5	B
2001 Int 2	3	C
2004 Int 2	5	C
2005 Int 2	3	C
2007 Int 2	4	B
2002 Int 2	22. (a)	horizontal motion is constant speed, vertical motion is acceleration
	(b)	(i) 8 ms^{-1} (ii) Light gate at exit of firing device, diameter of ball measured, time for ball to cut light gate measured, $speed = \frac{diameter}{time}$ (iii) d = 0.313 m
	(c)	v = 11.5 ms^{-1}

Space Exploration

Source	Question	Answer
2000 Int 2	9	A
2001 Int 2	6	E
2002 Int 2	7	C
2003 Int 2	6	C
2004 Int 2	7	E

Source	Question	Answer
2006 Int 2	2	E
	3	C
	6	B
2003 Int 2	26. (a)	(i) Eh = 16700 J (ii) P = 55.7 W
	22. (a)	(i) w = 2.1×10^7 N (ii)  (iii) a = 6.8 ms^{-2}
	(b)	Acceleration on Y less, smaller unbalanced force
2005 Int 2	24. (a)	Eh = 45360 J
	(b)	Eh = 140 400 J
	(c)	(i) t = 1548 s (ii) No heat energy enters the ice cream
2008 SG C	15. (a)	(i) friction between the craft and the atmosphere produces heat (ii) $\Delta T = 1300^oC$ (iii) some of the heat produced is lost to the surroundings

Cosmology

Source	Question	Answer
2001 SG C	13. (a)	X-rays are absorbed by Earth's atmosphere
	(b)	
	(c)	Different signals have different wavelengths Different wavelengths need different types of detector
2004 SG C	13. (a)	Light

Source	Question	Answer
	(b)	Different telescopes are needed to detect different types of radiation
	(c)	at the focal point
	(d)	Arecibo, because it is a radio telescope and has the largest diameter reflector
2006 SG C	13. (b)	helium and nitrogen
2007 SG C	14. (a)	(i) P - X-rays; Q - visible light; R - microwaves (ii) gamma rays
	(b)	Infrared - (black bulb) thermometer OR photodiode OR phototransistor Ultraviolet - fluorescent paint/material/UV film
2008 SG C	14. (a)	distance travelled by light in one year
	(b)	(i) different detectors are required for different radiations/ frequencies/ wavelengths (ii) C, A, B (iii) GM tube or photographic film