L-Università ta' Malta

MATSEC
Examinations Board

Marking Scheme

SEC Physics

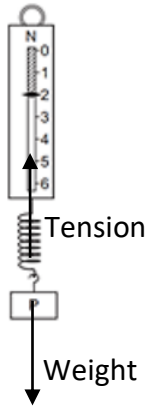
Special September Session 2020

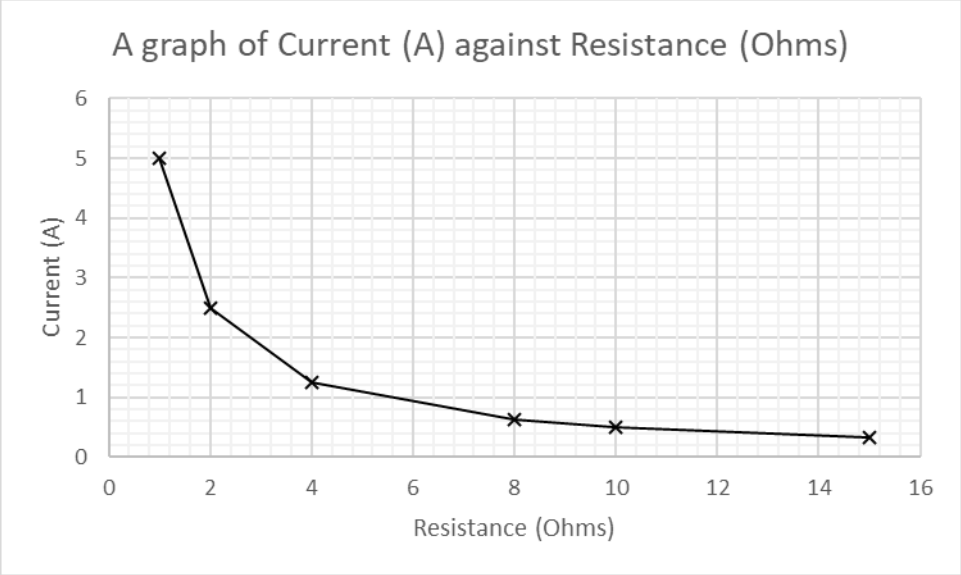
Marking schemes published by the MATSEC Examination Board are not intended to be standalone documents. They are an essential resource for markers who are subsequently monitored through a verification process to ensure consistent and accurate application of the marking scheme.

In the case of marking schemes that include model solutions or answers, it should be noted that these are not intended to be exhaustive. Variations and alternatives may also be acceptable. Examiners must consider all answers on their merits, and will have consulted with the MATSEC Examinations Board when in doubt.

Paper 1

Question			Suggested Answer	Marks Distribution	Marks
1	a	i	Centre of gravity is the point where all the weight of the object appears to act.		1
		ii	The boy will lose balance (fall)… … and he will fall clockwise. Any other indication of correct direction is accepted.	1 1	2
		iii	The centre of gravity (weight/line of action) is no longer acting within the area of the base. OR Total clockwise moments are larger than the total anti-clockwise moments.		1
		iv	No.		1
	b	i	He is crouching so that he has a lower centre of gravity. Accept also 'lower down'. The legs are wide open, further away from each other (to increase the area of the base).	1 1	2
		ii	The weight bar is pivoted on its centre of gravity so weight is balanced evenly (on the centre of gravity of the weightlifter). Any correct reference to no resultant moment is accepted. No marks are awarded if pivot on CoG is not mentioned.		1
		iii	100 + 100 + 20 + 80 = 300 kg W = 300 x 10 = 3000 N Deduct 1 mark if the 80 kg are omitted. If further quantities are omitted, no marks are awarded.	1 1	2
				Total:	**10**
2	a		a = F/m a = $1x10^7/590000$ a = 16.95 m/s^2	 1 1	2
	b		v = u + at t = (v-u)/a t = 11000/16.95 t = 649 s	 1 1	2
	c		W = mg (equation is expected as part of the method) W = 900 x 3.7 W = 3330 N	 1 1	2
	d		10 km = 10000 m $v^2 = u^2 + 2as$ a = $(110^2-820^2)/(2x10000)$ a = -33 m/s^2	1 1 1	3
	e		By increasing the air resistance.	1	1
				Total:	**10**

3	a		 Accept weight or W, pull of gravity, force of gravity, gravitational force but do **not** accept gravity. Accept 'reaction' and tension, but do **not** accept T, or upward force. Weight should start from centre of P.	Award no marks for directions only.	2
	b		W = mg m = 2/10 m = 0.2 kg	1 1	2
	c	i	16.4 – 16 = 0.4 cm Accept 4 mm.		1
		ii	1N → 0.4 cm 2 N → 0.8cm Therefore, 16.0 – 0.8 = 15.2 cm	1 1	2
		iii	1 N → 0.4 cm 5 N → 0.4 x 5 = 2 cm New pointer reading = 15.2 + 2 = 17.2 cm	1 1	2
		iv	The extension of a stretched material is directly proportional to the force applied, as long as its elastic limit is not exceeded.		1
				Total:	**10**
4	a		In a gas, the molecules are free to move randomly. They travel at great speed and continuously collide with each other and with the sides of the container.		1
	b		F x 0.25 = 4 x 0.5 F = 2/0.25 = 8 N Assume that piston and mechanical arm have negligible mass.	1 1 Do not deduct marks if assumption is missing	2
	c		P = F/A = 8/0.01 P = 800 Pa or N/m^2	1 1	2
	d	i	Pressure increases. Volume remains the same. Density remains the same.	1 1 1	3
		ii	Increase the size of the load. Increase the distance between the pivot and the point where the load is acting. Accept also increase the length of the arm.	1 1	2

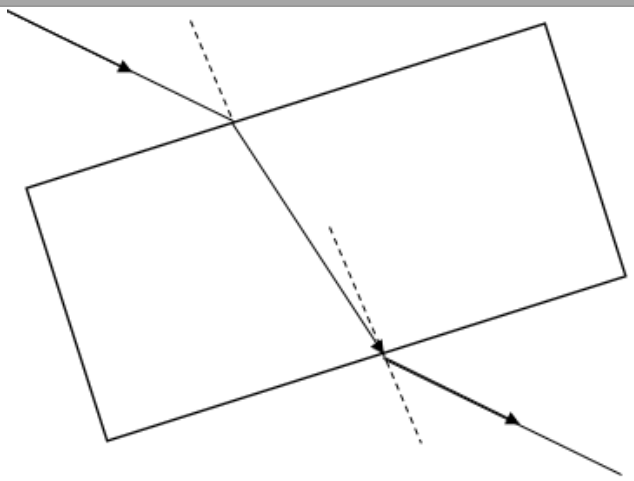
				Total:	**10**
5	a		V = IR = 1.25 x 4 = 5.0 V	1 1	2
	b		Correct axes chosen. Correct axes labeling, quantity + unit + title. Reasonable scale. Accurate plotting. Smooth curve drawn.  	1 1 1 1 1	5
	c		0.83 A		1
	d		Total resistance decreases. Hence, added resistor is in parallel to the 8 ohm.	1 1	2
				Total:	**10**
6	a		Planet. Comet was accepted as well, although strictly speaking not the most exact answer. However, in this case, in part (b), the properties listed must be corresponding to a comet.		1
	b		A Planet because it: is in orbit around the sun; has a nearly round shape; has cleared the neighbourhood around its orbit.	 1 1 1	3
	c	i	Gravitational force.		1
		ii	The gravitational force will double too. Do not award marks for 'increases' only.		1
	d	i	Satellite.		1
		ii	Speed is a scalar. Velocity is a vector.		2
		iii	The astronaut has the same mass on Earth as on the moon.		1
				Total:	**10**
7	a		Transverse Waves.		1
	b		Frequency is the number of waves passing through a particular point per second.		1
	c		Microwave.		1
	d		$\lambda = v/f$ $\lambda = 3x10^8/1x10^{11}$	1 1	3

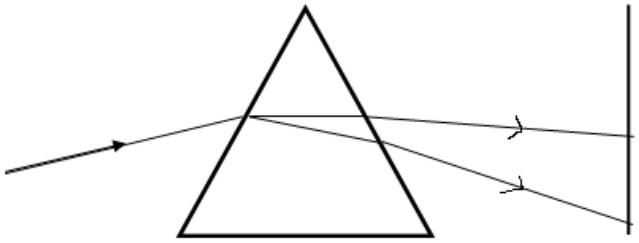
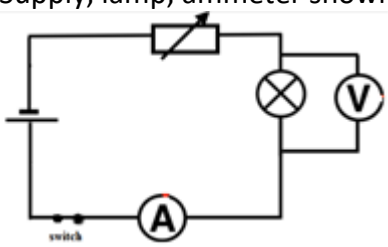
			λ = 0.003 m	1	
	e		Gamma rays: Sterilisation of medical equipment, radiotherapy, cancer treatment. X-rays: Check bone structure (X-ray radiography). Ultraviolet: Scan money, tanning, vitamin D. Infrared: TV remote controls.	1 mark each for any one use of each wave	4
				Total:	**10**
8	a		(65x1000)/(60x60) = 18.06 m/s		1
	b		Momentum = m x v Momentum = 1540 x 18.06 Momentum = 27,812.4 kgm/s	 1 1	2
	c		Momentum = m x v Momentum = 5600 x -5 Momentum = - 28000 kgm/s Deduct 1 mark if – sign is not used. Accept any reference to correct direction, such as to the left, or in the direction of the lorry.	 1 1	2
	d		27812.4 - 28000 = -187.6 kgm/s Accept any reference to correct direction such as to the left.		1
	e		-187.6 = (1540 + 5600) x v v = - 0.026 m/s Accept any reference to correct direction such as to the left.	1 1	2
	f		In the direction of the lorry. Since it has a larger momentum (or since answer is negative, hence in same direction as lorry having had a negative momentum initially).	1 1	2
				Total:	**10**
9	a		Convection.		1
	b		The water particles directly above the flame receive heat energy and so they move faster. As a result, they occupy a larger volume and therefore this hot water becomes less dense than the surrounding cold water. Therefore, it rises to the top and cool water replaces it.	1 1	2
	c		They will move towards the edges of the water tank.		1
	d		E = P x t = 8190 x 300 = 2,457,000 J	 1 1	2
	e		H = mCΔT ΔT = (2457000)/(15x4200) ΔT = 39°C T_2 = 21 + 39 = 60°C	 1 1 1	3
	f		Heat losses.		1
				Total:	**10**
10	a	i	Have same number of protons /atomic number and different number of neutrons/nucleons/mass number. Accept more neutrons/ nucleons or greater mass number.	1 1	2
		ii	I-131 More particles in nucleus means more mass.	1 1	2
	b	i	Any 2 distinguishing properties from nature, charge, mass, range, ionizing ability, penetration, deflection in mag field, etc		2

		ii	Longer half-life hence more chance to do damage. Ionizing ability of β is greater and hence more damage. Do not accept I-131 emits 2 types of radiation.	1 1	2
	c		After 26 hours (2 half-lives) Isotope decays to ½ x ½ = ¼ Hence, original amount must be 4 times as much.	1 1	2
				Total:	**10**

Paper IIA

Question			Suggested Answer	Marks Distribution	Marks
1	a		Gravitational Potential Energy (PE accepted). Kinetic Energy (KE accepted). Heat and Sound (only 1 is enough).	1 1 1	3
	b		Place the ball and record the height. Release the ball and record the height the ball reached after the bounce. Repeat this procedure for the other two balls.	1 1 1	3
	c		60 g = 0.06 kg PE = mgh PE = 0.06x10x1 PE = 0.6 J	1 1 1 Deduct 1 mark if units are missing	3
	d		PE = KE $0.6 = 0.5mv^2$ $0.6 = 0.5x0.06xv^2$ v = 4.47 m/s $v^2 = u^2+2as$ can also be used.	1 1 Deduct 1 mark if units are missing	2
	e		Energy can neither be created nor destroyed, But it can only change from one form to another	1 1	2
	f		Converting 56 cm into 0.56 m PE = mgh PE = 0.06x10x0.56 PE = 0.336 J	 1 1	2
	g		Energy lost = [(0.6 – 0.336)/0.6] x 100 = 44%	1 1 Deduct 1 mark if units are missing	2
	h		Take readings from the ruler at eye level. Take the height reading from the same position of the ball. The ball was released with no initial force. Accept any other correct precaution.	1 mark each for any two	2
	i		In car tyres during breaking. Car radiators. No full explanation of how these work is needed. Accept any other relevant situation.	1 mark each for any one	1
				Total:	**20**
2	a	i	Radiation / Infra Red Rays.	Do not accept waves	1
		ii	The clothes dry by evaporation. The water particles gain energy from the sun and escape the T-shirt.	1 1	2
		iii	Simon's T-shirt will dry first. More surface area so more possibility of evaporation.	1 1	2

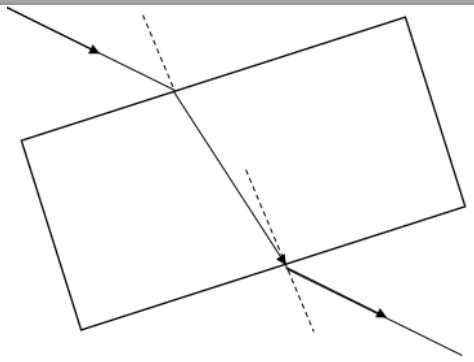
		iv	Graph X = Beaker A Graph Y = Beaker B Beaker B has a larger surface area through which heat can escape via evaporation.	1 1	2
	b		Simon's is more efficient (silver shiny surface… …since it reflects the heat from the iron back into the bottom of the T-shirt.	1 1	2
	c	i	Stopwatch. Thermometer.	1 1	2
		ii	Boiling water was poured into the beakers. The initial temperature of the water was recorded. The stopwatch is switched on and the temperature of the water in both beakers is recorded every 2 minutes. The final temperature of the water is recorded, and the temperature drop in each beaker is calculated.	1 1 1 1	4
		iii	Amount of water in each beaker. Same time for cooling. Exposed to same external conditions.	1 mark each for any two	2
		iv	Graph X = Beaker A Graph Y = Beaker B Beaker B has a larger surface area through which heat can escape via evaporation.	1 1	2
	d		The large surface area of the ears increases the rate of heat loss thus allowing the fox to feel cooler.		1
				Total:	**20**
3	a	i	 Normal. Refracted ray including an arrow. Emergent ray including an arrow, which is parallel to the other ray in air.	 1 1 1	3
		ii	Correct placement of angle of incidence. Correct placement of angle of refraction. The 'i' and 'r' should be at the same point.	1 1	2
		iii	Ƞ = (speed of light in air)/(speed of light in medium) $= (3x10^8)/(2x10^8)$ = 1.5 Deduct 1 mark if unit is included.	 1 1	2
		iv	Since water is less dense than glass and has a smaller refractive index, the velocity of light in water is greater. The light will be refracted more towards the normal in glass.	1 1	2

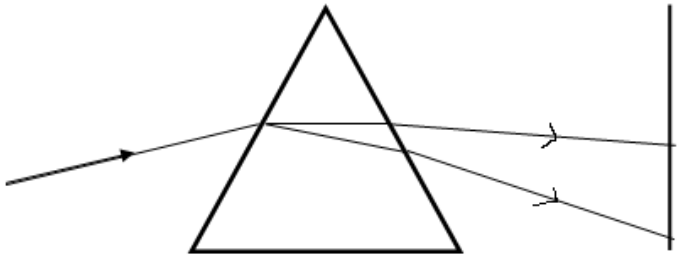
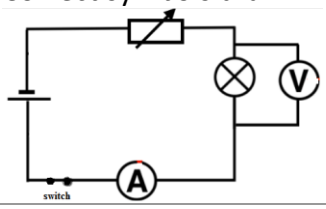
			Angle of refraction will be larger in water.		
		v	Water surface acts as a shiny surface.		1
	b	i	 Normals are not assigned any marks, just for this answer. Refraction of light in the correct directions. Arrows. 2 or more rays.	 1 1 1	3
		ii	Dispersion.		1
		iii	White light consists of different colours (wavelengths). Each colour will be refracted differently/different speed.	1 1	2
		iv	Red on top. Violet on bottom.	1 1	2
		v	A: Refraction. B: Total internal reflection. At B accept 'reflection'.	1 1	2
				Total:	**20**
4	a	i	Polythene: Electrons transferred from cloth to rod. Perspex: Electrons transferred from rod to cloth.	1 1	2
		ii	Water present is a conductor. Any charges produced transferred away/leaked to earth.	1 1	2
	b		Conductors: Electrons free to move about. Insulators: Electrons tightly bound to nucleus/atom.	1 1	2
	c		Polythene to polythene: Repulsion. Polythene to perspex: Attraction. Accept push/pull, but do not accept movement.	1 1	2
	d		Material used is a conductor.		1
	e		Discharge passes through conductor and not through building as copper is better conductor than building. Accept reference to pointed top and/or to being higher up. Do not accept discharge passes through conductor without giving a reason.		1
	f	i	Should include a variable voltage supply or a battery and a variable resistor. Ammeter in series + voltmeter in parallel with lamp. Supply, lamp, ammeter shown in series.  	1 1 1	3

		ii	Ammeter – Low Voltmeter - High		2
		iii	Do not exceed 12 V (voltage rating of lamp).		1
		iv	When different values of potential difference are applied, the temperature of the filament lamp increases and thus resistance increases as well since resistance and temperature are directly proportional. Thus, it does not obey Ohm's Law.	1 1	2
		v	Obeys Ohm's Law: Any metallic conductor at constant temperature (fixed resistor). Does not obey Ohm's Law: Diode, thermistor, any semiconductor.	1 1	2
				Total:	**20**
5	a	i	AC is passed through the primary coil. This produces a constantly changing magnetic field around it since it is an alternating current and thus it changes its direction multiple times each second. The changing magnetic field produced by the primary coil 'cuts' continuously the secondary coil. An alternating voltage is produced in the latter, which induces a continuous flow of current in the secondary coil.	1 1 1	3
		ii	DC produces a steady field and thus the 'cutting' of field lines in the secondary coil stops.		1
		iii	Energy is lost if some of the magnetic field lines of the primary coil does not pass through the secondary coil. Heat energy in the wires increase the resistance.	1 1	2
	b	i	E = Pt = 1000 x (12 x 60) = 720 000 J Deduct 1 mark for each value not converted in S.I. units.	1 1	2
		ii	40% of 720 kJ = 288 kJ		1
		iii	Cooking pot. Cooker itself. Surroundings.	1 mark each for any two	2
		iv	E = Pt = 1.0 x (12/60) = 0.2 kWh	 1 1	2
		v	0.2 x 12 c = 2.4 c		1
	c	i	Alternating current is a current, which changes its direction multiple times per second.	1 1	2
		ii	No current is induced in it since it is an insulator and hence remains cooler.		1
		iii	The eddy currents in a transformer are greatly reduced by laminating the core (accept also the core composed of individual sheets stacked on each other).		1
		iv	P = IV I = P/V = 1500/230 I = 6.5 A	 1 1	2
				Total:	**20**

Paper IIB

Question			Suggested Answer	Marks Distribution	Marks
1	a		Gravitational Potential Energy (PE accepted). Kinetic Energy (KE accepted). Heat and Sound (only 1 is enough).	1 1 1	3
	b		Ball. Height (Distance). Ruler. Bounces.	1 1 1 1	4
	c		PE = mgh PE = 0.06x10x1 PE = 0.6 J	1 1 Deduce 1 mark if unit/units are missing	2
	d		PE = KE $0.6 = 0.5mv^2$ $0.6 = 0.5x0.06xv^2$ v = 4.47 m/s $v^2 = u^2+2as$ can also be used.	1 1 Deduce 1 mark if unit/units are missing	2
	e		Energy can neither be created nor destroyed, but it can only change from one form to another.	1 1	2
	f		PE = mgh PE = 0.06x10x0.56 PE = 0.336 J	1 1 Deduce 1 mark if unit/units are missing	2
	g		Efficiency = (output/input) x 100 = (0.336/0.6) x 100 = 56% % loss = 44%	1 1 Deduce 1 mark if unit/units are missing	2
	h		Take readings from the ruler at eye level. Take the height reading from the same position of the ball. The ball was released with no initial force.	Accept any other correct precaution	1
	i		In car tires during breaking… …so that they do not burst. Accept any other relevant situation.	1 1	2
				Total:	**20**
2	a	i	Radiation / Infra Red Rays. Do not accept waves.		1
		ii	The water particles gain energy from the sun, and leave the surface of the T-shirt.	1 1	2

		iii	More surface area from where evaporation can happen.		2
		iv	Shorter.		1
	b		Simon's is more efficient (silver shiny surface)… …since it reflects the heat from the iron back into the bottom of the T-shirt.	1 1	2
	c	i	Stopwatch, Thermometer.	1 1	2
		ii	3 The stop watch is switched on and the temperature of the water in both beakers is recorded every 2 minutes. 4 The final temperature of the water in each beaker is recorded. 5 The temperature drop in each beaker is calculated by subtracting the final temperature from the initial temperature. 1 Some boiling water was poured into each beaker. 2 The initial temperature of the water in each beaker was recorded.	Mark allocated only if the number of the order matches the correct statement	5
		iii	Same time of cooling. Same time for cooling. Exposed to same external conditions. Reading thermometer at eye level stirring.	1 mark each for any two	2
		iv	Beaker B		1
	d		The larger surface areas of the ears increases the rate of heat loss thus allowing the fox to feel cooler.	1 1	2
				Total:	**20**
3	a	i	 Normal. Refracted ray including an arrow. Emergent ray including an arrow which is parallel to the other ray in air.	 1 1 1	3
		ii	Correct placement of angle of incidence. Correct placement of angle of refraction. The 'i' and 'r' should be at the same point.	1 1	2
		iii	η = (speed of light in air)/(speed of light in medium) = $(3x10^8)/(2x10^8)$ = 1.5	 1 1	2
		iv	Since water is less dense than glass and has a smaller refractive index, the velocity of light in water is greater. The light will be refracted (bent) more towards the normal in glass.		2

			Angle of refraction will be larger in water.	1 1	
	b		Water surface acts a shiny surface.		1
	c	i	 Normals are not assigned any marks, just for this answer. Refraction of light. Arrows. Clear spread of white light into the different colours.	 1 1 1	3
		ii	Dispersion.		1
		iii	White light consists of different colours (wavelengths). Each colour will be refracted differently.	1 1	2
		iv	Red on top. Violet on bottom (accept purple).	1 1	2
		v	A: Refraction. B: Total internal reflection.	1 1	2
				Total:	**20**
4	a	i	Polythene: Electrons transferred from cloth to rod. Perspex: Electrons transferred from rod to cloth.	1 1	2
		ii	Water present is a conductor. Any charges produced transferred away/leaked to earth.	1 1	2
	b		Conductors: Electrons free to move about. Insulators: Electrons tightly bound to nucleus/atom.	1 1	2
	c		Polythene to polythene: Repulsion. Polythene to perspex: Attraction.	1 1	2
	d		A conductor carries any charges produced safely to earth.		1
	e		A conducting plate/rod buried in the ground.	Accept earth	1
	f	i	All in series. Except voltmeter in parallel with lamp. Correct symbols drawn.  	1 1 1	3
		ii	Ammeter - Low Voltmeter - High	1 1	2
		iii	Do not exceed 12 V (voltage rating of lamp).		1

		iv	Current proportional to pd across conductor. Provided temperature (or resistance) remains constant	1 1	2
		v	Obeys: Any metallic conductor at constant temperature. Does not obey: Diode, thermistor, any semiconductor.		2
				Total:	**20**
5	a	i	<table><tr><td>The secondary coil lies in the changing magnetic field</td><td>3</td></tr><tr><td>An alternating voltage is applied across the primary coil</td><td>1</td></tr><tr><td>A voltage is induced across the secondary coil</td><td>4</td></tr><tr><td>A changing magnetic field is produced in the core</td><td>2</td></tr></table>		4
		ii	Energy is lost if some of the magnetic field lines of the primary coil does not pass through the secondary coil. Heat energy in the wires increase the resistance.	1 1	2
	b	i	E = Pt = 1000 x (12x60) = 720 000 J	 1 1	2
		ii	40% of 720 kJ = 288 kJ		1
		iii	Cooking pot. Cooker itself. Surroundings.	1 mark each for any two	2
		iv	E = Pt = 1.0 x 0.2 = 0.2 kWh	 1 1	2
		v	0.2 x 12 c = 2.4 c		1
	c	i	Alternating current is a current, which changes its direction multiple times per second at a controlled rate. A large number of times per second (oscillations/waves per second are accepted). (Eddy) current induced in pan/magnetic material as it lies in a changing magnetic field.	1 1 1	3
		ii	No current is induced in it since it is an insulator and hence remains cooler.		1
		iii	P = IV I = P/V I = 1500/230 I = 6.52 A	 1 1	2
				Total:	**20**