OP JINDAL UNIVERSITY

Mid Semester Examination, October-2023

BSc 5th Semester [03UG021]

Physics

Quantum Mechanics and Applications

Time: 2 Hrs.			Max. Marks: 50		

Note:

			M	CO	KL
		Section A (20 marks) Answer any 4 questions [04 x 05 marks=20 marks]			
1	a.	Explain about phase velocity.	5	CO1	K2
	b.	Derive the expression of time dependent Schrodinger wave equation.	5	CO2	K2
	c.	(i) Write the conditions for physical acceptability of wave function. (ii) $\Psi(x) = x^3, \frac{-L}{2} < x < \frac{L}{2}$ Find $<x>$ and $<p^2>$.	5	CO2	K2
	d.	Derive the expression for total energy operator and momentum operator in one and three dimension.	5	CO2	K2
	e.	(i) Write the expression of expectation value of position and momentum in one and three dimension. (ii) What do you mean by expectation value and write its general formula.	5	CO2	K1
		Section B (30 marks) Answer any 3 questions [03 x 10 marks=30 marks]			
2	a.	What do you mean by Ehrenfest Theorem. Prove that $\frac{d<x>}{dt} = \frac{<p_x>}{m}$	10	CO2	K2
	b.	Prove that $\frac{d<p_x>}{dt} = <F_x>$ from Ehrenfest Theorem.	10	CO2	K2
	c.	(i) If $\Psi(x) = A. \cos\frac{\pi x}{L}, 0 < x < L$ then normalize $\Psi(x)$ and find the value of A. (ii) Explain about group velocity.	10	CO2	K2
	d.	(i) Explain Davison and Germer experiment. (ii) Derive the expression of time independent Schrodinger wave equation.	10	CO1	K3

OP JINDAL UNIVERSITY

Mid Semester Examination, October-2023

B.Sc. 5th Semester [03UG021]

Physics

Solid State Physics

Time: 2 Hrs.				Max. Marks: 50		

Note:

			M	CO	KL

Section A (20 marks)

Answer any 4 questions [04 x 05 marks=20 marks]

			M	CO	KL
1	a.	Explain the difference between (a) Crystalline and Amorphous Solids (b) a unit cell and a primitive cell of a crystal.	5	CO1	K1
	b.	Find the packing density (PD) of Face-centered cubic structure.	5	CO1	K2
	c.	Define the miller indices of a plane. How to find Miler indices of a plane? In a triclinic crystal, a lattice plane makes intercept at a length (a, 2b and -3c/2). Find the Miller Indices of the plane.	5	CO1	K2
	d.	X rays of wavelength 0.12 nm are found to undergo second order reflection at a Bragg angle of 280 from a lithium fluoride crystal. What is the interplanar spacing of the reflecting planes in the crystal?	5	CO1	K2
	e.	Define the terms (a) conductor, (b) insulator, and (c) semiconductor. Discuss Quantum Hall effect and band formation in semiconductor.	5	CO3 & CO8	K2

Section B (30 marks)

Answer any 3 questions [03 x 10 marks=30 marks]

			M	CO	KL
2	a.	Draw the Diamond structure and find its packing density.	10	CO1	K3
	b.	What do you mean by Brillouin zones? How is it constructed?	10	CO1	K3
	c.	Derive Bragg's Law for the diffraction of X-rays from a crystal. Explain powder photograph method for the determination of crystal structure.	10	CO1	K2
	d.	Write down assumptions of "Drude - Lorentz theory and establish relations among electrical conductivity (σ), Relaxation time (τ) Electrical resistivity (ρ) and mobility of electron (μ).	10	CO3 & CO8	K3

OP JINDAL UNIVERSITY
Mid Semester Examination, October-2023
B.Sc. (Hons.) Physics 5th Semester [03UG021]
Department of Physics, School of Science
Nuclear and Particle Physics

Time: 2 Hrs.   **Max. Marks: 50**

Note:

			M	CO	KL
Section A (20 marks) Answer any 4 questions [04 x 05 marks=20 marks]					
1	a.	Which isobar of A = 75 does the liquid drop model suggest to be the most stable mucleus? Given a_1 = 15.5 MeV, a_2 = 16.8 MeV, a_3 = 0.7 MeV, a_4 = 23.0 MeV and a_5 = 34.0 MeV	5	CO2	K2
	b.	Determine, spin, parity and ground state of $^{17}_{9}F \ and \ ^{33}_{16}S$ nuclei.	5	CO2	K2
	c.	Discuss meson theory of nuclear force.	5	CO1	K2
	d.	Calculate surface and coulomb energy of $^{238}_{92}U$. Given: a_2 = 16.8 MeV and a_3 = 0.7 MeV.	5	CO2	K2
	e.	Why are even-even nuclei more stable? Explain.	5	CO1	K2
Section B (30 marks) Answer any 3 questions [03 x 10 marks=30 marks]					
2	a.	Derive semi-empirical mass formula.	10	CO2	
	b.	What is electrical quadrupole moment? Derive the formula for electrical quadrupole moment. Draw the shapes of nucleus for zero, negative and positive values of electric quadrupole moment.	10	CO1	K3
	c.	Which nucleus is more stable $^{7}_{3}Li, \ ^{8}_{3}Li$? Given m_p = 1.007825 amu, m_n = 1.008665 amu, m ($^{7}_{3}Li$) = 7.016003 amu, m ($^{8}_{3}Li$) = 8.022486 amu.	10	CO1	K3
	d.	Discuss how to determine size and charge of a nucleus using experimental methods.	10	CO1	K3

OP JINDAL UNIVERSITY

Mid Semester Examination, October-2023

B.Sc. 5th Semester   [03UG021]

Physics

Energy Materials I

Time: 2 Hrs.   **Max. Marks: 50**

Note:

			M	CO	KL
		Section A (10 marks) All Questions are compulsory [05 x 02 marks=10 marks]			
1	a.	Define Renewable energy carriers.	2	CO1	K1
	b.	What are solar fuels and how can they produced?	2	CO2	K1
	c.	What is the k-vector and its role in a semiconductor?	2	CO2	K2
	d.	What is meant by Fermi level in semiconductors? Where does the Fermi level lie in an intrinsic semiconductor?	2	CO1	K1
	e.	What is the effect of temperature on the reverse current of a PN junction?	2	CO2	K1
		Section B (16 marks) Answer any 4 questions [04 x 04 marks=16 marks]			
2	a.	Explain the term doping and the reasons for doping in a semiconductor.	4	CO1	K2
	b.	What is the mechanism by which conduction takes place inside the semiconductor?	4	CO1	K2
	c.	Why does a pure semiconductor behave like an insulator at absolute zero temperature?	4	CO2	K2
	d.	Explain the methods of energy conversion with a suitable block diagram.	4	CO5	K2
	e.	Explain the Optics of flat interfaces.	4	CO2	K2
		Section C (24 marks) Answer all questions [03 x 08 marks=24 marks]			
3	a.	Explain the working principle of a solar cell with suitable diagrams.	8	CO2	K3
	b.	Explain the term:1. Irradiance and irradiation 2. Solar constant 3. Terrestrial radiation 4. Basic Sun-Earth Angles	8	CO1	K2
	c.	Explain the conductivity of metals and deduce its formula.	8	CO2	K3

OP JINDAL UNIVERSITY

Mid Semester Examination, October 2023

B.Sc 5th Semester BSP1084

Physics

Energy Materials I

						CO	KL

Section A (10 marks)

All Questions are compulsory. [05 x 02 marks = 10 marks] (L2)

a.	Define Renewable energy sources.					CO1	K2
b.	What are solar cells and how can they produced?					CO2	K1
c.	What is the k-score and its role for a semiconductor?					K4	CO3
d.	What is meant by Fermi level in semiconductors? What does the Fermi level in an intrinsic semiconductor?					CO1	K1
e.	What is the effect of temperature on the reverse current of a PN junction?					CO3	K1

Section B (16 marks)

Answer any 4 question. [04 x 04 marks = 16 marks]

a.	Explain the term doping and the reasons for doping in a semiconductor.					CO1	K2
b.	What is the mechanism by which conduction takes place inside the solid insulator?					CO3	K2
c.	Why does a pure semiconductor behave like an insulator at absolute zero temperature?					CO2	K2
d.	Explain the conduction of current with a circuit block diagram.					CO2	K3
e.	Explain the Origin of the semiconductor.					CO3	K2

Section C (24 marks)

Answer all questions. [03 x 08 marks = 24 marks]

a.	Explain the working principle of solar cell with a neat diagram.					CO1	K4
b.	Explain the solar 1) Radiance and Irradiation 2) Solar constant 3) Terrestrial radiation 4) Bare Sun-Earth angles.					CO2	K4
c.	Explain the conductors, insulators and semiconductor materials.					CO3	K2

OP JINDAL UNIVERSITY
Mid Semester Examination, October-2023
B.Sc.(H) 5th Semester [03UG022]

OPJU

CHEMISTRY
CC XII: Organic Chemistry- IV

Time: 2 Hrs. Max. Marks: 50

Note: Attempt all sections

			M	CO	KL
		Section A (10 marks) All Questions are compulsory [05 x 02 marks=10 marks]			
1	a.	What is EMR? Write its important characteristics.	2	1	1
	b.	Define Photon. Write the relationship between frequency, wavelength and energy of the electromagnetic radiation.	2	1	1
	c.	What is Bathochromic shift?	2	2	2
	d.	Write the mathematical equation for Beer–Lambert's Law.	2	2	2
	e.	State the importance of Mid IR region in spectroscopy.	2	3	2
		Section B (16 marks) Answer any 4 questions [04 x 04 marks=16 marks]			
2	a.	Write the basic principles involved during interaction of EMR.	4	1	2
	b.	Calculate the energy of a photon of laser light with frequency of 4.74×10^{14} Hz	4	1	2
	c.	State the principle of UV-Vis spectroscopy. Also state the selection rule.	4	2	2
	d.	Discuss with suitable examples Chromophores & Auxochromes.	4	2	1
	e.	For a linear molecule like CO_2, how many vibrational modes are possible, draw them. Which of these modes are IR active/inactive and why?	4	3	2
		Section C (24 marks) Answer any 3 questions [03 x 08 marks=24 marks]			
3	a.	Discuss various regions of electromagnetic spectrum and their applications in different spectroscopic techniques	8	1	2
	b.	What happens when Electromagnetic Radiations interact with matter? Discuss the types of Spectra obtained after interaction.	8	1	2
	c.	Explain the effect of Conjugation on λ_{max}.	8	2	2
	d.	Use Woodward-Fieser rules for Calculation of λ_{max} in the following molecules: 	8	2	3
	e.	Describe all possible vibrations that may occur in a molecule when it absorbs IR radiations.	8	3	2
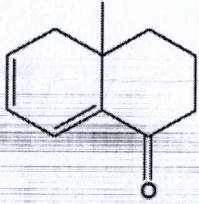
OP JINDAL UNIVERSITY
Mid Semester Examination, October-2023
B.Sc 5th Semester [03UG022]
Department of Chemistry
Physical Chemistry-V

Time: 2 Hrs.   **Max. Marks: 50**

Note: All questions are compulsory

			M	CO	KL
		Section A (20 marks) Answer any 4 questions [04 x 05 marks=20 marks]			
1	a.	Explain why energy of black body radiation is temperature dependent ?	5	CO1	2
	b.	What do you mean by progressive and standing wave ?	5	CO1	1
	c.	Give brief review of classical mechanics ?	5	CO1	1
	d.	Give reason for evolution of quantum mechanics ?	5	CO1	2
	e.	Show that the commutator $$\left[x, \frac{d}{dx}\right] = -1$$	5	CO1	3
		Section B (30 marks) Answer any 3 questions [03 x 10 marks=30 marks]			
2	a.	Derive equation for standing wave ?	10	CO1	3
	b.	Determine whether the momentum operator commutes with KE ?	10	CO1	2
	c.	Find the expression for the following operators: a) $\left(\frac{d}{dx} - x\right)\left(\frac{d}{dx} + x\right)$ b) $\left(\frac{d}{dx} + x\right)^2$	10	CO1	3
	d.	Show that: a) $[\hat{A}^2, \widehat{B}] = \hat{A}[\hat{A}, \hat{B}] + [\hat{A}, \hat{B}]\hat{A}$ b) $[\hat{A}, \hat{B}] = -[\widehat{B - A}]$	10	CO1	3

OP JINDAL UNIVERSITY

Mid Semester Examination, October-2023

B.Sc. (Hons) Chemistry (03UG022)

GREEN CHEMISTRY

Time: 2 Hrs.   Max. Marks: 50

			M	CO	KL
		Section A (20 marks) Answer any 4 questions [04 x 05 marks=20 marks]			
1	a.	Briefly define the Green Chemistry.	5	1	1
	b.	Why we need green chemistry? Explain.	5	1	1
	c.	Write all the twelve principles of green chemistry.	5	2	2
	d.	Explain atom economy with two examples.	5	2	2
	e.	Explain how the real time monitoring can help in the implementation of green chemistry.	5	2	2
	f.	Why we need greener synthetic method for the synthesis of disodium iminodiacetate. Explain with chemical reactions.	5	3	3
		Section B (30 marks) Answer any 3 questions [03 x 10 marks=30 marks]			
2	a.	Explain the main goals of green chemistry in detail.	10	1	1
	b.	Explain the obstacles in the pursuit of the goals of green chemistry.	10	1	2
	c.	Write the conventional method as well as green method for the synthesis of Catechol and Adipic acid.	10	3	3
	d.	Write any two principles of green chemistry (except Atom economy and real time monitoring) with at least two examples.	10	2	3

OP JINDAL UNIVERSITY
Mid Semester Examination, October-2023

OPJU

B.Sc. 5th Semester [03UG022]
BSc Honors Chemistry
Polymer Chemistry DSE II

Time: 2 Hrs.   **Max. Marks: 50**

Note:

			M	CO	KL
		Section A (20 marks) Answer any 4 questions [04 x 05 marks=20 marks]			
1	a.	What is Polymers? To write any four synthetic polymers name with structure.	5	1	1
	b.	What is Thermoplastic and Thermosetting polymers with suitable examples.	5	1	1
	c.	To write Molecular forces and chemical bonding in polymers.	5	1	2
	d.	To writ difference between Addition and condensation polymerization process?	5	5	2
	e.	What is Teflon and PVC ? To write their monomers with polymerization reaction.	5	5	1
		Section B (30 marks) Answer any 3 questions [03 x 10 marks=30 marks]			
2	a.	Write short notes on: a) PET b) Nylon 6,6 c) Bakelite d) Polystyrene	10	1	1
	b.	What do you mean by polymerization? Explain different schemes of classification of polymers with suitable examples.	10	1	1
	c.	Explain classification of polymerization processes with free radical polymerization	10	2	2
	d.	Derive Carothers Equation for bifunctional and polyfunctional polymer system.	10	2	2

OP JINDAL UNIVERSITY

Mid Semester Examination, October-2023

B.Sc. (H)-5th Semester [03UG021/22/23]

PHYSICS/ CHEMISTRY/ MATHEMATICS

THE ONE THING AND EXTREME OWNERSHIP

Time: 2 Hrs.		Max. Marks: 50

Note: **Section A:** All Questions are compulsory [05 x 02 marks=10 marks]
Section B: Answer any 4 questions out of 5 [04 x 04 marks=16 marks]
Section C: Answer any 3 questions out of 5 [03 x 08 marks=24 marks]

			M	CO	KL

Section-A (10 Marks)

All Questions are compulsory [05 x 02 marks=10 marks]

			M	CO	KL
1	a.	What do you mean by 'The One Thing'?	2	CO1	K1
	b.	Write the Six Lies which mislead and derail from the path of success?	2	CO1	K1
	c.	What do you mean by 'Going Small'?	2	CO1	K1
	d.	What do you mean by GPS and 411?	2	CO2	K1
	e.	What do you mean by 'Ordinary Habits' and 'Keystone Habits' ?	2	CO2	K1

Section-B (16 Marks)

Answer any 4 questions [04 x 04 marks=16 marks]

			M	CO	KL
2	a.	What is the impact of *doing too many things?* Discuss	4	CO1	K2
	b.	What do you mean by "Success is sequential, not simultaneous"? Discuss.	4	CO1	K2
	c.	What do you mean by "SIXTY-SIX DAYS TO THE SWEET SPOT." Discuss.	4	CO2	K2
	d.	Do you agree with the statement-'No one is self-made'. Discuss.	4	CO1	K1
	e.	What do you mean by 'Time your task. Do what matters most first each day when your willpower is strongest'. Discuss.	4	CO2	K1

Section-C (24 Marks)

Answer any 3 questions [03 x 08 marks=24 marks]

			M	CO	KL
3	a.	What do you mean by Pareto's Principle? Discuss the Big Ideas related to the 'Willpower is Always on Will-Call.'	8	CO1	K1
	b.	Discuss in detail the THREE TRUTHS which lead to the simple path of productivity?	8	CO2	K1
	c.	What is your 'ONE Thing' for this academic year? Create your GPS to achieve the ONE Thing.	8	CO1	K2
	d.	What do you mean by 'The Focusing Question is a double-duty question'? Discuss in detail with example.	8	CO2	K2
	e.	What do you mean by 'Live with purpose'? Discuss the statement- "Life isn't about finding yourself. Life is about creating yourself."	8	CO2	K2

OP JINDAL UNIVERSITY
Mid Semester Examination, October-2023
B. Sc. 5th Semester [03UG023]

Mathematics

Discrete Mathematics

Time: 2 Hrs.   **Max. Marks: 50**

Note:

			M	CO	KL
		Section A (10 marks) All Questions are compulsory [05 x 02 marks=10 marks]			
1	a.	Define Tautology and contradiction.	2	CO1	K1
	b.	Use Truth table to show that $(p \to q) \equiv (\sim p \lor q)$	2	CO1	K1
	c.	Define Inverse relation with one example.	2	CO2	K1
	d.	Define Equivalence class with one example.	2	CO2	K1
	e.	Consider the following: p: Today is Thursday q: It is raining r: It is cold Write in simple sentences the meaning of the following (i) $p \to q$ (ii) $\sim q \to (r \land p)$ (iii) $\sim p \to (q \lor r)$ (iv) $(p \lor q) \leftrightarrow r$	2	CO1	K1
		Section B (16 marks) Answer any 4 questions [04 x 04 marks=16 marks]			
2	a.	Prove that the following (i) Associative Laws (ii) Distributive Laws	4	CO2	K2
	b.	Show by using Mathematical Induction that $$\frac{1}{1.4}+\frac{1}{4.7}+\frac{1}{7.10}+\cdots+\frac{1}{(3n-2)(3n+1)}=\frac{n}{3n+1}$$	4	CO1	K1
	c.	Prove that the following propositions are Tautologies. (i)$((p \to q) \to r) \leftrightarrow ((p \leftrightarrow r) \lor (q \to r))$ (ii) $(p \land q) \lor (\sim p \land q) \lor (p \land \sim q) \lor (\sim p \land \sim q)$	4	CO1	K1
	d.	If $A = \{1,2\}, B = \{2,3\}, C = \{3,5\}$ then find (i) $A \times (B \cup C)$ (ii) $(A \times B) \cup (A \times C)$ (iii) $A \times (B \cap C)$ (iv)$(A \times B) \cap (A \times C)$	4	CO2	K1
	e.	Write a short note on types of relations with one example.	4	CO2	K1

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Section C (24 marks)
Answer any 3 questions [03 x 08 marks=24 marks]

3	a.	Define Equivalence relation. If **I** is the set of integers and the relation $x \, R \, y$ then $(x - y)$ is an even integer, then prove that **R** is an equivalence relation, where $x, y \in \mathbf{I}$	8	CO2	K1
	b.	Prove by using Mathematical Induction that $n! \geq 2^n \, for \, n \geq 4$.	8	CO1	K2
	c.	Construct the truth tables for the following: (i) $(p \wedge \sim r) \leftrightarrow (q \vee r)$ (ii) $[(p \wedge q) \vee (\sim r)] \leftrightarrow p$	8	CO1	K1
	d.	(i) A computer company must hire 25 programmers to handle system programming jobs and 40 programmers for applications programming. Of those hired, 5 are expected to perform jobs of both types. How many programmers must be hired. (ii) Prove that $A - (B \cap C) = (A - B) \cup (A - C)$	8	CO2	K2
	e.	Define Partial order relation. Let **N** be the set of partial integers, prove that the relation $\leq$, where $\leq$ has its usual meaning, is a partial order relation on **N**	8	CO2	K2

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OP JINDAL UNIVERSITY
Mid Semester Examination, October-2023
B. Sc. (Hons.) 5th Semester (03UG023)
Mathematics
DSE I: Ring Theory

Time: 2 Hrs.   **Max. Marks: 50**

Note:

			M	CO	KL
		Section A (20 marks) Answer any 4 questions [04 x 05 marks=20 marks]			
1	a.	Define Ring Without Zero Devisor and check the following for ring without zero devisor – (a) $\mathbb{R}$ ($\mathbb{R}$ denote the set of real number) (b) ($z_5 , + , \cdot$) , (z_5 denote the set of residue class over modulo 5)	5	1	2
	b.	Show that $51\mathbb{Z}$ in $\mathbb{Z}$ is neither Maximal Ideal nor Prime Ideal .	5	4	2
	c.	If $\emptyset$ is Homomorphism from $\mathbb{Z}$ to $\mathbb{Z}$ then check for the Homomorphism of the following – (a) $\emptyset(n) = \{2n : n \in \mathbb{Z}\}$ (b) $\emptyset(n) = 0$	5	5	2
	d.	If $\emptyset: M_2(R) \to R$,defined by $\emptyset (A) = Tr (A)$, where $Tr (A)$ denotes the trace of the matrix A .Then Check that $\emptyset$ is homomorphism or not .	5	5	2
	e.	Show that the Intersection of two ideals of any ring (R ,+ , .) is an ideal of R	5	2	2
		Section B (30 marks) Answer any 3 questions [03 x 10 marks=30 marks]			
2	a.	Define Ring and Check that ($Z_8 , + , \cdot$) be a Ring or not with respect to the operation of addition and multiplication of Ring .	10	1	3
	b.	Explain the following- (a) Maximal Ideal with an example. (b) Check that ($z_5 , + , \cdot$) is Integral Domain or not. (c) Characteristics of Ring. (d) Integral Domain with an example. (e) Ring with Zero Devisor and one example.	10	2	2
	c.	If $\emptyset : G \to G'$ be a Homomorphism of group G to G' then prove that $\frac{G}{Ker\ \emptyset} \cong G'$	10	5	3
	d.	Prove that an ideal S in the ring of Integers is Maximal ideal if and only if S can be generated by an Integers .	10	4	3

OP JINDAL UNIVERSITY
Mid Semester Examination, October-2023
B.Sc. 5th Semester Mathematics (HONS)[03UG023]
School of Science

DSEII:Number Theory

Time: 2 Hrs.

Max. Marks: 50

			M	CO	KL
		Section A (10 marks) AllQuestions are compulsory [05 x 02 marks=10 marks]			
1	a.	If a/c and b/c with $\gcd(a,b)=1$ then ab/c.	2	1	K1
	b.	For an arbitrary integer a, verify that $3/a(a+1)(a+2)$.	2	1	K1
	c.	For $n>3$, show that the integers $n, n+2, n+4$ cannot all be prime.	2	1	K1
	d.	Solve the linear congruence $5x \equiv 2(\mod 26)$.	2	2	K1
	e.	Find the remainder when 2^{50} is divided by 7.	2	2	K1
		Section B (16 marks) Answer any 4 questions [04 x 04 marks=16 marks]			
2	a.	Use Mathematical induction to prove for $n \geq 1$, $15/2^{4n}-1$	4	1	K2
	b.	Find the gcd of (12378, 3054) using Euclidean algorithm. Represent 6 as linear combination of 12378 and 3054.	4	1	K2
	c.	Show that $\sqrt{p}$ is irrational for any prime p.	4	1	K1
	d.	Solve the set of simultaneous congruence $x \equiv 5(\mod 11)$, $x \equiv 14(\mod 29)$, $x \equiv 15(\mod 31)$.	4	2	K2
	e.	Derive $a^{21} \equiv a(\mod 15)$ for all a.	4	2	K2
		Section C (24 marks) Answer any 3 questions [03 x 08 marks=24 marks]			
3	a.	State and prove Fundamental theorem of arithmetic.	8	1	K2
	b.	(i) Show that there is infinite number of primes. (ii) Show that sum of twins prime $p, p+2$ is divisible by 12 provided that $p>3$.	8	1	K2
	c.	(i) Prove that the integer $53^{103}+103^{53}$ is divisible by 39, and $111^{333}+333^{111}$ is divisible by 7. (ii) For $n \geq 1$, use congruence theory to establish $43/6^{n+2}+7^{2n+1}$.	8	2	K2
	d.	(i) Show that $a^m \equiv b^m (\mod n)$. (ii) Show that 41 divides 2^{20-1}	8	2	K2
	e.	State and Prove Fermat's theorem. Use Fermat's theorem to verify that 17 divides $11^{104}+1$.	8	2	K2